# Program & Abstract Book

# CMBEBIH

International Conference on Medical and Biological Engineering in Bosnia and Herzegovina, Sarajevo, 16 – 18 March, 2017

Organised by

## About the Volume

This volume presents the Abstract Book of the International Conference on Medical and Biological Engineering in Bosnia and Herzegovina (CMBEBIH 2017), held in Sarajevo from 16th to 18th March, 2017. Papers from this Abstract Book are published at IFMBE Conference Proceeding by Springer Nature.

CMBEBiH is a scientific, exciting, informative and inspiring conference infusing rigorous scientific and engineering practices. CMBEBiH2017 is the largest Medical and Biological Engineering gathering in South East Europe. The goal of CMBEBIH 2017 is to serve as a platform for sharing ideas, experiences, best practices and latest advancements in biomedical engineering and all related fields while staying true to the conference motto: „*Pursuing innovation. Shaping the future.* "

The conference is endorsed by academic institutions in Bosnia and Herzegovina as well as international organization's such as International Federation for Medical and Biological Engineering (IFMBE), Bosnia and Herzegovina and Croatia IEEE Sections, and foundation for education in the field of biomedical engineering in Europe (ESEM). The Abstract Book features 120 contributions of more than 300 scientists from 30 countries, including: Bosnia and Herzegovina, Croatia, Serbia, Montenegro, Albania, Australia, Austria, Germany, Hungary, India, Iran, Italy, Japan, Pakistan, Russian Federation, Saudi Arabia, Slovenia, Spain, Sweden, Switzerland, Poland, Portugal, Taiwan, Turkey, Ukraine, United Kingdom, United States.

## Bosnia and Herzegovina Medical and Biological Engineering Society (DMBIUBIH)

The Bosnia and Herzegovina Medical and Biological Engineering Society (DMBIUBIH) is a non-profit organization which was established in 2014 to encourage and promote Medical and Biological Engineering in Bosnia and Herzegovina. Members of the Society are University Professors, Medical Doctors, Engineers and Technicians in the disciplines of Medicine and Engineering, as well as students, youth with interest in this field. It serves as the lead Society and Professional home for Medical and Biological Engineering in Bosnia and Herzegovina. DMBIUBIH activities include participation in the formulation of public policy and the dissemination of information through publications and forums. The organization promotes and enhances knowledge and education in Medical and Biological Engineering in Bosnia and Herzegovina Society through organized scientific meetings, and diversity initiatives. DMBIUBIH Society is a national representative in IFMBE.

http://www.dmbiubih.org/

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## WELCOME

International Conference on Medical and Biological Engineering in Bosnia and Herzegovina (CMBEBIH2017) is an exciting, informative and inspiring conference infusing rigorous scientific and engineering practices. CMBEBiH2017 is the largest Medical and Biological Engineering gathering in South East Europe. The goal of CMBEBIH 2017 is to serve as a platform for sharing ideas, experiences, best practices and latest advancements in biomedical engineering and all related fields while staying true to the conference motto: „*Pursuing innovation. Shaping the future.* "

The conference is a continuation of the extensive work conducted by the Bosnia and Herzegovina Medical and Biological Engineering Society to encourage and support development of Medical and Biological Engineering in Bosnia and Herzegovina and Balkan region. The predecessor conference yielded great results with 7 eminent keynote speakers from all around the world, 120 oral presentations, 50 poster presentations and 3 international workshops.

Medical and Biological Engineering covers all disciplines of the Biomedical and Clinical Engineering spectrum. Research and development in these areas are impacting the science and technology by advancing fundamental concepts in medicine. They are helping us better understand human physiology and function at multiple levels by improving tools and techniques for the detection, prevention and treatment of diseases. The 2017 program consists of 120 accepted papers on new developments encompassing the conference theme.

More specifically the parallel scientific sessions cover the topics of biomedical signal processing, biomedical imaging and image processing, biosensors and bioinstrumentation, bio-micro/nano technologies, biomaterials, biomechanics, robotics and minimally invasive surgery, cardiovascular, respiratory and endocrine systems engineering, neural and rehabilitation engineering, molecular, cellular and tissue engineering, bioinformatics and computational biology, clinical engineering and health technology assessment, health informatics, e-health and telemedicine, biomedical engineering education, pharmaceutical engineering, genetic engineering.

International workshops include topics of new perspectives in health technologies regarding diagnostics and therapy, management systems in the health sector and discussions on how to build a thriving Medical and Biological Engineering Industry in Bosnia and Herzegovina and other South East European Countries.

Furthermore, the Conference program is highlighted by the seven keynote lecturer sessions. All sessions discuss different areas of Medical and Biological (biomedical) engineering and are moderated by prominent experts and professionals in the area.

The session held by dr. Ernesto Iadanza (Italy), Chair of IFMBE Clinical Engineering Division discuss the Clinical Engineering. The title of his lecture is "*Biomedical and Clinical Engineers: the key to success is a wide knowledge*".

Keynote lecture in the area of processing of biomedical signals is held by dr. Ervin Sejdic (USA) and focus on discussing the usage of big data to understand functional changes in swallowing, gait and handwriting.

This keynote lecture entitled "Neuro-prosthetic technologies to restore movement and communication of people with paralysis" is held by dr. Tomislav Milekovic (Croatia). Dr. Milekovic is one of the rising stars of Neuro-prosthetics, a field at the intersection between Engineering, Mathematics and Neuroscience.

More on neural networks, complex algorithms and new advancements is a focus of prof. dr. Christopher James (UK) keynote lecture.

Prof. Dr. Nesrin Hasirci (Turkey) will give lecture entitled “Multifunctional Biomaterials and Tissue Engineering Applications”, while prof. dr. Vesna Maras (Montenegro) will focus and discuss advancements in Genetic Engineering.

Nanotechnology, one of the Conference themes will be discussed by prof. dr. Sefik Suzer (Turkey), leading scientists in surface science and spectroscopy.

We express our gratitude to the Bosnia and Herzegovina leading academic institutions for supporting this project. Particular thanks are expressed to the kind support and effort of international organizations such as IFMBE, IEEE and ESEM for endorsing this project, as well as our publisher Springer Nature. Furthermore, there is a limited number of external sponsors for which we are sincerely thankful.

Finally, a heartfelt thanks to all of you, the participants, for your outstanding contributions. We wish you all the best with your ongoing research in advancing medical and biological engineering for humanity. We hope that CMBEBIH 2017 creates opportunities for professional growth and networking with fellow scientist, engineers and other enthusiasts. It is our vision that this conference creates a lasting memory of Sarajevo and that the networking enables successful and ongoing collaborations amongst fellow professionals.

We hope that you will appreciate the CMBEBIH 2017 Abstract Book as much as we have and that you take pride in the this outstanding project.

Sincerely,

**Almir Badnjevic, Phd.**

CMBEBIH 2017 Conference Chair

Sarajevo, 16-18 March, 2017

# 1. ORGANISATION

**Organised by**

Bosnia and Herzegovina Medical and Biological Engineering Society (DMBIUBiH)

**Endorsed by**

International Federation for Medical and Biological Engineering (IFMBE)

European Foundation for Education in Biomedical Engineering (ESEM - Educating Students in Engineering and Medicine)

**Technical Co-Sponsors**

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Institute of Electrical and Electronics Engineers (IEEE) Croatia Section

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Sponsors:

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FDS, Bosnia and Herzegovina

Coca Cola, Bosnia and Herzegovina

Klas dd Sarajevo, Bosnia and Herzegovina

BioIRC, Serbia

D-Med Healthcare, Bosnia and Herzegovina

# 2. CONFERENCE ORGANISATION BOARD

**Conference Chair**

Almir Badnjevic, Bosnia and Herzegovina Medical and Biological Engineering Society

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Mario Cifrek, University of Zagreb, Croatia and President of IEEE Croatia EMB Chapter

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Thomas Penzel, Charite University Hospital Berlin, Germany

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Vedran Bilas, University of Zagreb, Croatia

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Vesna Spasić – Jokić, University of Novi Sad, Serbia

Yves Lemoigne, IFMP Ambilly France & CERN, Switzerland

Zdenka Babić, University of Banja Luka, Bosnia and Herzegovina

Zlata Mujagić, University of Tuzla, Bosnia and Herzegovina

## LOCAL ORGANIZING COMITTEE

*Members of Bosnia and Herzegovina Medical and Biological Engineering Society

**President of Local Organising Comittee**
Lejla Gurbeta

**Members:**

Ahmed Osmanović

Alma Jakupović

Amra Mujkanović

Amra Dautbegović

Berina Alić

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Lemana Spahić

Nerma Kantić

Sabahudin Ćordić

Sabina Halilović

Snežana Prorok

Zerina Bešić

Zerina Đozić

# 3. CONFERENCE THEMES

## *BIOMEDICAL SIGNAL PROCESSING*

- Physiological systems modeling
- Time-frequency and time scale analysis
- Nonlinear dynamic analysis
- Adaptive and parametric filtering and estimation
- Pattern recognition and soft computing techniques
- Data mining and processing

## *BIOMEDICAL IMAGING AND IMAGE PROCESSING*

- Magnetic resonance imaging / Computed tomography / Mammography
- Ultrasound imaging / Optical imaging and microscopy
- PET and SPECT
- Electrical and magnetic source imaging / Impedance imaging
- Multimodality imaging / Novel imaging modalities
- Image processing, analysis and classification

## *BIOSENSORS AND BIOINSTRUMENTATION*

- Physical sensors and sensor systems
- Bioelectric, biological and chemical sensors and sensor systems
- Physiological monitoring / Instrumentation / Integrated systems
- Implantable technologies, sensors and systems
- Wearable sensors / Body area and wireless sensor networks / Telemetric systems

## *BIO-MICRO/NANO TECHNOLOGIES*

- Internal, implanted and portable miniaturized systems
- BioMEM / NEMS
- Microfluidics / Lab-on-a-chip devices
- Nano-biotechnology

## *BIOMATERIALS*

- Biomaterials for sensing and actuation
- Biomimetic, bioinspired and patterned biomaterials
- Biomaterials in cellular and tissue engineering

## *BIOMECHANICS, ROBOTICS AND MINIMALLY INVASIVE SURGERY*

- Musculoskeletal models and human movement analysis
- Orthotic, prosthetic and rehabilitation robotics and biomechanics
- Cardiovascular and respiratory fluid mechanics and biomechanics
- Human-robot interaction / Robot-aided surgery
- Biologically inspired robotics / Micro-bio robotics

- Minimally invasive surgery

## *CARDIOVASCULAR, RESPIRATORY AND ENDOCRINE SYSTEMS ENGINEERING*

- Cardiac and respiratory function and modeling
- Cardiovascular and respiratory signal processing and modeling
- Cardiovascular electrophysiology and regulation
- Respiratory disease / Sleep disorder / Respiratory engineering
- Endocrine systems, function, modeling and control

## *NEURAL AND REHABILITATION ENGINEERING*

- Brain physiology and modeling
- Neural signal processing
- Neural interfaces and regeneration
- Motor and sensory neuroprostheses / Brain-machine interface
- Rehabilitation and wearable technologies
- Brain functional imaging / Neurological disorders

## *MOLECULAR, CELLULAR AND TISSUE ENGINEERING*

- Biomaterial-cell interactions
- Cellular force transduction
- Embryonic and stem cells in regenerative medicine
- Electrical fields at the cell and protein scale
- Electroporation
- Tissue engineering / Scaffolds in tissue engineering

## *BIOINFORMATICS AND COMPUTATIONAL BIOLOGY*

- Bioinformatics and computational modeling of complex omic data
- Systems biology / Systems medicine
- Translational biomedical informatics for clinical applications
- Modeling of molecular, cellular and organ pathways

## *CLINICAL ENGINEERING AND HEALTH TECHNOLOGY ASSESSMENT*

- Clinical engineering / Health technology management
- Health technology policy, economics and ethics / Health technology assessment
- Technology development, commercialization, assessment and management
- Safety and human factors engineering for medical devices and systems
- IT in medicine / Equipment interconnectivity and integration
- Clinical engineering and disaster preparedness

## *HEALTH INFORMATICS, E-HEALTH AND TELEMEDICINE*

- Personal, pervasive, preventive, and participatory health systems
- Ambient assisted living / Smart homes
- Body area networks / Wireless technologies
- mHealth / eHealth / Telemedicine
- Health information management / Electronic health records
- Decision support methods and systems

## *BIOMEDICAL ENGINEERING EDUCATION*

- Biomedical engineering education and curriculum development
- Biomedical undergraduate and graduate student research projects
- Career development in biomedical engineering

## *PHARMACEUTICAL ENGINEERING*

- Pharmaceutical Development in Industry
- Bio-/Pharmaceutical Manufacturing
- Pharmaceutical Devices
- Pharmacokinetics

## *GENETIC ENGINEERING*

- Forensic Genetics
- Molecular Markers
- Immunotherapy, Gene, Individual and Cancer Therapy
- Molecular Antropology
- Stem cell technology
- Genomics, Proteomics and Pharmagenomics
- GMO and Biosafety
- Genetic Screening and Counseling

## 4. KEYNOTE SPEAKERS

**Christopher James, Ph.D** (UK)
„Neural engineering“

**Ervin Sejdić, Ph.D** (USA)
„From big data to functional outcomes: Can we use big data to understand functional changes in swallowing, gait and handwriting?“

**Ernesto Iadanza, Ph.D** (Italy)
„Biomedical and Clinical Engineers: the key to success is a wide knowledge“

**Vesna Maras, Ph.D** (Montenegro)
„Plant genetics“

**Sefik Suzer, Ph.D** (Turkey)
„Use of Layer-By-Layer Deposition Technique for Inserting Anti-Bacterial Nanoparticles and Their Characterization by XPS“

**Nesrin Hasirci, Ph.D**(Turkey)
„Multifunctional Biomaterials and Tissue Engineering Applications“

**Tomislav Mileković, Ph.D** (Croatia)
„Neuroprosthetic technologies to restore movement and communication of people with paralysis“

**Shankar Krishnan, Ph.D** (USA)
„Innovative Technologies in Emerging Clinical Cardiovascular Applications“

## 5. INDUSTRY PANELS

### 5.1. Digital/CX Transformation in Healthcare

ORACLE

Oracle Healthcare Cloud solutions meet the complex needs of healthcare payer and provider organizations and their patients. Oracle empowers the healthcare industry with the industries most complete and unified ERP, finance, HCM, supply chain, and EPM cloud applications.

The workshop is held by Tawab Hamidi – Oracle Business Development Director, Healthcare Division

**17 March, Plenary Lectures II 09:00 – 11:30, Hotel Hills Sarajevo, Butmirska cesta 18, Ilidza Bosnia & Herzegovina**

### 5.2. Demonstration of Software PlannerVasc and CFDVasc

Treatment of Abdominal Aortic Aneurysm (AAA) is a challenge in vascular surgery. Latest methods used for treatment requires implantation of stent graft - particular synthetic blood vessel (graft) combined with armature (stent). Safe implantation necessitates accurate planning since this procedure is performed without direct contact of surgeon and blood vessels but rather from remote site, under fluoroscopic monitoring (Xrays). For these purposes dedicated software are used. We will present you our new dedicated software for planning implantation of stent graft in abdominal aortic aneurysm. It provides physician with interactive tools capable of enclosing particular anatomy to surgeon and allowing simulation of the orthogonal views on the aortic cross section. Software has other tools facilitating the process of planning. Also some advanced computational predicting for stress and strain analysis of AAA will be demonstrated. Presented on the several working stations software will be available to use during our workshop

Session chair: Dr. Igor Koncar, vascular surgeon, Prof. Dr Nenad Filipovic, mechanical engineer, BioIRC, Serbia BioIRC, Serbia

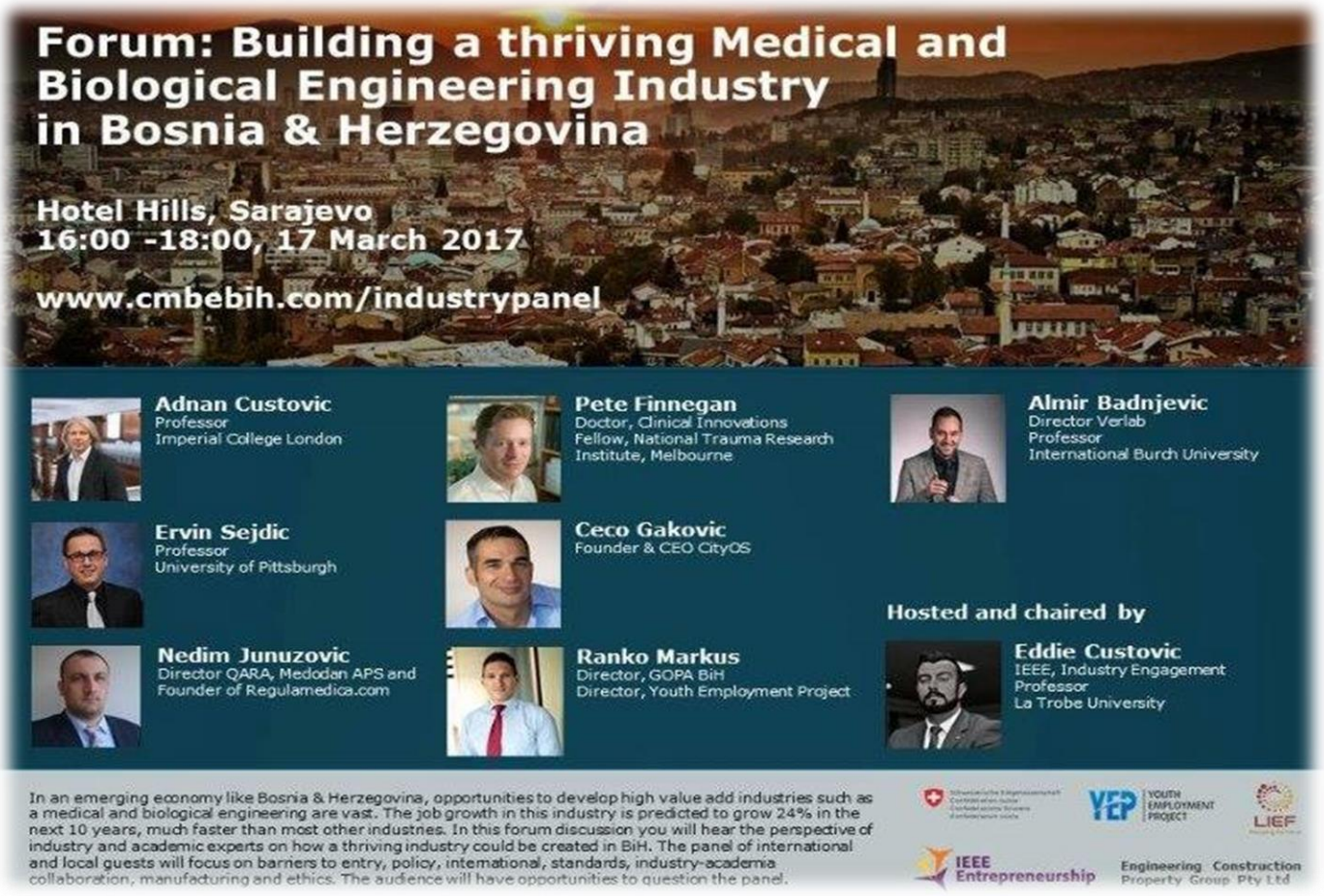
**16 March, 17:00 – 19:00, Hotel Hills Sarajevo, Butmirska cesta 18, Ilidza Bosnia & Herzegovina**

### 5.3. Building a thriving Medical and Biological Engineering Industry in Bosnia & Herzegovina

In an emerging economy like Bosnia & Herzegovina, opportunities to develop high value add industries such as a medical and biological engineering are vast. The job growth in this industry is predicted to grow 24% in the next 10 years, much faster than most other industries. In this forum discussion you will hear the perspective of industry and academic experts on how a thriving industry could be created in BiH. The panel of international and local guests will focus on barriers to entry, policy, international, standards, industry-academia collaboration, manufacturing and ethics. The audience will have opportunities to question the panel.

Session chair: Prof.dr Edhem (Eddie) Custovic, Director of LIEF, La Trobe University, Australia and IEEE Industry Engagement

**17 March, 16:00 – 18:00, Hotel Hills Sarajevo, Butmirska cesta 18, Ilidza Bosnia & Herzegovina**



# 6. GENERAL INFORMATION

## CONFERENCE VENUE

***HOTEL HILLS SARAJEVO,***

***BUTMIRSKA 18, 71 000 SARAJEVO***

***BOSNIA AND HERZEGOVINA***

**About Sarajevo**

Sarajevo is the largest city and country's administrative, economic, cultural, university and sport center.

Due to its long and rich history of religious diversity and coexistence Sarajevo has often been called the "Jerusalem of Europe".

The history of Sarajevo is very rich. Sarajevo became a city in the 15th century. It is also a place of assassination that sparked World War I. 1984 it was host city for Winter Olympics. More recently, Sarajevo underwent the longest siege in modern military history during the Bosnian War.

The city itself has its fair share of hilly terrain, as evidenced by the many steeply inclined streets and residences seemingly perched on the hillsides. The Miljacka river is one of the city's chief geographic features. It flows through the city from the east to the west where eventually meets up with the Bosna river.

## REGISTRATION

The registration desk is opend all three days of the event, as follows:

THURSDAY, March 16th 2017 - 08:00 - 19:00

FRIDAY, March 17th 2017 - 08:00 - 19:00

SATURDAY, March 18th 2017 - 08:00 - 10:00

## FEES INCLUDE

**Member (100E – LATE: 140E) and nonmember fee (130E – LATE: 170E)**

Conference materials including Program book (on CD/DVD)
- IFMBE Proceeding Book by Springer Nature (CD/DVD)
- Admission to all Conference sessions
- Welcome reception
- Coffee breaks
- Lunches
- Guided city tour/Excursion
- Conference Galla dinner

**Student fee (30E – LATE: 40E)**

- Conference materials including Program book (on CD/DVD)
- IFMBE Proceeding Book by Springer Nature (CD/DVD)

- Admission to all Conference sessions
- Welcome reception
- Coffee breaks
- Lunches
- Students party

**Passive participant fee (10E – LATE: 15E)**

- Conference materials including Program book (on CD/DVD)
- IFMBE Proceeding Book by Springer Nature (CD/DVD)
- Admission to all Conference sessions
- Welcome reception
- Coffee breaks
- Lunches
- Guided city tour/Excursion

## CONFERENCE GALA DINNER AND LUNCHES:

- Conference Gala Dinner and lunches will be served in the Restaurant at the venue of the conference.
- Welcome reception will be held at the Conference Venue.
- Student party will be held at Mala pivnica Restaurant Sarajevo.

## CERTIFICATE OF ATTENDANCE

- All certificates are included in conference material bag.

## INTERNET

- Wireless internet is available at the venue free of charge.

## TIME ZONE

- CET – Central European Time (Europe)
- GMT +01:00

## CLIMATE

- medium continental
- average summer temperature 19,1°C
- average winter temperature –1,3°C
- average annual temperature 9,5°C

## IMPORTANT PHONE NUMBERS

- Police – 122
- Firefighters – 123

- First Aid – 124
- Sarajevo Taxi – 1515
- Airport – +387 33 289 100

## ELECTRICITY

- The electric supply is 220V with 50Hz frequency.

## WATER SUPPLY

- It is safe to drink tap water in Sarajevo.

## CURRENCY

Currency in BiH is Convertible Mark. The international abbreviation for currency is BAM, while KM is used locally (1.95 KM = 1 Euro). You can exchange your currency in any bank or post office. Banks are generally open from 08:00 to 18:00 on working days, and from 09:00 to 13:00 on Saturdays. Main post office is open from 07:00 to 20:00 from Monday to Saturday.

## PUBLIC TRANSPORT

Sarajevo is well connected with a network of trams, trolley-buses, buses and minibuses. The one-way ticket for an inner-city zone is 1,6 KM if you purchase it in a kiosk and 1,8 KM if you purchase it with a driver. The ticked must be punched as soon as you enter the vehicle. Failure to do so will result in a fine, on the spot. The bus line connecting airport with Baščaršija runs several times per day and it costs 6 KM (3 Euros) one way.

## SOUVENIRS

To pick up authentic souvenirs, head to Baščaršija, the city's Turkish quarter. During its golden period, it boasted 12 000 various shops selling products and services of 80 different craftsmen and tradesmen. Baščaršija's most popular street is Kazandžiluk (Coppersmith Street), where you can find superbly created engraved copper products: džezve (coffee pots), fildžani (cofee cups), ibrici (copper water dish). The city's jewelry makers were well known throughout Ottoman Empire for their particular designs. Jewelry makers (silver and gold smiths) are mostly located on GaziHusrev-begova Street (Zlatarska or Goldsmiths' Street). While in Baščaršija you can also visit the GaziHusrevBey's Bezistan (covered bazaar) which was built between 1537 and 1555 and newly renovated City Hall.

## SHOPPING CENTERS

Sarajevo is increasingly becoming an interesting shopping destination. Modern boutiques and fashion shops, as well as those featuring designs of local designers, can be found along Ferhadija and Titova Street. We recommend a visit to BBI Center (www.bbicentar.ba), located in the city center and Importanne Center (www.importanne.ba), and located near the Wilson's Walkway and Historical Museum of BiH. There is also the recently opened Alta (www.alta.ba) as well as SCC (www.sarajevocitycenter.com) shopping center on Marijin Dvor.

**NATURAL LANDMARKS**

Vrelo Bosne

Vrelo Bosne (English: Spring of the Bosna River) is the spring of the River Bosna located in the central region of Bosnia and Herzegovina, southwest of Sarajevo. The park is usually entered by foot or by horse-carriage via the main avenue leading into it. The avenue itself contains traditional buildings from the AustroHungarian-era offering a peek into the luxuries of the past. The paths and roads inside the park are ideal for walks and give the visitors the opportunity to take a closer look at the bubbling streams and waterfalls. Typical animals are ducks and swans among others. Olympic mountains Igman, Bjelašnica and Jahorina are aproximatly 40 minutes drive form the city center. These Mountains hosted Winter Olympics in 1984. Extraordinary configuration, good quality snow, suitable climate make these mountains worth of seeing.

# Social events

Beside very diverse and informative scientific part of Conference held through oral sessions, poster sessions, invited keynote lectures and industry panels you will have a chance to enjoy exciting social events during the Conference. Social events include following:

## ***BioIRC Serbia Cocktail party and B2B Meeting Point***

*Location: Sky Bar Hotel Hills at 11th Floor*
*Time: 20:00 – 22:00, March 16,*

This is the first social gathering on the Conference sponsored by the BioIRC Serbia and it will take place at the Venue Hotel. It will be a relaxing evening during which attendees will have the opportunity to talk to colleagues while enjoying drinks. The participations is able only with invitations provided by the Conference Organiser.

## ***Student Party***

*Location: Resturant Mala Pivnica Sarajevo*
*Time: 21:00 – 00:00, March 16, 2017*

This event will be organised at one of the best restaurants in Sarajevo – Mala Pivnica Sarajevo promising a night to remember.

This event is included in STUDENT registration fees.
Ticket(s) for attending event: € 10 (20 BAM)
Ticket(s) can be purchased on the Registration desk.

## ***Conferece Gala dinner***

*Location: Hotel Hills Restaurant*
*Time: 20:00 – 00:00, March 17, 2017*

Conference Gala Dinner will beheld at the Venue Hotel. During gala dinner, attendees will enjoy an array of dishes complimented with local drinks and desserts. For the entertaiment, live music and singing will be performed by a musician Amina Hamzić ft. Open Mind Group.

This event is included only in MEMBER/NON-MEMBER registration fees.
Ticket(s) for attending event: € 30 (60 BAM)
Ticket(s) can be purchased on the Registration desk.

### LIABILITY AND INSURANCE

The organizers cannot be held responsible for accidents to conference participants or accompanying persons, for damage or loss of their personal property, or for cancellation expenses, regardless of cause. Participants are advised to carry out their own insurance arrangements during their stay in Bosnia and Herzegovina.

## 7. PRESENTING AUTHORS INSTRUCTIONS

### ORAL PRESENTATIONS

1. Please make your presence known to one of the chairmen 5 minutes before your session starts and be present during the entire session in which your presentation is scheduled.

2. Number of papers in each session is up to 8. All authors are kindly asked to finish their presentation under 10 minutes.

3. Authors and Speakers must report to the Speakers Area in order to preview and upload their presentations. Files must be handed-in a minimum of 2 hours prior to the start of their session (for morning sessions please upload it the day before). We recommend that you take advantage of the early file uploading opportunity.

4. All session rooms will be equipped with a data projector and a computer. You do not need to bring your own laptop to the lecture room.

5. When building your presentation, use standard fonts (e.g., Times New Roman, Arial, etc.). Basic fonts are included on the session room PC computers, but if an unusual font is used it may not display well.

6. Even if you have submitted your presentation files in advance, please plan to bring the latest version of your presentation to the session on a Windows-readable USB flash Drive or CD-ROM.

7. Computers in conference rooms are equipped with Windows 7, Microsoft Office 2010 package. Apple Mac computers will not be provided in any of the session rooms. If you are using Mac, please check compatibility with Microsoft Office 2010 package or use your own Mac computer if your presentation is created in Apple's “Keynote” presentation application. Videos handed in as an independent file must be coded under standard codec. Users are recommended to preview them in standard universal software, such as VLC Player or Quicktime.

### POSTERS

Please submit your poster to the Registration desk by the end of the first day of the Conference, or on the second day not later than 09:30 h.

## 8. CONFERENCE PROGRAM

# THURSDAY, March 16th 2017

### 08:00 - 10:00 Registration + Welcome Cocktail

### 10:00 - 10:45 Opening Ceremony, CONFERENCE HALL

1. **Ambassador Lars-Gunnar Wigemark and Khaldoun Sinno –** *Head and Deputy of Head of EU Delegation to Bosnia and Herzegovina and EU Special Representative in Bosnia and Herzegovina*
2. **Adil Osmanović -** *Ministry of Civil Affairs of Bosnia and Herzegovina*
3. **Elmedin Konaković** – *Prime Minister of Canton Sarajevo*
4. **Abdulah Skaka** – *Mayor of the City Sarajevo, Bosnia and Herzegovina*
5. **Senaid Memić** – *Mayor of the Municipality Ilidža, Bosnia and Herzegovina*
6. **Kang-Ping Lin –** *General Secretary of the International Federation for Medical and Biological Engineering (IFMBE), Chung-Yuan Christian University, Taiwan*
7. **Ratko Magjarević –** *International Union for Physical and Engineering Sciences in Medicine (IUPESM), University of Zagreb, Croatia*
8. **Eddie Custovic –** *Institute of Electrical and Electronics Engineers (IEEE), La Trobe University, Australia*
9. **Sebastian Dendorfer –** *European Society of Engineering and Medicine (ESEM) Board Member, OTH Regensburg, Germany*
10. **Sebija Izetbegović –** *University Clinical Centre Sarajevo (KCUS), Bosnia and Herzegovina*
11. **Ranko Škrbić –** *Medical Faculty Banja Luka, Bosnia and Herzegovina*
12. **Damir Marjanović** – *Rector of the International Burch University Sarajevo, Bosnia and Herzegovina*
13. **Almir Badnjević –** *Chair of the International Conference on Medical and Biological Engineering (CMBEBIH 2017), Bosnia and Herzegovina*

### 10:45 - 11:00 Media Press Conference, CONFERENCE LOBBY

### 10:45 - 12:30 Plenary Lectures I, CONFERENCE HALL

1. **Ernesto Iadanza, Ph.D**. - *Biomedical and Clinical Engineers: the key to success is a wide knowledge*
2. **Ervin Sejdic, Ph.D. –***From big data to functional outcomes: Can we use big data to understand functional changes in swallowing, gait and handwriting?*
3. **Nesrin Hasirci, Ph.D.** –*Multifunctional Biomaterials and Tissue Engineering Applications*

### 12:30 - 13:30 Lunch Break, Hotel Hills RESTAURANT by Platinum Sponsors: Oracle and Infostudio doo Sarajevo

## 13:30 - 15:30 Plenary Session I, Hotel Hall 2

***BIOMEDICAL SIGNAL PROCESSING 1***

Session Chairs: ***Emir Turajlić,*** *University of Sarajevo (Bosnia and Herzegovina),* ***Radovan Stojanovic****, University of Podgorica (Montenegro)*

S1-1: Abdel-Ilah L, Sahinbegovic H. - *Using machine learning tool in classification of breast cancer*

S1-2: Friganovic K, Jovic A, Jozic K, Kukolja D, Cifrek M. - *MULTISAB project: a web platform based on specialized frameworks for heterogeneous biomedical time series analysis - an architectural overview*

S1-3: Omerbegovic M. - *Short - term variations of parameters of heart rate variability in subjects with mild hypertension and normotensive subjects during preoperative period*

S1-4: Sorelli M, Perrella A, Bocchi L. - *Cardiac pulse waves modeling and analysis in laser Doppler perfusion signals of the skin microcirculation*

S1-5: Maras A, Aydin S. - *Discrimination of Psychotic Symptoms from Controls Through Data Mining Methods Based on Emotional Principle Components*

S1-6: Daunoraviciene K, Apanskienė V, Ziziene J, Ovcinikova A, Kizlaitiene R, Sereike I, Kaubrys G, Luksys D, Griskevicius J. - *Differences in temporal gait parameters between multiple sclerosis and healthy people*

S1-7: Turajlic E, Karahodzic V. - *An Adaptive Scheme for X-ray Medical Image Denoising using Artificial Neural Networks and Additive White Gaussian Noise Level Estimation in SVD Domain*

S1-8: Busatlic E, Osmanovic A, Jakupovic A, Nuhic J, Hodzic A. - *Using Neural Networks and Ensemble Techniques based on Decision Trees for Skin Permeability Prediction*

## 13:30 - 15:30 Plenary Session II, Hotel Hall 3

***BIOMEDICAL IMAGING AND IMAGE PROCESSING***

Session Chairs: ***Adnan Beganovic,*** *University Clinical Center Sarajevo (Bosnia and Herzegovina),* ***Mario Medvedec****, University Hospital Center Zagreb (Croatia)*

S2-1: Ogretmenoglu Ficici C, Erogul O, Telatar Z. - *Fully Automated Brain Tumor Segmentation and Volume Estimation Based on Symmetry Analysis in MR Images*

S2-2: Nasifoglu H, Erogul O, Atac G.K, Ozdemir G. - *Multi-Regional Adaptive Image Compression (AIC) for Hip Fractures in Pelvis Radiography*

S2-3: Frassineti L, Giardini F, Perrella A, Sorelli M, Sacconi L, Bocchi L. - *Evaluation of spatial distribution of skin blood flow using optical imaging*

S2-4: Sahin S, Akata E, Erogul O, Tuncay C, Sahin O, Sanal H.T. - *Computer-assisted diagnosis of osteoartrithis on hip radiographs*

S2-5: Ajanovic Z, Sarac-Hadzihalilovic A, Gojak R. - *Determination of sex by discriminant function analysis of linear diameters in bosnian human skulls*

## 13:30 - 15:30 Plenary Session III, Hotel Hall 4

***BIOSENSORS AND BIOINSTRUMENTATION***

Session Chairs: ***Shankar Krishnan,*** *University Boston (USA),* ***Hurija Dzurdzevic Cancar****, University of Sarajevo (Bosnia and Herzegovina)*

S3-1: Ozkul T, Ozkul M.H. - *Eustachian Tube Dysfunction Assessment Through Tympanic Cavity Air Exchange Sensor*

S3-2: Farshi H.T, Frounchi J. - *Design, Simulation and Implementation of a System for Selective Recording from Peripheral nervous system*

S3-3: Pale U, Cifrek M, Krois I, Peharec S. - *Personal electromyographic biofeedback system „MyMyo“*

S3-4: Djordjevic-Kozarov J, Sovilj P, Vujicic V, Mitic D, Simic M, Radenkovic D. - *Experimental verification of EOG signal measurement using the modified digital stochastic measurement method*

## 15:30-16:00 Coca Cola and Klas Break

## 16:00-18:00 Plenary Session IV, Hotel Hall 2

***BIO-MICRO/NANO TECHNOLOGIES***

Session Chairs: ***Sefik Suzer,*** *Bilkent University (Turkey),* ***Enisa Omanović - Mikličanin****, University of Sarajevo (Bosnia and Herzegovina)*

S4-1: Avdihodzic H, Redzovic Z, Halilovic S. - *Application of Artificial Neural Network in modelling of photo-degradation suspension of manganese doped zinc oxide nanoparticles under visible-light irradiation*

S4-2: Fojnica A, Osmanovic A, Tarakcija Dz, Demirovic S. - *Quantification of protein concentration adsorbed on gold nanoparticles using Artificial Neural Network*

S4-3: Dzebic M, Kurikov O, Dobroliubov O, Nava O.C.A. - *Design and Fabrication of a PDMS Microfluidic Device for Titration of Biological Solutions*

S4-4: Devedzic A. - *Beauty of Fine Dots-Detection and treatment of Alzheimer's disease using quantum dots*

S4-5: Lotfi A, Ghavidel-Aghdam E, Narimani-Rad M. - *Effect of chemically-synthesized silver nanoparticles (Ag-Np) on glycemic and lipidemic status in rat model*

S4-6: Maksimovic M, Omanovic-Miklicanin E. - *Towards green nanotechnology: maximizing benefits and minimizing harm*

S4-7: : Doric A, Mulaomerovic Dz, Fojnica A, Alispahic B, Halilovic S, Omanovic-Miklicanin E. - *Development of the method for quantification of amino acid adsorbed on nanoparticle surface*

S4-8: Omanovic-Miklicanin E, Husremovic T, Jakupovic A, Omerbasic A. - *Application of biological surface adsorption index approach (BSAI) in characterization of interactions between gold nanoparticles and biomolecules*

## 16:00-18:00 Plenary Session V, Hotel Hall 3

***BIOMECHANICS, ROBOTICS AND MINIMALLY INVASIVE SURGERY***

Session Chairs: ***Sebastian Dendorfer,*** *Ostbayerische Technische Hochschule Regensburg (Germany),* ***Ibrahim Omerhodžić****, University Clinical Center Sarajevo (Bosnia and Herzegovina)*

S5-1: Tatlisoz M.M, Canpolat C. - *Mechanical testing strategies for dental implants*

S5-2: Jelacic Z. - *Contact force problem in the rehabilitation robot control design*

S5-3: Aurbach M, Wagner K, Suß F, Dendorfer S. - *Implementation and Validation of Human Kinematics measured using IMUs for Musculoskeletal Simulations by the Evaluation of Joint Reaction Forces*

S5-4: Jungtaubl D, Schmitz P, Gross S, Dendorfer S. - *FEA of the transiliacal internal fixator as an osteosynthesis of pelvic ring fractures*

S5-5: Rupar M, Vucina A, Dedic R, Dindo H. - *Overview of the Development of Hydraulic Above Knee Prosthesis*

S5-6: Thomsen L.P, Aliuskeviciene A, Sorensen K, Norgaard C.A, Sorensen P.L, Bolvig E, Signe M, Riddersholm J, Thorgaard P. - *Non-invasive estimation of respiratory depression profiles during robot-assisted laparoscopic surgery using a model-based approach*

S5-7: Mancheva K, Stephanova D.I, Wolf W, Kossev A. *Long-latency intracortical inhibition during unilateral muscle activity*

## 16:00-18:00 Plenary Session VI, Hotel Hall 4

***CARDIOVASCULAR, RESPIRATORY AND ENDOCRINE SYSTEMS ENGINEERING***

Session Chairs: ***Ervin Sejdić,*** *University of Pittsburgh (USA),* ***Lejla Divović - Mustafić****, University Clinical Center Sarajevo (Bosnia and Herzegovina)*

S6-1: Filipovic N, Isailovic V, Milosevic Z, Nikolic D, Saveljic I, Radovic M, Nikolic M, Cirkovic-Andjelkovic B, Themis E, Fotiadis D, Pelosi G, Parodi O. - *Computational modeling of plaque development in the coronary arteries*

S6-2: Filipovic N, Koncar I, Milosevic Z, Davidovic L. - *Computational Vascular Surgery Planning and Predicting for Abdominal Aortic Aneurysm*

S6-3: Barakovic S, Barakovic Husic J, Barakovic F. - *Determination of Probabilistic Neural Network's Accuracy in Context of Cardiac Stress Test*

S6-4: Divanovic H, Mulic Dz, Padalo A, Rastoder E, Pedljak S, Ziga N, Bego T. - *Effects of electrical stimulation as a new method of treating diabetes on animal models*

S6-5: Godinjak A, Velija-Asimi Z, Burekovic A, Kulic M, Gicic S, Serdarevic F. - *Subclinical inflammation: The link between increased cardiovascular risk and subclinical hypothyroidism in postmenopausal women*

**17:00-19:00 Industry Workshop I, Hotel Hall 1**

*Demonstration of Software PlannerVasc and CFDVasc*

**20:00 – 22:00 BioIRC Serbia Cocktail party - B2B Meeting Point for Invited Guests and Media Representatives at Sky Bar Hotel Hills at 11th Floor *(only with Invitations)***

**21:00 – 02:00 Student Party at the Restoran Mala Pivnica Sarajevo *(only for registered participants – students, members and nonmembers)***

## FRIDAY, March 17th 2017

**08:00 - 09:00 Registration**

**09:00 - 11:30 Plenary Lectures II, CONFERENCE HALL**

1. **Tawab Hamidi – Oracle Business Development Director, Healthcare Division–** *Digital/CX Transformation in Healthcare*
2. **Sefik Suzer, Ph.D. –***Use of Layer-By-Layer Deposition Technique for Inserting Anti-Bacterial Nanoparticles and Their Characterization by XPS*

3. **Vesna Maras, Ph.D**. –*The importance of genetics in characterization and identification of grapevine varieties*
4. **Shankar M. Krishnan, Ph.D**. – *Innovative Technologies in Emerging Clinical Cardiovascular Applications*

**11:30 - 12:00 Book Promotion: "Uvod u nanotehnologiju (engl. Introduction to Nanotechnology) Authors: Enisa Omanović – Mikličanin and Almir Badnjević, CONFERENCE HALL *(will be presented on the local language)***

## 12:00 – 14:30 Poster session

Poster Chairs: ***Ervin Sejdić,*** *University of Pittsburgh (USA),* ***Vesna Maraš****, University of Donja Gorica (Montenegro),* ***Ratko Magjarević****, University of Zagreb (Croatia),* ***Eddie Custovic****, La Trobe University (Australia),* ***Shankar Krishnan,*** *University of Boston (USA),* ***Kang Ping Lin****, Chung-Yuan Christian University (Taiwan),* ***Shyh – Hau Wang,*** *National Cheng Kung University (Taiwan)*

P1: *People identification using Kinect sensor*
Authors: Ramakic A, Toroman A.

P2: *Artificial Neural Network: Gas recognition*
Authors: Keskic L, Hodzic J, Alispahic B.

P3: *A Fuzzy Model to Predict Risk of Urinary Infection*
Authors: Avdic-Ibrisimovic M, Karli G, Balkaya H.E, Ibrisimovic M, Hukic M

P4: *Conceptual image of heart – path to patient benefit*
Authors: Botonjic A, Begic E, Zvizdic D, Begic N.

P5: *A Novel Gait Detection Algorithm Based on Wireless Inertial Sensors*
Authors: Gao Y, Jiang Z, Ni W, Lucev Vasic Z, Cifrek M, Du M, Va M.I, Pun S.H.

P6: *Single-Chip Intrabody Communication Node*
Authors: Grilec F, Stanesic A, Lucev Vasic Z, Gao Y, Du M, Cifrek M.

P7: *Microneedle-assisted delivery of NSAIDs*
Authors: Vranic E, Tucak A, Vrabac Dz, Rahic O, Elezovic A, Hadziabdic J.

P8: *Preparation of Nanoemulsions by high-energy and low-energy emulsification methods*
Authors: Hadziabdic J, Orman Dz, Elezovic A, Vranic E, Rahic O.

P9: *Characterization of NiTi orthodontic archwires characteristic functional properties*
Authors: Rudolf R, Fercec J, Lazic V, Veselinovic V, Tomic S.

P10: *Simulation of kinematic behavior of prosthetic devices*
Authors: Raspudic V.

P11: *Thyroid pathology and platelet functional activity*
Authors: Ralchenko I.V, Chepis M.V, Ralchenko E.S.

P12: *Trends among neonatologists in decision to ventilate preterm infants with permissive hypercapnia*
Authors: Terzic S, Heljic S, Maksic H.

P13: *A mathematical model of the effect of metabolic control on joint mobility in young type 1 diabetic subjects*
Authors: Francia P, Perrella A, Sorelli M, Toni S, Piccini B, Sardina G, Gulisano M, Bocchi L.

P14: *Basics of mathematical modeling of pulmonary ventilation mechanics and gas exchange*
Authors: Popovic N, Naumovic M, Roganovic S.

P15: *Testing of the influence of media's pH value on the solubility and partition coefficient of the acetylsalicylic acid*
Authors: Knezevic D, Kasagic-Vujanovic I.

P16: *The use of ELM and MnM servers for the prediction of RANK function in osteoclast formation*
Authors: Alibegovic S, Causevic A, Kulas S, Kranjc T, Marc J, Bego T.

P17: *QSAR modeling and structure based virtual screening of new PI3K/mTOR inhibitors as potential anticancer agents*
Authors: Oluic J, Nikolic K, Vucicevic J, Gagic Z, Filipic S, Agbaba D.

P18: *Career development in Green Biotechnology in B&H: roadblocks and prospects*
Authors: Karalija E.

P19: *E-health in Bosnia and Herzegovina: exploring the challenges of widespread adoption*
Authors: Popovic B, Maksimovic M.

P20: *5-HIAA and HVA in the Coma Cerebri, Hydrocephalus and Tumor Cerebri*
Authors: Salihovic M, Sofic E.

P21: *Estimation of lipophilicity data for derivatives of alkandiamine-N,N'-di-2-(3-cyclohexyl) propanoic acid with potential antineoplastic activity, by UHPLC-MS method*
Authors: Tubica B, Markovic B, Vladimirov S, Savic A, Pol Jarevic J, Sabo T.

P22: *Determination of kinetic effect of Metoprolol and Ranitidine on HRP-modified GC electrode biosensor*
Authors: Besic Z, Herenda S, Stankovic T, Ostojic J.

P23: *Monitoring of bisoprolol fumarate stability under different stress conditions*
Authors: Kasagic-Vujanovic I, Jancic Stojanovic B, Ivanovic D.

P24: *Measuring the feeling: correlations of sensorial to instrumental analyses of cosmetic products*
Authors: Elezovic A, Hadziabdic J, Rahic O, Vranic E.

P25: *Hydrophilic antioxidant scores against hydroxyl and peroxyl radicals in honey samples from Bosnia and Herzegovina*
Authors: Tahirovic I, Helbet Dz, Gastan A, Buza N, Dizdar M, Topcagic A, Toromanovic J, Copra-Janicijevic A, Kurtagic H.

P26: *Polymorphisms of 1691G>A FV and 4070A>G FV (HR2) in recurrent pregnancy loss in Bosnian women*
Authors: Mahmutbegovic E, Adler G, Medjedovic E, Mahmutbegovic N, Dogan S, Pawinska-Matecka A, Czerska E, Marjanovic D.

P27: *Lack of association between I/D ACE and -675 ID 4G / 5G PAI-1 polymorphisms and predicting risk of pregnancy loss (PROPALO) in Bosnian women*
Authors: Mahmutbegovic E, Skonieczna-Iydecka K, Valjevac A, Mahmutbegovic N, Pawinska-Matecka A, Czerska E, Marjanovic D, Adler G.

P28: *Gene clustering using Gene expression data and Self-Organizing Map (SOM)*
Authors: Keskic L, Hodzic J, Alispahic B.

P29: *Public opinion toward GMOs and biotechnology in Bosnia and Herzegovina*
Authors: Bevanda L, Zilic M, Ecimovic B, Matkovic V.

P30: *Future trends and possibilities of using induced pluripotent stem cells (iPSC) in regenerative medicine*
Authors: Tucak A, Vrabac Dz, Smajic A, Sazic A.

P31: *The influence of the metabolic syndrome on the articular manifestations in patients with rheumatoid arthritis*
Authors: Abdullaev B., Tukhtaeva N.

P32: *Medical students´ dietary habits as a function of stress*
Authors: Mujanovic A., Sabic L.

P33: *Eating patterns and nourish status among medical students of Sarajevo University*
Authors: Catovic A., Kurspahic-Mujcic A., Nadarevic E.

P34: *Transcranial doppler analysis in adults with classic migraine*
Authors: Music M., Mutevelic-Turkovic A., Muslic D., Dervisevic A., Fajkic A., Alic L.

P35: *Investigation of the use of anodic aluminum oxide membranes as SERS substrates and detection of myoglobin protein*
Authors: Celik M., Altuntas S., Buyukserin F.

P36: *Benefits of early ultrasound diagnosis of congenital urinary tract obstruction in children*
Authors: Jovicic S., Sarovic Vukajlovic M., Bojanic Lj., Obradovic Z., Petrovic Tepic S.

P37: *Pharmacoeconomic analysis of antineoplastic agents consumption in Republic of Srpska during the period from 2011 to 2015*
Authors: Bojanic Lj., Djermanovic M., Sarovic M., Jovicic S., Obradovic Z.

P38: *Open surgery vs. Laparoscopic living donor nephrectomy*
Authors: Beganovic S., Babajic E., Grapkic J.

P39: *Determination of clinical target volume to planning target volume margin without setup correction protocol for localized high-risk prostate cancer irradiation*
Authors: Jaros D., Cazic D., Kolarevic G.

P40: *DNA identification of plane crash victims at the airfield "Zalužani"Banja Luka*
Authors: Obradovic Z., Sarovic M., Jovicic S., Bojanic Lj., Karan Z., Zoric B.

P41: *Do doctors in Republic of Macedonia prescribe irrational antibiotics for acute respiratory tract infections?*
Authors: Angjelov M., Krstevska E., Naumovski F., Mitrevska V., Rustemovska S., Mujkanovic A., Stavric K.

P42: *Clinical experience with the use of CAD/CAM technology in making below-the-knee prosthesis*
Author: Majstorovic B.

P43: *Utilizing the solid-state detector for assessment of geometric efficiency in computed tomography*
Authors: Civa L, Begaovic A, Redzic M, Skopljak-Beganovic A, Gazdic-Santic M, Jasic R.

P44: *Tyrosinase related activity of 2,2'-(arylmethylene)bis(3-hydroxy-5,5-dimethylcyclohex-2-enones) – docking study*
Authors: Veljovic E, Spirtović-Halilovic S, Osmanovic A, Muratovic S, Tahric T, Peštović D, Fazlić L, Jerlagić A, Karačić A, Kovač N, Tucak A, Zavrsnik D.

## 12:30 - 13:30 Lunch Break, Hotel Hills RESTAURANT by Platinum Sponsor: Računari doo Banja Luka

## 13:30 - 15:30 Plenary Session VII, Hotel Hall 2

***BIOMEDICAL SIGNAL PROCESSING 2***

Session Chairs: ***Dusanka Boskovic,*** *University of Sarajevo (Bosnia and Herzegovina),* ***Kang Ping Lin****, Chung-Yuan Christian University (Taiwan)*

S7-1: Memic J. - *ECG Signal Classification Using Artificial Neural Networks: Comparison of Different Feature Types*

S7-2: Abdullah A.A, Subasi A, Qaisar S.M. - *Surface EMG Signal Classification by Using WPD and Ensemble Tree Classifiers*

S7-3: Ackar H, Kico I, Tahirbegovic A, Boskovic D. - *Tool for Comparative Case Studies of Heart Rate and Heart Rate Variability*

S7-4: Simic M, Babic Z, Risojevic V, Stojanovic G. - *A novel approach for parameter estimation of Fricke-Morse model using Differential Impedance Analysis*

S7-5: Ramovic A, Bandic L, Kevric J, Germovic E, Subasi A. - *Wavelet and Teager Energy Operator (TEO) for Heart Sound Processing and Identification*

S7-6: Osmanovic A, Abdel-Ilah L, Hodzic A, Kevric J, Fojnica A. - *Ovary Cancer Detection using Decision Tree Classifiers based on Historical Data of Ovary Cancer Patients*

S7:7: Akman Aydin E, Bay O.F, Güler I. - *A Dynamic Stopping Algorithm for P300 Based Brain Computer Interface Systems*

S7-8: Maljkovic N, Pantovic S, Mitrovic J. - *Human-machine interface via EMG signals derived from EEG measurement device*

## 13:30 - 15:30 Plenary Session VIII, Hotel Hall 3

***BIOMEDICAL IMAGING AND IMAGE PROCESSING 2***

Session Chairs: ***Igor Lackovic,*** *University of Zagreb (Croatia),* ***Eddie Custovic****, La Trobe University (Australia)*

S8-1: Ozic M.U, Ozsen S, Ekmekci A.H. - *A Novel Feature Extraction Approach with VBM 3D ROI Masks on MRI*

S8-2: Ashfaq A, Adler J. - *A modified fuzzy C means algorithm for shading correction in craniofacial CBCT images*

S8-3: Ture H, Kayikcioglu T. - *Detection and Segmentation of Nodules in Chest Radiographs Based on Lifetime Approach*

S8-4: Maretic I, Lackovic I. - *Automated Colony Counting Based on Histogram Modeling Using Gaussian Mixture Models*

S8-5: Korel D.Y, Sonmez M., Lederman R.J., Kocaturk O. – *A novel active device fabrication method for interventional MRI Procedures*

## 13:30 - 15:30 Plenary Session IX, Hotel Hall 4

***CLINICAL ENGINEERING AND HEALTH TECHNOLOGY ASSESSMENT***

Session Chairs: ***Magdalena Krbot Skoric,*** *University of Zagreb (Croatia),* ***Zijad Dzemic****, Institute of Metrology of Bosnia and Herzegovina (Bosnia and Herzegovina)*

S9-1: Krbot Skoric M, Cifrek M, Krois I, Jerbic A.B, Isgum V. - *The electrode setup for vibratory evoked potentials*

S9-2: Redzic M, Beganovic A, Civa L, Jasic R, Skopljak-Beganovic A, Vegar-Zubovic S - *Quality control of tube current modulation in computed tomography*

S9-3: Jafari A, Shirali M, Ghassemian M. - *A testbed evaluation of MAC layer protocols for smart home remote monitoring of the elderly mobility pattern*

S9-4: Kovacevic Z, Stojanovic R. - *Proposal of integrated software system for simulation and GIS visualization of accidents caused by emission of hazardous gases*

S9-5: Bosnjakovic A, Dzemic Z. - *Legal metrology for medical devices*

S9-6: Subasi A., Alickovic E., Kevric J.- *Diagnosis of Chronic Kidney Disease by Using Random Forest*

S9-7: Medvedec M. - *Global Survey on Biomedical Engineering Professionals in Health Technology Assessment*

## 15:30-16:00 Coca Cola and Klas Break

## 16:00-18:00 Plenary Session X, Hotel Hall 2

***BIOINFORMATICS AND COMPUTATIONAL BIOLOGY***

Session Chairs: ***Tomislav Mileković,*** *École Polytechnique Fédérale de Lausanne (Switzerland),* ***Elma Veljovic,*** *University of Sarajevo (Bosnia and Herzegovina)*

S10-1: Alic B, Gurbeta L, Badnjevic A, Badnjevic-Cengic A, Malenica M, Dujic T, Causevic A, Bego T. - *Classification of Metabolic Syndrome Patients Using Implemented Expert System*

S10-2: Badnjevic A, Gurbeta L, Cifrek M, Pecchia L. - *Pre-classification process symptom questionnaire based on fuzzy logic for pulmonary function test cost reduction*

S10-3: Veljovic E, Spiritovic-Halilovic S, Muratovic S, Osmanovic A, Badnjevic A, Gurbeta L, Tatlic B, Zorlak Z, Imamovic S, Husic D, Zavrsnik D. - *Artificial Neural Network and Docking Study in Design and Synthesis of Xanthenes as Antimicrobial Agents*

S10-4: Krivdic A. - *Mathematical and Computational Models of Cell Cycle in Higher Eukaryotes*

## 16:00-18:00 Plenary Session XII, Hotel Hall 3

***HEALTH INFORMATICS, E-HEALTH AND TELEMEDICINE***

Session Chairs: ***Shankar Krishnan,*** *University of Boston (USA),* ***Zerina Masetic,*** *International Burch University Sarajevo (Bosnia and Herzegovina)*

S12-1: Khan A.S, Khan S.A. - *Using Information and Communications Technology as an Enabler for Designing an Efficient National Level Vaccination Planning and Dispensing System*

S12-2: Bilic D, Kaharevic A, Dumic D, Sunj E, Nuhic J, Hodzic N, Ibrahimpasic T. - *Stroke Center Heart Rate Data Acquisition*

S12-3: Ceyhan M, Orhan Z, Domnori E. - *Health service quality measurement from patient reviews in Turkish by opinion mining*

S12-4: Ceyhan M, Orhan Z, Domnori E. - *e-Medical Test Recommendation System Based on the Analysis of Patients' Symptoms and Anamnesis*

S12-5: Begic E, Mandzuka M, Begic Z, Dobraca A, Hasanbegovic E. - *Antihypertensive therapy dosage calculator*

S12-6: Ozderya H.Y, Erdol H, Kayikcioglu T, Yilmaz A.O, Kaya I. - *Wireless Body Area Network Studies for Telemedicine Applications Using IEEE 802.15.6 Standard*

S12-7: Kayikcioglu I, Akdeniz F, Kayikcioglu T, Kaya I. - *Real-Time Monitoring of ST Change for Telemedicine*

## 16:00-18:00 Plenary Session XIII, Hotel Hall 4

***MULTIDISCIPLINARY SESSION***

Session Chairs: ***Shyh – Hau Wang,*** *National Cheng Kung University (Taiwan),* ***Sefik Suzer,*** *Bilkent University (Turkey)*

S13-1: Balihodzic A.,Henic H., Maltez N., Mrzic A., Music E., Omerbasic Z., Salhab A., El-Amin Zeid M., Ibrisimovic Mehmedinovic N., Salihovic V., Galijasevic S., Ibrisimovic M. - *Alternative approaches for total protein isolation from human blood leukocytes*

S13-2: Klepo Dz. - *DNA vaccines*

S13-3: Bode R. - *Role of imagery in preoperative evaluation of parathyroid lesions in Hyperparathyroidism.*

S13-4: Hromic A., Kumar P., Padmanabha Das K.M., Madl T., Jajcanin-Jozic N., Wallner S., Oberer M., Gruber K. - *Biophysical and structural characterization of dipeptidyl peptidase III from Porphyromonas gingivalis*

S13-5: Altuntas S., Haider A., Altinok A., Aslim B., Biyikli N., Buyukserin F. - *Modulation of Nerve-Cell Behavior on Conductive Nanoporous Alumina Membranes*

S13-6: Wang S.H., Liu K.Y. - *Detection of 3-dimensional Kinetic Trajectory of Median Nerve by Ultrasound Images and 3D Motion Tracking Technique*

S13-7: Muhedinovic H., Kico I., Boskovic D. - *Sensor node for pressure monitoring for the IoT biomedical applications*

S13-8: Özgür Doğan R., Kayikçioğlu T., Yağci Y., Yildirim O. - *Developing electronic health recording system for telemonitoring chronic patients*

**16:00-18:00 Industry Workshop II, Hotel Hall 1**

***"Building a thriving Medical and Biological Engineering Industry in Bosnia and Herzegovina"***

Panel Experts:

1. *Adnan Custovic (Professor, Imperial College London, UK)*
2. *Ervin Sejdic (Professor, University of Pittsburgh, USA)*
3. *Pete Finnegan (Clinical Innovations Fellow, National Trauma Research Institute, The Alfred, Australia)*
4. *Eddie Custovic (IEEE Industry Engagement & Director of LIEF, La Trobe University, Australia)*
5. *Nedim Junuzovic (Director QARA, Medodan APS and Founder of Regulamedica.com)*
6. *Ceco Gakovic (CityOS Foundation, San Francisco Bay Area)*
7. *Ranko Markus (Director of the GOPA Consultants mbH and manager of the Swiss funded Youth Employment Project (YEP))*
8. *Almir Badnjevic (Director of Verlab & University Professor)*

**20:00 – 00:00 Gala dinner at Hotel Hills Restaurant with Amina Hamzic ft. Open Mind Group *(only for registered Members, Non-Members and special Invitations)***

## SATURDAY, March 18th 2017

**08:00 - 09:00 Registration**

## 09:00 - 10:30 Plenary Lectures III, CONFERENCE HALL

1. **Christopher James, Ph.D. –** *Independent Component Analysis in Brain Signals*
2. **Tomislav Milekovic, Ph.D***. - Neuroprosthetic technologies to restore movement and communication of people with paralysis*

## 10:30 - 12:00 Plenary Session XIV, Hotel Hall 2

***BIOMEDICAL SIGNAL PROCESSING 3***

Session Chairs: ***Radovan Stojanovic****, University of Podgorica (Montenegro),* ***Alma Secerbegovic,*** *University of Tuzla (Bosnia and Herzegovina)*

S14-1: Avdihodzic H, Halilovic S, Hasicic M, Bilic D. - *Micro cell culture analog Apparatus (μCCA) output prediction using artificial neural networks on a microcontroller based framework*

S14-2: Sejdinovic D, Gurbeta L, Badnjevic A, Malenica M, Dujic T, Causevic A, Bego T. -*Classification of Prediabetes and Type 2 Diabetes using Artificial Neural Network*

S14-3: Stanger J, Felicetti M, Jenkins M, Custovic E. - *Multi-biophysical event detection using blind source separated audio signals*

S14-4: Ozturk M.A, Tamer U, Yilmaz A.O, Ozdemir T, Kaya I. - *Diversity performance of microstrip patch antennas placed on human body at ISM and MBAN frequencies*

S14-5: Jankovic D, Stojanovic R. - *Flexible system for HRV analysis using PPG signal*

S14-6: Ciobanu O, Ciobanu G, Aiello A. - *An application of Kinect depth sensor for scoliosis and kyphosis screening*

S14-7: Yin H, Chiu S, James C. - *Development of a muscle activated switch for the severely debilitated*

S14-8: Secerbegovic A, Ibric S, Nisic J, Suljanovic N, Mujcic A. - *Mental workload vs. stress differentiation using low-cost EEG signals*

## 10:30 - 12:00 Plenary Session XV, Hotel Hall 3

***PHARMACEUTICAL ENGINEERING***

Session Chairs: ***Hurija Dzurdzevic Cancar****, University of Sarajevo (Bosnia and Herzegovina),* ***Tamer Bego,*** *University of Sarajevo (Bosnia and Herzegovina)*

S15-1: Ibrisimovic M, Ibrisimovic-Mehmedinovic N. - *Effects of various metal and drug agents on excretion of enzyme aspartyl proteinase in Candida albicans and its role in human physiological processes*

S15-2: Zunic E, Djedovic A, Juric Z. - *Practical Transport Optimization Method and Concept in Pharmaceutical Industry*

S15-3: Muratovic S, Veljovic E, Osmanovic A, Dedibegovic J, Niksic H, Dzudzevic-Cancar H, Zavrsnik D. - *Antiproliferative Evaluation and Docking Study of Synthesized Biscoumarin Derivatives*

S15-4: Terzic V, Tarakcija A, Vardo A, Hadzajlic A, Sakic V, Smajlovic S , Milisav A.M, Midzic E, Smajovic A, Dedic M. - *Passive absorption prediction of transdermal drug application with Artificial Neural Network*

S15-5: Duspara K, Smits A, Allegaert K, Heljic S, Turcic P, Rakovac-Tupkovic L, Kusturica J, Rakanovic-Todic M, Burnazovic-Ristic L, Maleskic S, Kulo A. - *The role of population pharmacokinetic analysis in rational antibiotic therapy in neonates*

S15-6: Hasanefendic B, Hajrovic A, Begovic E, Uzunalic H. - *The ratio of hematological parameters and markers of inflammation in patients with iron deficiency and pernicious anemia*

S15-7: Hercegovac A, Hajdarevic E, Hodzic S, Halilovic E, Avdic A, Habibovic M. - *Blood group, hypertension, and obesity in the student population of Northeast Bosnia and Herzegovina*

## 10:30 - 12:00 Plenary Session XVI, Hotel Hall 4

***GENETIC ENGINEERING***

Session Chairs: ***Damir Marjanovic**, International Burch University Sarajevo (Bosnia and Herzegovina), **Safija Herenda,** University of Sarajevo (Bosnia and Herzegovina)*

S16-1: Mandal S, Causevic A, Dzudzevic-Cancar A, Semiz S. - *Free fatty acid profile in Type 2 diabetic subjects with different control of glycemia*

S16-2: Maras V, Kodtulovic V, Mugosa M, Raicevic J, Gazivoda A, Sucur S, Perisic M. - *Clonal selection of Montenegrin autochthonous grape variety Vranac*

S16-3: Konakli H, Balkaya H.E, Ozcoban I, Dogan S. - *A Dissimilar Approach to Associating Angiotensin Converting Enzyme Polymorphisms*

S16-4: Sofo-Hafizovic A, Dizdarevic-Rekic A, Ibricevic-Balic L, Burazerovic L, Vila M, Suljovic-Hadzimesic E, Skuric-Tomic M, Catovic-Baralija E, Ahmetovic G, Sahovic A, Sicanica S, Omanovic A. - *Successful collection of stem cells in one day in the process of autologous stem cell transplantation*

## 12:00-12:30 Closing Ceremony, CONFERENCE HALL

## 13:00 – 14:00 Annual Assembly of the Bosnia and Herzegovina Medical and Biological Engineering Society

# CMBEBIH

International Conference on
Medical and Biological Engineering

# Abstracts

## 9. ABSTRACTS

### BIOMEDICAL SIGNAL PROCESSING

### 1. MULTISAB PROJECT: A WEB PLATFORM BASED ON SPECIALIZED FRAMEWORKS FOR HETEROGENEOUS BIOMEDICAL TIME SERIES ANALYSIS - AN ARCHITECTURAL OVERVIEW

*Kresimir Friganovic[1], Alan Jovic[1], Kresimir Jozic[2], Davor Kukolja[1], Mario Cifrek[1]*

*[1]University of Zagreb Faculty of Electrical Engineering and Computing, Unska 3, 10000 Zagreb, Croatia*

*[2]INA – industrija nafte, d.d., Avenija Veceslava Holjevca 10, p.p. 555, HR – 10002 Zagreb, Croatia*

Abstract - The aim of this work is to present an architectural overview of a novel web platform used for heterogeneous biomedical time series analysis. Its architecture is based on three subprojects: frontend, backend, and processing. Frontend uses several contemporary web technologies to present a fast, responsive and pleasing user interface. Backend, written in Java, communicates with a database and with other servers, on which the processing subproject is deployed. The processing subproject contains several frameworks intended for: record input handling, signal preprocessing, data visualization, general time series features extraction, specific time series features extraction (e.g. heart rate variability and electroencephalogram), data mining, and reporting. The platform is in an early phase of implementation, but we demonstrate its features and capabilities, of which feature extraction frameworks and signal visualization currently stand out.

*Keywords: framework, web platform, biomedical time series, frontend development, signal visualization*

### 2. MENTAL WORKLOAD VS. STRESS DIffERENTIATION USING SINGLE-CHANNEL EEG

*A. Secerbegovic, S. Ibric, J. Nisic, N. Suljanovic and A. Mujcic*

*Faculty of Electrical Engineering, University of Tuzla, Bosnia and Herzegovina*

Abstract - The emergence of wearable low-cost wireless devices has allowed for continuous acquisition of physiological signals. Recently number of studies have applied these acquisition systems in different types of health monitoring. Since continuous elevation of stress hormones can have negative impact on individuals' health, it is important to recognize and possibly prevent stress episodes in working environments. In this paper, we have tested if single-channel electroencephalography (EEG) signals can be utilized in assessment of different levels of mental workload and stress. Experimental study was conducted in laboratory settings with nine participants. In addition to EEG signals, we have acquired electrocardiogram (ECG) and electrodermal activity (EDA) recordings during all stages. Two scenarios are tested: first group of participants was introduced to only mental workload assignments, while second group was tested with mental workload and public speaking task as an stress inducing assignment. The experimental results show that EEG features have an acceptable separation ability between investigated states, where best classification accuracy, obtained between relaxed and high mental workload states, was 86.66%. Compared to only ECG or EDA features, EEG-based classification accuracy is higher in both scenarios, but lower in comparison with combined features from all three physiological signals.

*Keywords: hormone,acquisition systems, electroencephalography (EEG), electrocardiogram (ECG), electrodermal activity (EDA)*

## 3. HUMAN-MACHINE INTERFACE VIA EMG SIGNALS DERIVED FROM EEG MEASUREMENT DEVICE

*Nina Maljković[1], Sofija Pantović[1], and Jovan Mitrović[2]*

*[1] Faculty of Technical Sciences, University of Novi Sad, Novi Sad, Serbia*

*[2]Faculty of Technical Sciences, University of Novi Sad, Novi Sad, Serbia*

Abstract - This paper presents application of electroencephalography (EEG) measurement device for recording EMG signals from the arm muscles in order to generate motor shaft movements. System used for this experiment consists of electrodes primarily intended for use in electroencephalography, which are placed on persons sin and connected to the simple EEG device. Recorded signals are forwarded to the PC in purpose of filtration using BrainBay software and later sent to the development board. Firmware in the microcontroller on this board regulates rotation of the stepper motor, whether clockwise or counterclockwise. This implementation enables real-time response to muscle contractions, thus moving the stepper motor.

*Keywords: EEG, EMG, signals, BrainBay, stepper motor*

## 4. MICRO CELL CULTURE ANALOG APPARATUS (μCCA) OUTPUT PREDICTION USING MICROCONTROLLER SYSTEM BASED ON A ARTIFICIAL NEURAL NETWORK

*Halida Avdihodzic[1], Sabina Halilovic[1], Mehrija Hasicic[1], Damir Bilic[1]*

*[1]International Burch University Sarajevo*

Abstract - This paper presents a framework for the prediction of naphthalene concentrations in the liver and lung compartments of a micro cell culture analog apparatus (CCA) using a microcontroller system based on an Artificial Neural Network (ANN). The system can be used to simulate organ and circulatory system reactions in terms of residual naphthalene concentrations before conducting experiments on a CCA. The system is implemented as follows: a keypad which is used to input the quantities of inhaled air (naphthalene), a microcontroller for processing and data prediction, a LCD to display the predicted values. The ANN, previously trained in MATLAB, was transferred to the microcontroller in order to obtain predicted naphthalene concentrations in the liver and lungs. The complete framework is described with guides for future work.

*Keywords: μCCA, micro cell culture analog apparatus, artificial neural network, prediction, naphthalene, microcontroller*

## 5. FLEXIBLE SYSTEM FOR HRV ANALYSIS USING PPG SIGNAL

*Danilo Janković[1] ,PhD Radovan Stojanović[1]*

*[1]University of Montenegro,Podgorica, Montenegro*

Abstract - This paper presents an approach for detecting characteristic points in PPG (Photoplethysmogram) signal for the purpose of HRV (Heart Rate Variability) analysis. From IBI (Inter Beat Intervals) distribution several statistical parameters are extracted. For the purpose of comparison the same distribution and parameters are extracted from ECG signal by most used Pan-Tompkin's algorithm. Using experimental set of data, under different conditions (spontaneous, controlled or assisted ventilation) and performing tests on the signals from the database which is consisted of patients of various ages, the high correlation in terms of statistical errors has been achieved, mean square error less than 100 ms in 89.19 % of calculations, error in calculating HRV less

than 5 beats/minute in 91.89 % of tests. The proposed method provides additional advantages because it can be used for simplified measurement and signal processing, which can include easy hardware-software implementation and low cost. After the introductory notes, processing principles, verification and comparison procedure as well as preliminary results are presented.

*Keywords: modified, Zong, PPG, ECG, HRV, MATLAB, absolute error, MSE, BPM, STD*

**6. AN APPLICATION OF KINECT DEPTH SENSOR FOR SCOLIOSIS AND KYPHOSIS SCREENING**

*Octavian Ciobanu[1], Gabriela Ciobanu[2] and Antonella Aiello[1]*

*[1]Faculty of Medical Bioenineerin, "Griore . Popa" niversity of Medicine and Pharmacy, Iasi, Romania*

*[2]Faculty of Chemical Enineerin and Environmental Protection, "Gheorhe Asachi" echnical University of Iasi, Iasi, Romania*

Abstract - Modern technologies for evaluation of spinal deformities are based on assessment of the surface geometry of the torso in different ways. 3D scanning and 3D reconstruction using low cost Kinect sensor can contribute in rapid and low cost elaoration of a 3D mesh of the patients ac. his paper describes the instrumentation, technique and the results of a Kinect based system for screening of scoliosis and kyphosis. The system proposed in this investigation uses infrared ray technology to evaluate the torso surface of patients. This work discusses the advantages and limitations of the proposed scanning system. Experimental results demonstrated that the low-cost depth sensors can produce accurate 3D models when combined with specialized software. Due to numerous transducers, the Kinect sensor may be used in a lot of medical bioengineering applications.

**7. MULTI-BIOPHYSICAL EVENT DETECTION USING BLIND SOURCE SEPARATED AUDIO SIGNALS**

*Jonathan Stanger, Matthew Felicetti, Michael Jenkins, Edhem Custovic*

*La Trobe University, Department of Engineering Plenty Road, Melbourne, Victoria, Australia 3086*

Abstract - This paper aims to use signal processing techniques to identify biophysical events using audio signals. The processing technique proposed is a combination of the mel frequency cepstral coefficients (MFCC) used as features, independent component analysis (ICA) and principle component analysis (PCA) algorithms to separate sources and noise. It was found that compressing the data into the energies of 26 filter banks mapped to the mel frequencies, sufficient descriptive information was conserved as validated by visually identifiable source signal patterns. Subsequently performing PCA isolated global background noise to an individual component. Further, by performing ICA, components contained independent and visually identifiable patterns that correlated to events associated with heart rate, squatting motion and involuntary abdominal movements. This componentized feature space provides an optimized source for building a discriminant function for the classifier used in the machine learning algorithm to provide simultaneous and automatic classification of these biophysical events.

*Keywords: auscultation, independent component analysis, principle component analysis, biophysical monitoring*

**8. CLASSIFICATION OF PREDIABETES AND TYPE 2 DIABETES USING ARTIFICIAL NEURAL NETWORK**

*Dijana Sejdinović[1], Lejla Gurbeta[1,2], Almir Badnjević[1,2,3,4], Maja Malenica[5], Tanja Dujić[5], Adlija Čaušević[5], Tamer Bego[5], Lejla Divović-Mustafić[6]*

*[1] International Burch University, Sarajevo, Bosnia and Herzegovina*

*[2] Medical device inspection laboratory Verlab Ltd. Sarajevo, Bosnia and Herzegovina*

*[3] Faculty of Electrical Engineering, University of Sarajevo, Bosnia and Herzegovina*

*[4] Technical Faculty, University of Bihać, Bosnia and Herzegovina*

*[5] Faculty of Pharmacy, University of Sarajevo, Bosnia and Herzegovina*

*[6] Clinical Center University of Sarajevo, Bosnia and Herzegovina*

Abstract - In this paper development of Artificial Neural Network for classification of prediabetes and type 2 diabetes (T2D) is presented. For development of this system 310 samples consisting of information about Fasting Plasma Glucose (FPG) and blood test called HbA1c were used. All samples were obtained from several healthcare institutions in Bosnia and Herzegovina, and diagnosis of prediabetes, T2D and healthy patients in this dataset were established by medical professionals. Two-layer feedforward backpropagation network with 15 neurons in hidden layer and sigmoid transfer function, used for classification of prediabetes and T2D in this paper, was trained with 190 samples. Testing of developed neural network was performed with 120 samples for validation also obtained from healthcare institutions in Bosnia and Herzegovina. Out of 120 samples, developed network was accurate in 94.1% cases for the classification of prediabetes and in 93.3% cases for classification of T2D.

*Keywords: prediabetes, diabetes type 2, Fasting Plasma Glucose, HbA1c, classification, Artificial Neural Network, Pattern Recognition*

**9. CARDIAC PULSE WAVES MODELING AND ANALYSIS IN LASER DOPPLER PERFUSION SIGNALS OF THE SKIN MICROCIRCULATION**

*Michele Sorelli[1], Antonia Perrella[1], and Leonardo Bocchi[1]*

*[1]Dept. of Information Engineering - University of Florence, Italy*

Abstract - Blood pulse waveform relates to the physical properties of the circulatory system, and carries valuable hemodynamic information for the management of cardiovascular patients. In this paper, we present a modeling technique to reconstruct and characterize the cardiac-related pulse waves, observed in laser Doppler flowmetry signals of the peripheral skin perfusion. We tested the sensitivity of the proposed model to physiological alterations of the vascular system, investigating the effect of ageing on a set of parameters describing the reconstructed pulse waves. Waveform data collected from a set of 56 subjects demonstrate the existence of a significant correlation between ageing and the shape of the peripheral perfusion pulse waves, and indicate a possible relationship with the mechanical properties of the vascular tree.

*Keywords: circulatory system,Doppler,pulse waves*

**10. DISCRIMINATION OF PSYCHOTIC SYMPTOMS FROM CONTROLS THROUGH DATA MINING METHODS BASED ON EMOTIONAL PRINCIPLE COMPONENTS**

[1]Abdullah Maraş, [2]serap Aydin

[1] İstanbul University, Informatics Doctorate Program, İstanbul, Turkey

[2] Bahçeşehir University, Biomedical Engineering Department, İstanbul, Turkey

Abstract - In this study, different data mining techniques has been used for classification of healthy controls and patients diagnosed by First Episode Psychosis with respect to complexity of frequency band activities (Delta, Theta, Alpha, Beta, Gamma)in multi channel EEG measurements mediated by emotional, static and visual stimuli including affective pictures from IAPS. Degree of local EEG complexity has been correlated by largeness of the dominant principle component in each EEG sub-band. The best classification performances are provided by Rotation Forest, Simple Logistic and Artificial Neural Networks when the components from occipitoparietal and posterio-temporal locations (P3, P4, O1, O2, T5 and T6) are considered as features in Gamma with respect to neutral emotional state.

*Keywords: Data miningClassification Emotion Electroencephalography*

**11. DIFFERENCES IN TEMPORAL GAIT PARAMETERS BETWEEN MULTIPLE SCLEROSIS AND HEALTHY PEOPLE**

*Kristina Daunoravičienė[4], Vigita Apanskienė[2], Jurgita Žižienė[3], Agnė Ovčinikova[5], Rasa Kizlaitienė[6], Ieva Sereikė[7], Gintaras Kaubrys[8], Donatas Lukšys[9], Julius Griškevičius[1]*

*[1-4,9]Vilnius Gediminas Technical University, Lithuania*

*[5-8]Vilnius University, Department of Neurology and Neurosurgery, Centre for Neurology, Lithuania*

Abstract - Multiple sclerosis (MS) causes severe gait problems and there are limited studies to quantitatively identify the specific gait parameters that are affected. The aim of the current study was to characterize the temporal gait parameters in MS patients and ascribe them to clinical variables, in order to enable target-oriented management. A total of 14 MS patients and 11 healthy controls (CO) were evaluated clinically by expanded disability status scale (EDSS) and quantitatively by the Timed 25 Foot Walk (T25FW) using non-invasive wireless inertial sensors. The self-selected walking velocity was used as a covariate in the analysis to ensure that group differences were not due to differences in walking velocity between the MS and CO groups. Reduced step time and cadence were seen in patients with MS. We also found significant correlations between biomechanical gait parameters and EDSS score, which provides a clinical rating of disease severity. Temporal gait variability noted as associated to slower walk in MS.

*Keywords: EDSS, T25FW, multiple sclerosis, gait analysis, temporal parameters, spatial parameters*

**2. DIVERSITY PERFORMANCE OF MICROSTRIP PATCH ANTENNAS PLACED ON HUMAN BODY AT ISM AND MBAN FREQUENCIES.**

*Mehmet Ali Ozturk[1], Ufuk Tamer[1], Ali Ozgur Yilmaz[2], Tayfun Ozdemir[1], Ismail Kaya[3]*

*[1] Anketek Elektronik Teknoloji Ltd. ti., Ankara, Turkey.*

*[2]Middle East Technical University Dept. of Electrical and Electronics Eng., Ankara, Turkey; [3]Karadeniz Tekni Universitesi Dept. of Electrical and Electronics Eng., Trabzon, Turkey; Mehmet Ali tr, mehmet.ozturk@anketek.com.tr;*

Abstract - In this study, the diversity performance of microstrip patch antennas mounted on the chest and the back of a person is investigated in static and dynamic indoor environments at ISM (2.4-2.5 GHz) and medical body area network (2.36-2.4 GHz) bands. Power received by the radios worn by the person while standing and walking is recorded and compared. In addition, antennas are simulated on a human body to study the effect of the human body. The work was done as part of a remote patient monitoring project, and hence the effectiveness of the antenna diversity in the indoor data communications and the impact of the human body on the quality of the communication linked were studied as well.

*Keywords: Microstrip patch antenna, inverted F antenna, human body interaction, antenna diversity, indoor communication link, diversity measurements*

**13. AN ADAPTIVE SCHEME FOR X-RAY MEDICAL IMAGE DENOISING USING ARTIFICIAL NEURAL NETWORKS AND ADDITIVE WHITE GAUSSIAN NOISE LEVEL ESTIMATION IN SVD DOMAIN**

*Emir Turajlić, Vedran Karahodzic*

*Faculty of Electrical Engineering, University of Sarajevo, Bosnia and Hercegovina, Zmaja od Bosne bb, Kampus Univerziteta u Sarajevu, 71000 Sarajevo, Bosnia and Herzegovina emir.turajlic@etf.unsa.ba, vedran.karahodzic@etf.unsa.ba*

Abstract - Medical image denoising is an important and one of the most challenging fields of biomedical image processing. The presence of noise reduces the visual quality of medical images and impairs the ability to perform accurate diagnosis and treatment. The principal aim of denoising is to improve the perceived quality of images, remove the undesired noise, while preserving the diagnostically relevant information. This paper proposes an adaptive scheme for denoising of X-ray medical images. The proposed method adopts the use of multiple multilayer perceptrons to perform image denoising. Each multilayer perceptron is trained to perform image denoising at a specific noise level. The proposed method relies on the singular value decomposition of images to estimate the level of additive white Gaussian noise that is present in images. In an attempt to optimize the performance of the proposed method, the paper investigates how the choice of image segmentation block size and various options for the multilayer perceptron architecture affect the ability of artificial neural networks to perform image denoising at various noise levels. The performances of the proposed image denoising method is evaluated on a database X-ray images. The experimental results demonstrate that compared to a single MLP based approach to image denoising, the proposed image denoising scheme improves and provides a more consistent image denoising performance across noise levels.

*Keywords: Singular value decomposition, artificial neural networks, image denoising*

**14. USING NEURAL NETWORKS AND ENSEMBLE TECHNIQUES BASED ON DECISION TREES FOR SKIN PERMEABILITY PREDICTION**

*Emir Bušatlić[1], Ahmed Osmanović[2], Alma Jakupović[2], Jasna Nuhić[3], Adnan Hodžić[4]*

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Abstract - Development of an accurate skin permeability model is becoming increasingly important as skin has been more utilized in recent development of drug delivery methods. This paper presents results of development of Artificial Neural Network (ANN) for prediction of skin permeability. The performance of developed ANN was compared to three regression algorithms used in this paper. The prediction of skin permeability is based on three input parameters: molecular weight, partition coefficient - log(P), and melting temperature for each drug. The dataset of 400 samples was used for prediction of skin permeability. Out of that number, 75% was used for training of ANN, and testing of developed ANN was performed on 100 samples from the dataset. During testing, system correctly predicted 76.7%. This dataset was also used as input to three ensemble techniques based on decision trees: REPTree, Bagging, Random SubSpaceDeveloped. It was shown that Bagging algorithm outperformed developed ANN with 81% while RandomSubspace performed at 73.3%. System can be used in laboratory conditions and can be used in the future for drug discovery.

*Keywords: skin permeability, prediction, artificial neural network, regression algorithm, intelligent systems*

**15. ECG SIGNAL CLASSIFICATION USING ARTIFICIAL NEURAL NETWORKS: COMPARISON OF DIFFERENT FEATURE TYPES**

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Abstract - In this paper classification algorithm of ECG signals based on segmentation of basic waveform using artificial neural networks was implemented. Inputs of classification process are different types of features: time-domain features, morphological features, statistical features. Comparison of results using these types of features as well as their combination was performed. The algorithms are implemented in MATLAB environment and performance of algorithms is evaluated on the MIT-BIH Arrhythmia Database. Feature extraction process was done using Wavelet transform (detection of P, Q, R, S, T waves for time-domain features and its coefficients for morphological features) and statistical functions. The best results were gained using morphological features in combination with their statistical features.

*Keywords: ECG signal, P,Q,R,S,T waves, feature extraction, morphological features, artificial neural networks, classification*

**16. SHORT-TERM VARIATIONS OF PARAMETERS OF HEART RATE VARIABILITY IN SUBJECTS WITH MILD HYPERTENSION AND NORMOTENSIVE SUBJECTS DURING PREOPERATIVE PERIOD**

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Abstract - Monitoring of heart rate variability that could reflect autonomic nervous system tone might be of clinical importance in subjects who are scheduled for elective surgical treatment.Individuals with balanced autonomic nervous system tone in the situations of increased demands and stress load have been shown to have preserved hemodynamic reserve which is very important for hemodynamic stability. On the contrary , individuals who had developed some alterations of autonomic nervous tone as a result of different

physiological changes have shown predisposition to inadequate hemodynamic adaptability to different stressful conditions and surgical procedure as a possible major stressful event.The aim of the trial was to estimate the parameters of heart rate variability in time and frequency domain for subjects scheduled for elective surgical procedures. Thirty-six subjects were allocated to two groups. Individuals who had developed mild hypertension were allocated to first group while normotensive individuals constituted the second group. Recordings of electrocardiogram were analyzed in time domain : SDNN (standard deviation of NN intervals), RMSSD (root mean square of the successive differences), and in frequency domain: power of the total spectrum of heart rate variability(TP),power of low frequency band (LF, range 0,04-0,15Hz ), power of high frequency range(HF, range 0,15-0,4 Hz). Analysis of the values of hemodynamic parameters has shown different hemodynamic parameters but no significant statistical differences were found between the groups. Analysis of the values of time-domain and frequency-domain parameters of heart rate variability has shown variations of the SDNN, RMSSD and parameters of total spectrum power and LF and HF spectra while no statistically significant difference was found. The results have shown variations of time-domain and frequency-domain parameters of heart rate variability in individuals with mild hypertension and normotensive individuals, but for this specific groups of patients there was no statistically significant difference.

*Keywords: heart rate variability, mild hypertension, preoperative period*

**17. SURFACE EMG SIGNAL CLASSIFICATION BY USING WPD AND ENSEMBLE TREE CLASSIFIERS**

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Abstract - The Electromyogram (EMG) signals are used in exoskeleton robot control for the recognition of the electrical activity related to the muscle contractions. In this study, surface EMG signals are classified to recognize the different types of myoelectric signals. The performance of a classifier is affected by the variation of EMG signals due to the different categories of contraction. To avoid such variations, the Wavelet Packet Decomposition (WPD) is used for features extraction from surface EMG signals. Then, a set of features selection methods is employed to reduce the high-dimensional features. After a feature selection, different ensemble tree classifiers like Random Forest, Rotation Forest and MultiBoost are used for classification. Results are compared by using total classification accuracy, F-measure and Area Under ROC Curve (AUC). An effective combination of WPD and Random Forest achieves the best performance, using k-fold cross validation, with a total classification accuracy of 92.1%. The proposed methods in this study have potential applications in exoskeleton robot control and rehabilitation.

*Keywords: Surface Electromyography (sEMG); Multi-scale Principle Component Analysis (MSPCA); Wavelet Packed Decomposition (WPD); CART; C4.5; Random Forest (RF); Rotation Forest; MultiBoost*

**18. TOOL FOR COMPARATIVE CASE STUDIES OF HEART RATE AND HEART RATE VARIABILITY**

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Abstract - Heart Rate (HR) and Heart Rate Variability (HRV) are recognized and used in identifying and diagnosing different psychological conditions. HRV is also frequently used for diagnosing and monitoring autonomous nervous system. In this paper we propose a tool for analyzing HR and HRV in time and frequency

domain, and using geometric analyses as Poincare plots for visualization. Implemented tool is designed to accommodate requirements of contemporary research in this area and extended for comparative analysis of sets of measurements. Case study analyzing correlation between HR measurements and stress levels for students before and after an exam is conducted. Measurements are used to illustrate the benefits of using the tool in creating and managing sets of measurements and their comparative analysis.

*Keywords: heart rate, heart rate variability, stress monitoring*

**19. A NOVEL APPROACH FOR PARAMETER ESTIMATION OF FRICKEMORSE MODEL USING DIFFERENTIAL IMPEDANCE ANALYSIS**

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Abstract - In this paper we presented a new approach for parameter estimation of Fricke-Morse model (2R-1C circuit) of biological cell. Proposed method is based on Differential Impedance Analysis and it was applied in parameter estimation of five electrical bioimpedances: Total Body Composition, TrunkTrunk, Arm-Arm, Leg-Leg and Respiration Rate. The proposed method has been evaluated regarding the influence of the number of measurement frequencies on the overall numerical accuracy and processing time. Obtained results are compared with Complex Non Linear Least Squares data fitting and it was showed that presented approach is significantly faster (ratio of processing times depends on the number of measurement frequencies). Additional advantage of the proposed method is very low computation complexity (it is not iterative) so it can be easily implemented in portable and autonomous low-cost microcontroller-based systems for bioimpedance measurement and parameter estimation of the Fricke-Morse model in real-time.

*Keywords: Bioimpedance, estimation, signal processing*

**20. WAVELET AND TEAGER ENERGY OPERATOR (TEO) FOR HEART SOUND PROCESSING AND IDENTIFICATION**

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Abstract - The heart sound signal (heartbeat) recorded from normal subjects usually contains two separate tones, S1 and S2. In addition, an auscultation technique used to provide physicians with accurate and objective interpretation of heart sounds can be used to detect four sounds, namely, S1, S2, S3, and S4, during the heart cycle. In this project, we propose a technique to detect these four heartbeats effectively using the combination of multi-scale wavelet transform and Teager Energy Operator to increase the precision of the detection process. The purpose of combining TEO with Wavelets is to observe how different details obtained from the Wavelet Transform influence the Teager Operator success in detecting S1, S2, S3, and S4 heart sounds. The effectiveness of the proposed approach is evaluated in experiments related to different cardiac conditions, achieving 88 % accuracy for localization of S1 and S2, and 86 % accuracy for S3 and/or S4.

*Keywords: Heart Sounds, Discrete Wavelet Transform (DWT), Teager Energy Operator (TEO), Cardiovascular Diseases (CVD)*

## 21. A DYNAMIC STOPPING ALGORITHM FOR P300 BASED BRAIN COMPUTER INTERFACE SYSTEMS

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Abstract - P300 potentials are involuntary responses which were elicited when a subject recognizes a target item among a group of irrelevant items. In order to determine the target item that the subjects intend to select, multiple ERP responses for each stimulus must be evaluated. The number of intensification sequences required to select a target item may vary among the subjects as well as sessions which a subject participated in. Therefore, instead of using a predetermined number of intensification sequences, it should be determined automatically at the moment of selection. This paper proposes a dynamic stopping algorithm to determine required number of intensifications sequences. The algorithm uses the optimal operating point of the ROC (Receiver Operating Characteristics) curve to determine the threshold values. The proposed algorithm was tested on two different datasets which use row/column (RC) paradigm and region based (RB) paradigm. Dynamic stopping algorithm significantly improved SPM (symbol per minute) on both datasets by reducing number of intensification sequences and ratio of erroneous selections. Because it does not require to select two of the selections at same number of intensification sequences, RB paradigm provides more flexible, rapid and accurate BCI systems.

*Keywords: Brain Computer Interface (BCI), P300 Potentials, Dynamic Stopping, Row/Column Paradigm, Region Based Paradigm*

## 22. OVARY CANCER DETECTION USING DECISION TREE CLASSIFIERS BASED ON HISTORICAL DATA OF OVARY CANCER PATIENTS

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Abstract - This research implements decision tree classifiers and artificial neural network to predict whether the patient will live with ovary cancer or not. Dataset was obtained from Danish Cancer Register and contains five Input parameters. Dataset contains some missing values and a noticeable improvement in accuracy was detected after removing them. Three features of the original dataset were shown to be the most significant: Mobility of the cancer, Surface of the cancer, and the Consistency of the cancer. The addition of the other two features (Size of the cancer and age of the patient) did not improve the results significantly. It was noticed that the patients with a cystic, but fixed and even cancer have always died from the ovary cancer. In contrast, the patients with uneven, but fixed and solid cancer have always survived the cancer. It is recommended to include more information about either the cancer or the patient to increase the chance of predicting the output of such patients.

*Keywords: Ovary Cancer, Decision Tree Classifiers, Artificial Neural Network, Feature Selection*

**23. A NOVEL FEATURE EXTRACTION APPROACH WITH VBM 3D ROI MASKS ON MRI**

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Abstract - Alzheimer's disease is a neurological disorder that usually starts withaging. Alzheimer's disease is a serious health and economic burden on governments, along with an increase in elderly population in developed and developing countries. There is no known cause of this disease and there is no treatment. For this reason, early diagnosis of the disease, socioeconomic and psychological outputs and medical treatments are still a hot topic investigated in the world. Magnetic Resonance Imaging is one of the medical imaging techniques that show the progression of Alzhiemer in brain. Brain deterioration and volume loss of the disease first begins with memory regions and then spreads to other brain regions. If atrophy is observed and detected by manual methods, it may not be seen due to user dependency, operator error and inexperience. For these reasons, automatic, numerical and atlas-based methods are being developed for the observation and capture of neurological diseases. In this study, 99 Alzheimer patients and 99 normal control MR images were analyzed using Voxel Based Morphometry, one of the numerical methods of atrophy observations in Magnetic Resonance Imaging. Losses in the brain were then produced as threedimensional binary masks. Using these masks, normalized segmented, modulated normalized segmented, and normalized images that were stripped from the non-brain structures were masked. Histogram based first order statistical features were extracted in the masked areas. The efficany of this technique was statistically compared between Alzheimer's and normal control. MR images have been downloaded freely from the OASIS database.

*Keywords: Alzhiemer Disease, MR, First Order Statistic, Voxel Based Morphometry, Feature Extraction*

**24. A MODIFIED FUZZY C MEANS ALGORITHM FOR SHADING CORRECTION IN CRANIOFACIAL CBCT IMAGES**

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Abstract - CBCT images suffer from acute shading artifacts primarily due to scatter. Numerous image-domain correction algorithms have been proposed in the literature that use patient-specific planning CT images to estimate shading contributions in CBCT images. However, in the context of radiosurgery applications such as gamma knife, planning images are often acquired through MRI which impedes the use of polynomial fitting approaches for shading correction. We present a new shading correction approach that is independent of planning CT images. Our algorithm is based on the assumption that true CBCT images follow a uniform volumetric intensity distribution per material, and scatter perturbs this uniform texture by contributing cupping and shading artifacts in the image domain. The framework is a combination of fuzzy C-means coupled with a neighborhood regularization term and Otsu's method. Experimental results on artificially simulated craniofacial CBCT images are provided to demonstrate the effectiveness of our algorithm. Spatial non-uniformity is reduced from 16% to 7% in soft tissue and from 44% to 8% in bone regions. With shading-correction, thresholding based segmentation accuracy for bone pixels is improved from 85% to 91% when compared to thresholding without

shading-correction. The proposed algorithm is thus practical and qualifies as a *plug and play* extension into any CBCT reconstruction software for shading correction.

*Keywords: Cone beam CT, Shading correction, Fuzzy C means*

**BIOMEDICAL IMAGING AND IMAGE PROCESSING**

**1. FULLY AUTOMATED BRAIN TUMOR SEGMENTATION AND VOLUME ESTIMATION BASED ON SYMMETRY ANALYSIS IN MR IMAGES**

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Abstract - Abnormal and uncontrolled cell divisions cause brain tumors. Fast and accurate detection of tumors in early phase is important for succesfull diagnosis and treatment. Expert physicians use image slices obtained from advanced imaging techniques such as Magnetic Resonance Imaging (MRI), Computed Tomopghraphy (CT) to define existing of a tumor. This process has a difficulty as it requires a high concentration on many image slices. On the other hand, image processing techniques can successfully be used to detect a tumor and its sizes in order to assist to expert physicians. In this work, brain tumor detection and volume estimation by using FLAIR, T1 Pre Gadolinium and T1 Post Gadolinium (T1C) MRI protocols is presented. Method used in this study is fully automatic and applicable to different types of tumors. The work has been tested on 500 visual DICOM format axial brain MR slices of ten patients. Tumor detection is realized by using left-right symmetry analysis assuming that brain consists of two symmetric cerebral hemispheres. Also, thresholding, skull stripping and fuzzy c mean clustering techniques are applied to detect abnormal brain regions. Tumor volume is calculated by the help of detected tumor area of each MRI slice and MRI slice thickness information obtained from DICOM header.

*Keywords: Thresholding, fuzzy c-means clustering, removing non-brain regions, symmetry analysis*

**2. MULTI-REGIONAL ADAPTIVE IMAGE COMPRESSION (AIC) FOR HIP FRACTURES IN PELVIS RADIOGRAPHY**

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Abstract - High resolution digital medical images are stored in DICOM (Digital Imaging and Communications in Medicine) format that requires high storage space in database. Therefore reducing the image size while maintaining diagnostic quality can increase the memory usage efficiency in PACS. In this study, diagnostic regions of interest (ROI) of pelvis radiographs marked by the radiologist are segmented and adaptively compressed by using image processing algorithms. There are three ROIs marked by red, blue and green in every image. ROI contoured by red is defined as the most significant region in the image and compressed by lossless JPEG algorithm. Blue and green regions have less importance than the red region but still contain diagnostic data compared to the rest of the image. Therefore, these regions are compressed by lossy JPEG algorithm with higher quality factor than rest of the image.Non-contoured region is compressed by low quality factor which does not have any diagnostic information about the patient. Several compression ratios are used to

determine sufficient quality and appropriate compression level.Compression ratio (CR), peak signal to noise ratio (PSNR), bits per pixel (BPP) and signal to noise ratio (SNR) values are calculated for objective evaluation of image quality. Experimental results show that original images can approximately be compressed six times without losing any diagnostic data. In pelvis radiographs marking multiple regions of interest and adaptive compression of more than one ROI is a new approach. It is believed that this method will improve database management efficiency of PACS whil preserving diagnostic image content.

*Keywords: Adaptive compression, DICOM, JPEG, lossless, lossy, medical image, radiography, region of interest (ROI)*

## 3. DETECTION AND SEGMENTATION OF NODULES IN CHEST RADIOGRAPHS BASED ON LIFETIME APPROACH

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Abstract-Early detection and treatment opportunities for lung cancer is reduced the mortality of this disease. Chest radiography is one of the commonly used screening methods for the preliminary diagnosis of lung cancer. In this study, an algorithm for nodule detection in chest radiograph image is presented. It takes into account the suspicious salient regions. Firstly, in order to enhance the image contrast, the CLAHE filter is applied. Then, local maximal regions are extracted by multi-scale approach based on optimum lifetime. Some of these regions are eliminated by decision tree using the morphologic and the intensity features for detection and segmentation of candidate nodules. Finally, the texture features extracted from the segmented regions are classified by using RusBoost method. The method has been tested on the JSRT (Japanese Society of Radiological Technology) database images. Experimental results demonstrate that the proposed method achieves a very satisfactory performance for detection and segmentation of the suspicious salient regions at the same time.

*Keywords: Chest radiograph, lung nodule, salient, lifetime*

## 4. COMPUTER-ASSISTED DIAGNOSIS OF OSTEOARTRITHIS ON HIP RADIOGRAPHS

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Abstract - Hip osteoarthritis (OA) can be highly disabling and eventually may necessitate total replacement of the joint. Studies with computer-based analysis of the hip OA may give new insight both in imaging and clinical evaluation of the disease. In this study, new acetabular angle measurement methods of femoral headneck-shaft angle (CCD), center-edge angle (CE) and acetabular depth-to-width ratio (ADR) are reconstructed via a computer based analysis technique for robust detection of OA on anteroposterior (AP) hip radiographs. The evaluation and validation of this computer-assisted system is performed by comparing these new automated methods with those of traditional manual measurement methods done by one orthopaedist and one radiologist.

The 50 adult hip AP radiographs with OA are used and overall measurements are produced for both sides of the hip on radiographs separately. The mean average difference between these two measurement methods for CCD angle is found 1°±1,2°, for CE angle 1°±1,5° and for ADR ratio 1±1,4 respectively. The results show that this new automated angle and ratio measurement system can be found feasible and user friendly by clinicians owing to the similarity between the comparative results of two measurement methods statistically.
*Keywords: Hip Osteoartrithis; CCD angle; CE angle; ADR ratio; corner detection; Marker-based Watershed segmentation method.*

**5. DETERMINATION OF SEX BY DISCRIMINANT FUNCTION ANALYSIS OF LINEAR DIAMETERS IN BOSNIAN HUMAN SKULLS**

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Abstract - Sexual dimorphism manifests in all bodily structures, including bones, and as such is used to determine sex of skeletal remains. Two methodological approaches are used in skeletal sex determination - osteoscopic and osteometric. Our objectives were to determine the prediction (effectiveness) of sex determination based on observed craniometric (linear) diameters of the skulls and determine the most frequent and the least frequent craniometric (linear) skull diameters in our tested sample. Using the multivariate binary logistic regression, we tested the effect of craniometric (linear) diameters on sexual dimorphism in skulls. Methods and material: Our study was conducted on 211 macerated and degreased human skulls on which we measured seven linear diameters of the skull: L1, maximum cranial length, glabella-opisthion; L2, maximum cranial width, porion-porion; L3, maximum cranial height, vertex-porion; L4, maximum viscerocranium width, zygion-zygion; L5, upper face height, nasion-prosthion; L6, nasion-basion; L7, basion-prosthion.

Results: Univariately, all seven observed craniometric (linear) skull diameters showed statistically significant effect on sex determination. Multivariately, statistical significance in sex determination was shown by three linear diameters: L2 (porion-porion), L4 (zygion zygion) and L5 (nasion-prosthion), therefore, for sex determination of our sample population, we proposed the “L” model using these diameters.

Conclusion: Growth of all seven linear diameters growing probability that the skull is classified as the skull of the male sex . Univariately and multivariately, linear diameter L4 (zygon-zygon) proved to be most effective in sex determination. The accuracy of sex determination in male skulls from our sample using the “L” model is 85%, while the accuracy of sex determination in female skulls is much lower and is 68%.

*Keywords: skull, discriminant function analysis, osteometry, sexual dimorphism.*

**BIOSENSORS AND BIOINSTRUMENTATION**

**1. EUSTACHIAN TUBE DYSFUNCTION ASSESSMENT THROUGHTYMPANIC CAVITY AIR EXCHANGE SENSOR**

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*American University of Sharjah*

Abstract - Eustachian Tube Dysfunction (ETD) is an ailment many people suffer, yet the exact cause of the problem is a subject for research. A tympanic cavity air exchange sensor is designed and used for monitoring the air exchange during operation of the Eustachian tube. Observation of EMG activity of muscles together with the observation of air exchange activity of Eustachian Tube while the Eustachian Tube opens, have revealed important information about the state of Eustachian Tube and the ETD problem. Early results suggest the possibility of a new way of identifying deteriorating status of the Eustachian Tube before it becomes totally dysfunctional and even classifying ETD dysfunction levels according to the output provided by the Tympanic Cavity Air Exchange sensor. This paper intends to provide the design details of the air exchange sensor used in the experiments and explain how the sensor was used to get information about the state of Eustachian Tube Dysfunction problem.

*Keywords*: *Biomedical transducers, Tympanic cavity, Eustachian tube, Levator Veli Palatini muscle, Tensor Veli Palatini muscle, Tympanic membrane, Paratubal muscles*

**2. DESIGN, SIMULATION AND IMPLEMENTATION OF A SELECTIVE RECORDING SYSTEM FROM PERIPHERAL NERVOUS SYSTEM**

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Abstract - Nerve cuff electrodes provide a safe technique for recording nerve signals. A four-contact cuff electrode was modelled and used to evaluate selective recording from peripheral nerve. Fitzhugh-Nagumo equations were used to model the electromagnetic fields generated by active nerves and electrodes. The selectivity was increased with increasing the distance between active sources and increasing the number of contacts. Programmable System on Chip (PSoC) was used to implement and test proposed structure. Using the proper and low noise preamplifier and filter block we could record noiseless signals from sciatic nerve of a rat. The results of this study showed that FitzhughNagumo equations could model the nerve excitation accurately and be used in computer simulation for study nervous system. Also indicated that multicontact cuff electrode could be used in recording peripheral nerve signals to discriminate active fascicles in a nerve bundle.

*Keywords: Cuff electrode, Selective recording, action potential, FitzhughNagumo, PsoC*

**3. EXPERIMENTAL VERIFICATION OF EOG SIGNAL MEASUREMENT USING THE MODIFIED DIGITAL STOCHASTIC MEASUREMENT METHOD**

*J. Djordjević-Koarov, P. Sovilj, V. Vujičić, D. Mitić, M. Simić and D. Radenković*

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Abstract - Experimental verification of the simulation model for modified digital stochastic measurement (MDSM) of biomedical signals in the time domain, is presented in this paper. This method is based on well-known digital stochastic measurement method (DSMM) with low-resolution analog-to-digital converters (ADCs) and accumulation. An electrooculography (EOG) signal is used as an example of a real low nonstationary biomedical

signal. Realized experimental model is based on a personal computer (PC) with additional microcontroller hardware for analogue signal processing. The experimental printed circuit board (PCB) has been designed with microcontroller (MCU) STM32F303C6T6. The experimental results are compared with the results of simulations, and the comparison confirms the simulation. Considering obtained results, the suggested model can be used for design and realization of an instrument with sufficient accuracy, benefiting from the hardware simplicity of the method.

*Keywords: Digital stochastic measurement, electrooculography, biomedical signal processing, simulation model, computer based instrument*

**4. PERSONAL ELECTROMYOGRAPHIC BIOFEEDBACK SYSTEM „MYMYO“**

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Abstract - Typical EMG measurement system consists of one central device with several channels; which are connected to the central unit with wires. Central device samples data from channels and supplies energy for the channels. It transfers data further to a device providing the user with graphical interface. Connection from central device to user interface device can be with or without wires. Very common drawback of such systems is that the wires limit patient movements; make EMG measurements relatively uncomfortable and they are not available for personal use because of relatively high prices. The goal of this project was to design, construct and test a compact-size, wireless and surface-electrode EMG measurement system. The intention is that device could be used as a single channel wireless EMG acquisition system which uses smartphone as a graphical user interface. Due to its simplicity and low price it is hoped to be available for home, everyday, personal use.

*Keywords: EMG, biofeedback, three-electrode amplifier, Bluetooth Low Energy, BLE, smart phone*

**POSTER SESSION**

**1. CLINICAL EXPERIENCE WITH THE USE OF CAD/CAM TECHNOLOGY IN MAKING BELOW-THE- KNEE PROSTHESIS**

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Abstract - The term CAD/CAM technology stands for “computer-aided design” and “computer-aided manufacturing”. This scientific paper analyzes the use of CAD/CAM technology in designing and manufacturing the prosthetic sockets for below-the-knee amputees. Introduction of this technology in prosthetic rehabilitation is justified by the assumption of achieving higher precision, speed, efficiency and quality in the manufacturing of prosthetic sockets, and therefore better economic viability.

Objective: To examine whether the use of CAD/CAM technology in the manufacturing of the prosthetic sockets for below-the-knee amputees affects the time of the commencement of the amputee walking school and success

of primary prosthetic rehabilitation in comparison to patients in which below-the-knee prosthesis were made using the standard method.

Methods: The study included 40 patients who spent primary prosthetic rehabilitation in our institution in the second half of year 2015. All of the patients were below-the-knee amputees. The patients were divided into two groups. The first group consisted of patients (n1=20) in which we used CAD/CAM technology for the fabrication of prosthetic sockets, while the second group consisted of patients (n2=20) in which prostheses were made by standard methods. Both groups included patients aged 60 to 69. Etiologically, all the amputations were the result of vascular disorders. The success of primary prosthetic rehabilitation was tested by K-levels score, which indicates the level of mobility patients achieved with the prosthetic limb. We also analyzed the time of the commencement amputee walking school (in days) between groups. Statistical analysis was performed by t-test.

Results: In the first group there were 14 males (70%) and 6 females (30%), while in the second group 13 were males (65%) and 7 females (35%). The average age of the first group of patients was 64.6±2.6, and the second group 64.05±2.78 years.

The mean value of K-levels at the start of rehabilitation (without prosthesis) in the first group was 2.05±0.51, and at discharge from rehabilitation (with prosthesis) 2.35±0.59, statistical analysis showed no significant difference, $p= 0.0927$. The mean value of K-levels at the start of rehabilitation (without prosthesis) in the second group was 2.15±0.59, and at the discharge from rehabilitation (with prosthesis) 2.45±0.6, statistical analysis showed no significant difference, $p= 0.1198$. Statistical analysis also did not show significant difference in K-levels values at the beginning of the rehabilitation and at the discharge from rehabilitation between tested groups: $p= 0.5688$ and $p= 0.5988$. The first group started the amputee walking school within 3.05±0.83 days of the start of rehabilitation, while the second group started it within 5.4±0.94 days. This difference was highly singificant, $p< 0.01$.

The average duration of prosthetic rehabilitation for the first group was 26±5.05 days, and for the second group of 32.25±4.91 days, which was also highly statistically significant, $p< 0.0$.

Conclusions: The paper has shown that among the studied groups there was no difference in the success of primary prosthetic rehabilitation, regardless of the technology of making prosthetic sockets, however, in the group where CAD/CAM technology was used a significantly earlier start and shorter duration of rehabilitation was found. This shows that a more efficient and faster production of prostheses using CAD/CAM technology does not affect success of prosthetic rehabilitation, while it shortens time spent on rehabilitation, which implies significant economic effects.

*Keywords: CAD/CAM technology, prosthetic rehabilitation, amputation*

## 2. A FUZZY MODEL TO PREDICT RISK OF URINARY TRACT INFECTION

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Abstract **-** Urinary tract infections (UTIs) are among the most common bacterial infections and account for a significant part of the workload in clinical microbiology laboratories. Hence, urine is the specimen most frequently submitted for culture. Physicians distinguish UTIs from other diseases that have similar clinical presentations with use of a small number of tests to distinguish bacteriuria. The microbiological examination of urine consists of examining a methylene smear of the urine specimen, a screening test of significant bacteriuria and culture. In the smear one or more bacterial cells per oil- immersion field usually implies that there are 105 or more bacteria per milliliter in the specimen, the number of RBC and WBC is also a very important indicator. In literature, the normal ranges of these variables are differently defined. The analysis of this data could be very simplified using data management systems. Fuzzy logic, in a narrow sense, is a logical system, which is an extension of multivalued logic. The fuzzy logic works on a theory which relates to classes of objects with blurred boundaries in which membership is a matter of degree. This enables fuzzy systems applicable to broad range of parameters and expected output values in many aspects of science. The aim of this study was to create a fuzzy model, in the MATLAB environment, to aid physicians in interpreting the results of the microscopic urine analysis, considering the number of bacteria, RBC and WBC as well as turbidity of the sample.

*Keywords**:** Fuzzy logic, MATLAB, UTI, Microscope Examination of Urine*

## 3. SINGLE-CHIP INTRABODY COMMUNICATION NODE

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Abstrac t- The goal of this paper is to present the development of a phase modulated signal generator and receiver pair that are designed with intrabody communication (IBC) purposes in mind. The system is to be implemented using Programmable System-on-Chip (PSoC) microcontrollers produced by Cypress. The design and the firmware are to be implemented in Cypress PSoC Creator for the CY8C5888LTI-LP097.

*Keywords: intrabody communication, programmable system-on-chip*

## 4. CONCEPTUAL IMAGE OF HEART-PATH TO PATIENT BENEFIT

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Abstract: The conceptual representation allows visually differentiated understanding of certain ideas or structures. This simplified representation is used for easy understanding, and the understanding of certain idea/ structure whereby observer form a complete picture of the way in which he sees his mind, easily understandable to himself. Conceptual design of the anatomy of the heart, vascularization, and a conceptual design of theoretical occurrence of obstruction and involvement of a certain wall in relation to the occurrence of ST segment elevation that occurs in ECG display of myocardial infarction has importance in: display of places of obstruction of the patient, easier patientepresentation is important in the education of students, when performing practical part of the basic, pre-clinical medical subjects, theoretical possibility of using the conceptual design in the software connection with modern ECG devices, which would next to the finding, promptly show the place of obstruction, and conceptual design allows to add additional pathology of the heart, where it can take into account various disorders in the anatomical structure of the heart, or heart muscle.

*Keywords: heart, acute myocardial infarction, conceptual design.*

## 5. E-HEALTH IN BOSNIA AND HERZEGOVINA: EXPLORING THE CHALLENGES OF WIDESPREAD ADOPTION

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Abstract - The rapid advancements in Information and Communications Technologies (ICTs) and the increasing number of smart things (portable devices and sensors) enable the transfer of health resources and healthcare by electronic means. This is known as e-health, and today is closely related to the Internet, which provides a new medium for dissemination of healthcare-related information and for interaction and collaboration among institutions, health professionals, health providers and the public. Increased efficiency in healthcare, improved quality of care, availability, responsibility and satisfaction of patients and consumers are the main benefits e-health offers. Unfortunately, there are many challenges associated with e-health adoption, especially in developing countries like Bosnia and Herzegovina. To understand and address the challenges of implementing and adopting e health in Bosnia and Herzegovina, this paper presents a review which identifies the main political, economic and technological challenges for widespread e-health adoption.

*Keywords: e-health, challenges, economy, technology, politics, Bosnia and Herzegovina*

## 6. INVESTIGATION OF THE USE OF ANODIC ALUMINUM OXIDE MEMBRANES AS SERS SUBSTRATES AND DETECTION OF MYOGLOBIN PROTEIN

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Abstract - Surface-enhanced Raman spectroscopy (SERS) is a powerful technique used for molecular analysis that provides molecular fingerprint information and has the potential to detect down to a single molecule. Despite the ultra-sensitivity and specificity of this technique, SERS cannot be used as a routine sensing tool for biomedical applications because of the poor reproducibility and the low intensity of SERS signals. [2] In order to provide reproducible and high intensity SERS signals, reproducible strong SERS-active substrates should be designed.

*Keywords: SERS, anodic aluminum oxide membrane*

## 7. PEOPLE IDENTIFICATION USING KINECT SENSOR

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Abstract - In this work, we address a problem of people identification. People identification is an important feature in various application like using in banks, airports, border crossings etc. For purpose of people identification today are used different methods such as face recognition, fingerprint, scanning of eye retina, voice recognition etc. The most of these methods require interaction with people while one method, people gait recognition, can be proceeding even without awareness of people who is in process of identification. Because of that, people gait recognition is interesting field in identification process and biometrical techniques. Our approach for this imply using Kinect sensor from Microsoft and Matlab high level technical computing language. For image classification we use bag of features or bag of words. Process consists of extracting regions, compute descriptors, find clusters, and compute distance matrix and using SVM (Support Vector Machine) for Classification. Dataset which is used in this process is also created with Kinect sensor.

*Keywords: People identification, gait recognition, Kinect sensor, bag of features, SVM*

## 8. PUBLIC OPINION TOWARD GMOS AND BIOTECHNOLOGY IN BOSNIA AND HERZEGOVINA

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Abstract-Until 2009 Bosnia and Herzegovina was one of the few countries which didn't have the law on genetically modified organisms (GMOs). The aim of this paper is to identify the public opinion on genetically modified organisms and biotechnology in Bosnia and Herzegovina where the survey is enforced. The survey included a handful of questions related to genetically modified (GM) crops, foods, one on the safety of foods and related products, and one of other uses of biotechnology (e.g. in human medicine). The age range of respondents was from 17 to 67 years and total of 734 respondents were interviewed. The answers are represented in the percentage. In conclusion, although respondents were mainly introduced with the term “GM”, most of them were

not satisfied with their knowledge and available information considering biotechnology and its use. We established that the participants displayed a pessimistic attitude which reflected a belief that the widespread use of GMOs is presenting a risk to human health and a risk to environment in a term of endangering native species. Participants only showed a little bit more positive opinion about the use of biotechnology in medicine and pharmacy.

*Keywords: personal attitude, knowledge, genetically modified food, legislation, GMO labeling*

**9. FUTURE TRENDS AND POSSIBILITIES OF USING INDUCED PLURIPOTENT STEM CELLS (IPSC) INREGENERATIVE MEDICINE**

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Abstract - Animal testing has shown unsatisfaction when itcomes to examination of hepato- neuro- and cardiotoxicity, aswell as in the development of new therapies, while use of *in vitro*model systems is limited by unavailability of human tissues. Forthis reason, use of human embryonic stem cells (hESC) asunlimited source for producing differentiated somatic progeny,represents a great medical advance. Induced pluripotent stem cells (iPSC) represent a new typeof stem cells that occur by reprogramming of genomes of adultstem cells, such as dermal fibroblasts into a pluripotent state.These cells have many similarities with embryonic stem cells,and their reprogramming requests transcription factors OCT4,SOX2, and KLF4. IPSC are characterized by the ability ofrecovery and differentiation into different cell types such aspancreatic β-cells, hepatocytes, cardiomyocytes, hematopoieticcells, which opens the door to the new methods of treatment ofmany diseases especially in the field of personalizedregenerative medicine. This paperwork contains future trendsand possibilities of using iPSC's in regenerative personalizedmedicine, and with great certainty we can say that the discoveryof the same has brought a revolutionary changes to medicine,and that these cells will soon be used not only for modeling ofvarious diseases, but also for treating diseases and finding andtesting new drugs that will help to improve the quality of life inmany patients.

*Keywords: stem cells, regenerative medicine,reprogramming*

**10. POLYMORPHISMS OF 1691G>A AND 4070A>G *FV* IN BOSNIANWOMEN WITH PREGNANCY LOSS**

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Abstract - The 1691G>A *FV* polymorphism is considered to be one of the leading genetic risk factors of pregnancy loss. Recently, also other heritable factors of thrombophilia that may predispose to microthrombosis mainly in trophoblast or placenta leading to obstetrical complications attract an attention. In recent studies it was found that both, 1691G>A *FV* and 4070 A>G *FV*polymorphisms may increase risk of pregnancy loss, and double heterozygosity for 1691G>A *FV* and 4070A>G *FV* conferred a 3- to 4-fold increase in the relative risk of venous thromboembolism compared with 1691G>A *FV* alone.

Aim: We decided to determine the prevalence of 1691G>A *FV* (rs6025) and 4070A>G *FV* (rs1800595) polymorphisms in women with pregnancy loss, as well as in women without previous miscarriages. Another aim was to determine the possible association between 1691G>A and 4070A>G *FV* polymorphisms and a risk of pregnancy loss. Material and methods: Based on medical history, 154 women, mean age 33.0 (±5.4) years, that had one or more spontaneous pregnancy loss and 154 women without previous pregnancy loss with at least one live-born child, mean age 31.4 (±6.7) years were enrolled. Following DNA isolation from buccal swabs, real-time PCR for 1691G>A *FV* and PCR-RFLP for 4070A>G *FV* were done. Results: In woman with pregnancy loss we identified: 142 GG homozygotes, 12 GA heterozygotes and none AA homozygotes of 1691G>A *FV*, and 125 AA homozygotes, 27 AG heterozygotes and 2 GG homozygotes of 4070A>G *FV*, while in controls 142 GG homozygotes, 12 GA heterozygotes and none AA homozygotes of 1691G>A *FV* and 123 AA homozygotes, 28 AG heterozygotes and 3 GG homozygotes of 4070A>G *FV*. The prevalence of 1691G>A and 4070A>G *FV* polymorphisms are consistent with data for other European populations. We observed coinheritance mutated alleles 1691A and 4070G in 3 women with pregnancy loss, but it was not statistically significant compared to the control group,(p>0.05. We did not observe any differences in the prevalence of the genotypes and frequency of alleles in women with pregnancy loss compared to women without pregnancy loss, (p>0.05). Conclusion: Our results, did not confirm association between the prevalence of 1691G>A and 4070A>G *FV* and pregnancy loss in Bosnian women.

*Keywords: thrombophilia, pregnancy loss, polymorphism, FV, F.5*

**11. LACK OF ASSOCIATION BETWEEN I/D *ACE* AND -675 ID 4G / 5G *PAI-1* POLYMORPHISMS AND PREDICTING RISK OF PREGNANCY LOSS (PROPALO) IN BOSNIAN WOMEN**

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Abstract - Successful pregnancies, among others, require stabilization of the placental basal plate, preventing accumulation of fibrin in placental vessels and intervillous spaces. Fibrinolysis is regulated by PAI-1, which synthesis is induced by angiotensin II, which is being generated by ACE I. In recent studies, it was found that -675 ID, 4G/5G *PAI-1* gene polymorphism, as referred to "a new thrombophilic factor" may increase risk of pregnancy loss. Data on prevalence of genetic risk factors of thrombophilia in Bosnia and Herzegovina (B&H) are rare. Aim: Therefore, we aimed to determine prevalence of I/D *ACE* (rs I799752) and -675 ID, 4G/5G *PAI-1* (rs 1799889) polymorphisms in Bosnian women with pregnancy loss and evaluate the results of the risk of miscarriages. Material and Methods: We prospectively recruited 308 women in total, particulary 154 women with pregnancy loss (PL), mean age 33.0 (±5.4) years and 154 controls without pregnancy loss, at least one liveborn child, mean age 31.4 (±6.7) years. All women were enrolled from Institution of Health Protection of Women and Motherhood (Sarajevo, B&H). Following DNA isolation from buccal swabs, PCR for *ACE* and real-time PCR for *PAI-1* was performed. Results: In women with PL and controls, the frequencies of D and 4G alleles were: 52.3% and 55.5% and 60.1% and 59.7%, respectively. There was no difference of frequency of mutated alleles in group of PL compared to the controls (p>0.05). Conclusion: Our results, did not confirm association of I/D *ACE* and -675 ID, 4G/5G *PAI-1* polymorphisms with pregnancy loss in examined population.

*Keywords: thrombophilia, pregnancy loss, genetic risk factors, ACE, PAI-1*

## 12. MEDICAL STUDENTS' DIETARY HABITS AS A FUNCTION OF STRESS

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Abstract - Managing working life and personal life can result in conflicting demands and roles for young medical students. An increasing number of students report concerns about the amount of stress in their life, and at the same time obesity is an escalating health problem worldwide. Evidence is accumulating rapidly that stress related chronic stimulation of the hypothalamic– pituitary–adrenal (HPA) axis and resulting excess glucocorticoid exposure may play a potential role in the development of obesity. This paper focuses on analysis of consumption of different food groups in a correlation with the indicators for stress levels. The data was collected from the original questioner created by the authors of this paper, which consisted of stress symptoms and food related behavior pattern types of questions. The statistical analysis of the collected data has shown a slightly different pattern in eating behavior in male and female participants, especially when it comes to fast food and caffeinated drinks. The novelty that this article brings consists of the emphasis on how different stress levels and psychological states affect students´ eating habits and with that, their general health. Hence, this is a starting point for developing policies and coping strategies to reduce stress on students, and by doing so to increase the quality of life for the average student.

*Keywords: stress, dietary habits, medical students, hypothalamic-pituitary-adrenal (HPA) axis, cortisol*

## 13. THYROID PATHOLOGY AND PLATELET FUNCTIONAL ACTIVITY

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Abstract - Thyroid pathology takes the second place in endocrinology after diabetes mellitus. In patients with thyroid dysfunction the increase of hemorrhage time, partial thromboplastin time (PTT), ABP and coagulating time (CT) are observed. The important role in coagulating physiology and in pathology platelets play. Hypotheriosis can change platelets function changing adenozindephosphate-induced aggregation. Dysfunction of platelets activation: decreasing or stopping of adhesion and aggregation, increasing of disaggregation can lead to the development of severe hemorrhages. It is established that in patients with thyroid dysfunction there are prolonged PTT , fibrinogen increase which is to show the hypocoagulation tendency, decreasing of total platelet count, decreasing of platelets aggregation activity, growth of aggregation speed, decreasing of maximum aggregates size and prolonging the speed of receiving the maximum value . In patients prolonged PTT and increasing fibrinogen points to simalteneous intravascular blood coagulation, accompanied by medium hypocoagulation of consumption – consumption is proved by decreasing of platelet count. Hemostatic shifts in patients with manynodule non-toxic goiter are more evident in comparison with patients with hypotheriosis. Changes of total coagulation and platelets activity in patients with double pathology: hypotheriosis and manynodule non-toxic goiter are more significant. The presence of signs of intravascular blood coagulation acceleration assessed by fibrinogen is allowed to state that hypocoagulation is not related to the quality of thyroid hormones to decrease the activity or the production of plasmacoagulation factors or increase anticoagulation blood potencial. Moreover, hypocoagulation is recurrent, determined by recurrent tissue factor (RTF) activation which leads to quick consumption of coagulating factors. Decreasing of platelet content is the evidence of consumption. Thus, in patients with thyroid dysfunction hemocoagulating system is in strain which is expressed by the DVC- syndrome chronic development. These changes are evident in patients with uninodule non-toxic goiter.

*Keywords: platelet aggregation, hemostasis, hypotheriosis, manynodule nontoxic goiter*

**14. EATING PATTERNS AND NOURISH STATUS AMONG MEDICAL STUDENTS OF SARAJEVO UNIVERSITY**

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Abstract - Introduction: University students experience numerous health-related behavioral changes, including the adoption of unhealthy dietary habits. To implement a nutrition and health promotion program the food consumption patterns need to be explored. Our study aimed to assess the nourish status in a sample of students from Faculty of Medicine of Sarajevo University and correlate it with students eating habits. Methods: A cross-sectional survey of 68 students was performed during February and March 2016, at the Sarajevo University. Students were asked to fill out a self-reported questionnaire that included questions on their eating habits and anthropometrics measures, weight and height. Body mass index was used to assess students nourish status. Statistical analyses were performed using the Statistical Package for Social Sciences software (version 13.0). Results: This study showed that the majority of the students (69.12%) were of normal weight (36.84% of the male students compared to 81.63% of the female students). The prevalence of overweight was more common among male students compared to females (63.16% vs. 14.29%). Intakes of fruit were more common among students with BMI≤24.9 kg/m2 ($\chi$=9.644; P=0.0004) as well as raw vegetables ($\chi$=4.601;P=0.046). Consumption frequency of coca cola and beverages was less common among students with BMI≤24.9 kg/m2 than among students with BMI≥25 kg/m2 ($\chi$=10.428;P=0.005). Conclusion: This study gives baseline information about weight status and eating habits among a sample of university students. Regulating the energy density of food could be used as a approach for successful body weight control.

*Keywords: studying youth, lifestyle, diet, promotion program*

## 15. SIMULATION OF KINEMATIC BEHAVIOUROF PROSTHETIC DEVICES

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Abstract - Beside the possibility to actively control the amount of damping in artificial joints, modern prosthetic devices should have the ability to generate power. This would enable persons with amputation to achieve biologically realistic kinematics and dynamics of locomotion. Recent development in prosthetics is primarily influenced by new knowledge and research performed in the field of human body biomechanics. Tracking of human body motion is based on the use of appropriate optical or magnetic markers, which are placed on specific landmark points, and real-time estimating of their spatial coordinates. With the improvements introduced in computer monitoring of human motion, it is important to lay emphasis on the significance of combining motion capture data with commercial CAD packages, in order to conduct detailed motion analysis and evaluate the mechanical performance of prosthetic design using CAD virtual models. This paper presents a method of determining the functional dependence of relevant kinematic parameters on prosthetic devices, in order to define a set of data for the development of appropriate control systems for achieving the desired movement pattern. The functional dependence of change in length and velocity of linear actuators built into the knee and ankle joint of the powered transfemoral prosthesis has been analysed. These data can be used to enhance the control system during the stance period of stair ascent, in order to achieve biologically equivalent locomotion.

*Keywords: biomechanics, prosthetics, CAD, computer simulation*

## 16. GENE CLUSTERING USING GENE EXPRESSION DATA AND SELFORGANIZING MAP (SOM)

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Abstract - This paper presents the results of a study developing gene clustering of cancer patient's data using gene expression data and Self-Organizing Maps (SOM). The SOM used in this paper was especially designed for patients with myelodysplastic syndromes and leukemia to reveal and present expression pattern for following disease progression since the disease itself is very aggressive. Developed SOM is self-trained using BloodSpot: a database of gene expression profiles for healthy and malignant hematopoiesis. Implemented system used expression data for IL3RA gene of cancer patients and healthy individuals containing 754 samples each. Developed SOM was made using 10x10 grid, thus 100 neurons, resulting in 100 outputs grouped in two differentiable clusters. The SOM was trained and validated using expression of NSMAF gene for both groups of individuals. Results obtained showed two successful clusters; one representing acute myeloid leukemia (AML) patients and the other representing healthy individuals. Using SOM maps the different expression patterns can be easily followed as well as used for finding a research factor for the specific disease.

*Keywords: gene expression, clustering, ANN, self-organizing maps (SOM), diagnostics ·prognostic, cancer, myelodysplastic syndromes (MDS), acute myeloid leukemia (AML), IL3RA gene, NSMAF gene, real time PCR*

## 17. TRENDS AMONG NEONATOLOGISTS IN DECISION TO VENTILATE PRETERM INFANTS WITH PERMISSIVE HYPERCAPNIA

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Abstract - Introduction: Despite measures done to avoid neonatal respiratory distress syndrome, many prematurely born infants still suffer from this disease, they are artificially ventilated, or experience long term oxygen dependency and consequently have chronic lung disease/bronchopulmonary dysplasia. One of the proposed measures for shortening of mechanical ventilation is strategy of permissive hypercapnia. There are promising studies, but clear recommendations for this treatment option are still lacking. Aim: The aim of this study is to determine number of patients ventilated by permissive hypercapnia, and to analyze factors that lead neonatologists towards decision to treat preterm infants by this ventilation option. Methods: The present study was conducted in a tertiary research and educational hospital from April 2013 to July 2015. At admission we registered data regarding birth weight, gestational age, Apgar score, prenatally given steroids, mode of delivery, CRIB score. All infants had chest X-ray at admission. When establishing diagnosis of respiratory distress syndrome and conducting its treatment, we followed European Consensus Guidelines on the Management of Neonatal Respiratory Distress Syndrome in Preterm Infants – 2013 Update. After treatment, according to their mean PaCO2 patients were divided into hypercapnia and normocapnia group, and then analyzed. Results: There were 69/158 (43.7%) patients in hypercapnia (HP) group and 89/158 (56.3%) in normocapnia (NC) group. Out of total number of patients 48.7% were female. Mean PCO2 in PH was 7.46 kPa (range 6.3-10.6 kPa). In NC group mean PCO2 was 5.9kPa (range 4.6-7.3kPa). Two groups didn't differ regarding gestational age, prenatally given steroids, Apgar in 1. and 5.minute, mode of delivery, CRIB score, nor according to level of respiratory distress syndrome, and surfactant use. Group of neonates ventilated by strategy of permissive hypercapnia had significantly higher mean birth weight P=0.029. Conclusion: This study shows that in absence of clear recommendations and defined criteria for implementing strategy of permissive hypercapnia in prematurely born infants, in praxis we find almost half of the babies who have been treated by this mode of respiratory treatment. For this ventilation option neonatologists prefer children with higher birth weight.

*Keywords: preterm infant, respiratory distress syndrome, permissive hypercapnia*

**18. 5-HIAA AND HVA IN THE COMA CEREBRI, HYDROCEPHALUS AND TUMOR CEREBRI**

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Abstract - The concentration of metabolites of neurohormones in cerebrospinal fluid (CSF) is an index of turnover of substances in brain. 5- Hydroxyindoleacetic acid (5-HIAA) – serotonine metabolite and homovanillic acid (HVA) - dopamine metabolite, were studied in CSF of patients with coma cerebri, hydrocephalus and tumor cerebri. CSF concentrations of 5-HIAA and HVA were determined in 140 patients of different age and sex. The samples were analyzed for 5-HIAA and HVA by high pressure liquid chromatography with electrochemical detector (HPLC-ED). Average concentration of 5-HIAA was 9.54 +/- 2.09 ng/mL, and for HVA it was 27.17 +/- 4.39 ng/mL. Average concentration of 5-HIAA in CSF of male subjects was 13.39 +/- 3.30 ng/mL, and for female subjects 4.23 +/- 1.34 ng/mL. Average concentration of HVA in CSF of male subjects was 31.52 +/- 4.86 ng/mL, and for female subjects 21.19 +/- 3.70 ng/mL ($p<0.05$). Results increased 5-HIAA and HVA concentration in CSF in comparison with other pathochemical conditions, such as acute lymphocyte leukemia, encephalitis, meningitis serosus, multiple sclerosis, quadriplegia and sepsis. Long-term follow-up is required to assess if they could be of prognostic significance as regards to long term attainment of brain functions in coma cerebri, hydrocephalus and tumor cerebri patients.

*Keywords: Cerebrospinal Fluid (CSF), 5-Hydroxyindoleacetic acid (5-HIAA), Homovanillic acid (HVA), High Pressure Liquid Chromatography with electrochemical detection (HPLC-ED), coma cerebri, hydrocephalus, tumor cerebri*

## 19. ESTIMATION OF LIPOPHILICITY DATA FOR DERIVATIVES OFALKANDIAMINE-N,N'-DI-2-(3-CYCLOHEXYL) PROPANOIC ACIDWITH POTENTIAL ANTINEOPLASTIC ACTIVITY, BY UHPLC-MSMETHOD

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Abstract - During the early stages of drug discovery, it is very important to determine lipophilicity and to investigate and predict processes of drug distribution and resorption in human body, *i.e.* their bioavailability. Novel fourteen compounds representing ester derivatives of (*S,S*)-1,2-ethanediamine-*N,N'*-di-2- (3-cyclohexyl)propanoic and (*S,S*)-1,3-propanediamine-*N,N'*-di-2-(3- cyclohexyl)propanoic acids, expressing antiproliferative activity *in vitro* were examined. The objective of this study was to estimation a lipophilicity data of observed fourteen compounds by ultra-high performance liquid chromatographic tandem mass spectrometry (UHPLC-MS) method. It was used gradient and isocratic method to obtain chromatographic parameters of lipophilicity/hydrophobicity, which are needed for calculated logP values. Results of lipophilicity data for observed 14 compounds, which were obtained by UHPLC-MS method and presented in this paper, are showed that the derivatives of 1,2- ethandiamine-N,N'-di-2-(3-cyclohexyl) propanoic acid have higer values of logP, than derivatives of 1,3-propanediamine-N,N'-di-2-(3-cyclohexyl) propanoic acid. Also, value of lipophilicity data for each of investigated compounds depends on the length of the alkyl chain on the esters bounds. Branching of the alkyl chain on the esters bounds has insignificant influence on the values of lipophilicity/hydrophobicity.

*Keywords: lipophilicity, UHPLC-MS, antiproliferative activity*

## 20. DETREMINATION OF KINETIC EFFECT OF METOPROLOL AND RANITIDINE ON HRPMODIFIED GC ELECTRODE BIOSENSOR

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Abstract - Peroxidase is classified as oxidoreductive enzyme which catalyzes the oxidation of the substrate by a hydrogen peroxide solution, the composition of a protein which is the prosthetic group of HEM. In this paper, the effect of active substance from the different groups of drugs on peroxidase activity was studied. Electrochemical tests were performed in classical three – electrode system with techniques of cyclic voltametry and chronoamperometry. Amperometric biosensor for the determination of H2O2 is presented, based on GC electrode on which peroxidase is immobilized in Nafion film. Cyclic voltametry technique was used to research the influence of different substrate concentration on the enzyme activity in a potential range between – 1,0 V and 0,7 V and scan rate of 50 mV/s. Chronoamperometric technique was used for the determination of kinetic parameters Km and Vmax at a constant potential of 0,9 V.

*Keywords: GC Electrode Biosensor, enzym*

**21. THE USE OF ELM AND MNM SERVERS FOR THE PREDICTION OF RANK FUNCTION IN OSTEOCLAST FORMATION**

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Abstract - Osteoporosis is a skeletal disorder which weakens the bones and increases the risk of the bone cracking. There are many factors included in the pathogenesis of osteoporosis and a lot of them still remain unknown. The RANK/RANKL system is involved in osteoclast maturation. By binding to its receptor (RANK), RANKL stimulates osteoclast precursors to develop into fully mature osteoclasts. RANK transmits biochemical signals after the recruitment of the intracellular adaptor TNF receptor associated factor (TRAF) proteins. TRAF6 binds to RANK and plays an essential role in RANKL-mediated NF-κβ activation in transfected cell systems. The Eukaryotic Linear Motif (ELM) and MiniMotif Miner (MnM) servers are web-based tools that can be very useful to identify small linear sequences, called motifs. In this paper, we have researched the possibility to predict some protein functions with ELM and MnM servers, using an example of RANK protein interactions with other proteins involved in osteoclast maturation. We couldn't find prediction of the experimentally proven RANK/RANKL interaction, but on the other hand, the prediction for the RANK/TRAF interactions where mostly true. The use of these tools can be a good starting point for the research of unknown protein functions, but every claim has to be experimentally proven afterwards.

*Keywords: RANK, ELM, MnM, protein functions prediction, motif.*

**22. A MATHEMATICAL MODEL OF THE EffECT OF METABOLIC CONTROL ON JOINT MOBILITY IN YOUNG TYPE 1 DIABETIC SUBJECTS**

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Abstract - Diabetes mellitus is a metabolic disorder representing one of the main problems for the global public health. The impairment of metabolic control can influence periarticular tissue and other major risk factors of limited joint mobility (LJM) also in young type 1 diabetic patients. LJM is a widespread phenomenon in diabetic patients and it is often characterized by ankle stiffness. In particular, a deficit of ankle joint mobility may occur with the onset of the disease; later, this deficit tends to deteriorate in presence of a poor glycemic control. We hypothesized a mathematical model of diabetes mellitus long-term effects, assuming that a reduced metabolic control affects joint mobility according with a Gaussian function: it requires some time for developing a reduction of joint mobility, that persists for a stable period, before fading out with time (in case metabolic control has been recovered). A non-linear optimization estimated the model parameters for obtaining the best fit over a set of

patients. Results are in good accordance with empirical estimates: lack of control needs to persist for at least a few months before generating a sensible effect, that persists for up to one year.

*Keywords: diabetes,LJM,Gaussian*

**23. A NOVEL GAIT DETECTION ALGORITHM BASED ON WIRELESS INERTIAL SENSORS**

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Abstract - Gait event detection has been widely implemented in realtime gait monitoring devices, orthoses and FES system. Certainly, the latency and the accuracy of the gait-even detection under diversities of gait are crucial. However, due to the high detection accuracy usually comes with high time-delay, it is somewhat hard to find a trade-off between high accuracy and low latency. Therefore, this paper presents a real-time algorithm based on wireless inertial sensor placed on the shank for gait-even detection. It combines the use of the cycle-extremum and the updating threshold method to detected the heel-strike (HS), as the minimum of the flexion/extension angle, the toe-off (TO), as minimum of the angular velocity and the mid-swing (MS), as maximum of the angular velocity. The angle and angular velocity were collected from 2 subjects who imitated the patient that suffered from drop-foot for different degrees to validate the algorithm against the wireless inertial measurement system. The results showed that the proposed method achieved comparable levels of accuracy and significant lower detection delays compared with other published methods.

*Keywords: event detection; wireless inertial sensor; the updating threshold; the cycle-extremum;*

**24. HYDROPHILIC ANTIOXIDANT SCORES AGAINST HYDROXYL AND PEROXYL RADICALS IN HONEY SAMPLES FROM BOSNIA AND HERZEGOVINA**

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Abstract- The aim of this study was to evaluate the total hydrophilic antioxidant scores (THAS) against peroxyl (ROO• ) and hydroxyl (OH • ) free radicals in different types (d.t.) of bee honey from Bosnia and Herzegovina (B&H). It has been analyzed 46 honey samples of d.t. such as: meadow honey (MeH), acacia honey (AH), forest honey (FH), mountain honey (MoH), heather honey (HH), and chestnut honey (CH). All analyses were performed by oxygen radical absorbance capacity (ORAC) assay, using trolox as a standard. Antioxidant capacity (AC)

against ROO • and OH • (ACROO • and ACOH • ) expressed as trolox equivalents per honey weight (mM TE/g): as the THAS [(AC(LA+HA)ROO•+AC(LA+HA)OH•), AC derived from low-molecular and highmolecular weight antioxidants (LA and HA, respectively) together in the bulk], then as the HAS against ROO •and OH • derived from LA only (HAS(LA)), and as the HAS against ROO • and OH • derived from HA only (HAS(HA)). ORAC analysis showed that THAS d.t. of honeys decreased as follows FH>HH>AH>MoH>MeH>CH, then HAS(LA) d.t. of honeys decreased as follows MoH>FH>AH>HH>MeH>CH. Also, HAS(HA) for AH was higher than HAS(HA) for MeH. Based on obtained results, it can be concluded that bee honey from B&H has a significant AC against ROO • and OH•.

*Keywords: honey, antioxidant scores, ORAC, free radicals.*

## 25. BASICS OF MATHEMATICAL MODELING OF PULMONARY VENTILATION MECHANICS AND GAS EXCHANGE

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Abstract - The human cardiovascular-respiratory system is a complex system which exhibits the properties of a control system of the regulator type. The gas exchange combines many processes that occur in the brain, lungs, vasculature, and body tissues. This paper deals with a simple model that provides a linearized description of pulmonary ventilation mechanics. Some equations describing the introduction to chemical regulation of lung ventilation are derived.

*Keywords: human respiratory system, pulmonary ventilation, gas exchange, mathematical modeling*

## 26. QSAR MODELING AND STRUCTURE BASED VIRTUAL SCREENING OF NEW PI3K/MTOR INHIBITORS AS POTENTIAL ANTICANCER AGENTS

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Abstract - Phosphatidylinositol-3-kinase (PI3K) / mammalian target of rapamycin (mTOR) kinases belong to the phosphatidylinositol-3-kinase-related kinase (PIKK) family of kinases. Dysregulation of PI3K/mTOR signaling pathway is often detected in various types of malignancies and is correlated with a poor prognosis. PI3K and mTOR share considerable homology in the structure of their active sites and rational advantages of dual inhibition of PI3K/mTOR are known. In order to identify the most important structural determinants that influence antiproliferative activity, 3D-QSAR (quantitative structure activity relationship) studies were performed on two groups of structurally diverse PI3K/mTOR inhibitors. Created QSAR models passed internal and external validation allowing the reliable activity prediction of new PI3K/mTOR inhibitors that were designed based on the obtained 3D-pharmacophores. Initial pool of designed compounds was subjected to structure based virtual

screening in order to select the best candidates. Results of this study may be very helpful in further discovery of selective PI3K/mTOR dual inhibitors as novel antineoplastics.

*Keywords: PI3K/mTOR, dual inhibitor, QSAR, drug design, screening.*

**27. MICRONEEDLE-ASSISTED DELIVERY OF NSAIDS**

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Abstract - Transdermal drug delivery offers a number of advantages including sustained release, improved patient compliance, avoidance of gastric irritation, as well as elimination of pre-systemic first-pass effect. However, only few medications can be delivered through the transdermal route in therapeutic amounts. NSAIDs are consisted of a group of drugs that are widely used, but their use by oral or transdermal system is limited due to a number of side effects. Therefore, NSAIDs are ideal candidates for delivery via microneedles, a relatively new method of drug delivery. A new concept was introduced known as microneedles and these could be used to effectively deliver drugs using micron-sized needles in a minimally invasive and painless manner. Microneedles can be used to enhance transdermal drug delivery and they can be fabricated in different forms.

*Keywords: transdermal drug delivery, nanopatches, minimally invasive procedures, physical enhancement*

**28. MONITORING OF BISOPROLOL FUMARATE STABILITY UNDER DIFFERENT STRESS CONDITIONS**

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Abstract - Stability studies of drugs by stress study is a very important process which is done by treating the study drug with different stress agents, with the aim to define the critical factors affecting the stability of the drug, to accurately define the storage conditions of the drug, as well as to identify the resulting degradation products. In this paper, stress studies of bisoprolol fumarate were performed, in order to examine what are the stress agents that affect its stability.For the analysis previously optimized and validated HILIC method was usedIt was demonstrated that oxidative stress agent has the largest effect on the degradation of bisoprolol fumarate, and then the acid and base stress agent successively. Water, as a neutral medium, and light had no significant effect on the stability of bisoprolol fumarate. During degradation under acid conditions impurity A was formed and it was confirmed with UPLC/MS/MS method. In order to more clearly define the processes of degradation, kinetic studies of degradation of bisoprolol fumarate have been carried out, in order to determine the order of the reaction rate of degradation and degradation half-time, which provided clearer definition of the mechanism of degradation.

*Keywords: bisoprolol fumarate, stress study, HILIC, LC-MS/MS, kinetic studies*

**29. BENEFITS OF EARLY ULTRASOUND DIAGNOSIS OF CONGENITAL URINARY TRACT OBSTRUCTION IN CHILDREN**

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Abstract - INTRODUCTION Transvaginal ultrasound may reveal a large number of congenital urinary tract malformations as early as in 14th week of gestation. Purpose of this study was to estimate benefits of ultrasound examination in early stages of urinary tract obstruction (UTO).

METHODS This cross-sectional study included 79 patients of both sexes, diagnosed with UTO, hospitalized at the Nephrology Department of Children's Hospital in Banja Luka in 2012. The study included all hospitalized patients aged 0 to 18 years. Data were collected by available medical documentation (logbook, medical history, discharge summary). We analyed patients' age and symptoms of .

RESULTS In 83.7% of all patients that were analyzed, UTO was detected by the end of the first year. In 32 (40.5%) patients UTO was diagnosed by prenatal ultrasound examination, and in 12 (15.2%) of them during the hip ultrasound examination in the first three months of life. There is a statistically significant difference between these groups ($p < 0.001$). In 35 (44.3%) patients UTO was discovered during the diagnostic evaluation of manifested symptoms (urinary tract infections, urinary disorders or abdominal pain).

CONCLUSION Ultrasound diagnosis of congenital anomalies in early stage has many benefits, and one of the most significant is prevention of complete function failure of the affected organ.

*Keywords: Ultrasonography, congenital abnormalities, obstruction, kidney*

**30. TESTING OF THE INFLUENCE OF MEDIA'S pH VALUE ON THE SOLUBILITY AND PARTITION COEFFICIENT OF THE ACETYLSALICYLIC ACID**

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Abstract - Experimental data of the influence of media's pH value on the solubility and partition coefficient of the acetylsalicylic acid (ASA) is presented in order to define the place in the human digestive system where ASA is absorbed after oral administration. The solubility of ASA in three media with different pH value (pH 1.2; purified water and pH 7.4) was determined using UV spectrophotometric measurement (based on Beer-Lambert's law that says that absorbance represents the linear function of concentration). Data for partition coefficient calculating was obtained by using classical shake-flask method, whereby as polar phase previously mentioned media were used and as organic phase chloroform was used. The study showed that both solubility and partition coefficient are pH-dependent, whereby solubility increases with increasing pH value above the pKa value, while partition coefficient decreases in the same conditions. ASA is theoretically expected to be the best absorbed in a medium where it is mostly presented in the unionized form. In this case, it is a hydrochloric acid buffer (pH value 1.2) which is similar to one found in the stomach. However, data from previous experimental studies have

shown that ASA is the best absorbed in the proximal small intestine, due to larger surface area and more permeable membranes.

*Keywords: acetylsalicylic acid, pH value, solubility, absorbance, partition coefficient*

**31. CAREER DEVELOPMENT IN GREEN BIOTECHNOLOGY IN B&H: ROADBLOCKS AND PROSPECTS**

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Abstract - Biotechnology industry worldwide is an enormous industry, and in 2005 only in the US 1400 biotechnology companies with trades worth $419 billion was registered. Green biotechnology involves, among others, processes such as development of pest resistant plants, new plant derived drugs and new nutritive plants. Research in this area offers possibilities for the development of new food products and mechanisms for the control of pathogenic agents in foods. In Bosnia and Herzegovina green biotechnology is slowly developing branch of biotechnology. If we consider last two years, green biotechnology in Bosnia and Herzegovina produced less than 10 research papers, in the same time period neighbouring countries have developed research laboratories for green biotechnology and are successfully applying for HORIZON 2020 grants (example of Sinisa Stanković Institute – FP7 - Plant Terpenoids for Human Health: a chemical and genomic approach to identify and produce bioactive compounds). Why is this the case? First of all the average laboratory for plant *in vitro* culture oriented for evaluation of gene expression and metabolic engineering costs around 1 million euros. The field is constantly evolving and the costs of making the laboratory productive rises even more. Governmental supported projects in B&H are usually around 10 000 euros and it is impossible to establish such laboratory without international projects. HORIZON 2020 usually seen as a golden goose by the researchers, offers large projects but for a scientist, dealing with green biotechnology, from Bosnia and Herzegovina (speaking from my own experience, after 8 years working in green biotechnology field) to apply for such founds is a borderline science fiction. We are enclosed in vicious circle of different roadblocks in the process of making green biotechnology interesting for the researchers and students in Bosnia and Herzegovina. First of all funding of the green biotechnology projects is usually considered to be less important than biomedical engineering. We are forgetting that in pursuit for new medicines in this era of the emergence of antibiotic resistance we must return our focus to green biotechnology and plant metabolic engineering. By stimulating students to pursue career in green biotechnology we are investing in our future, in new medicines, in new food products and crop resistant to pests. For this reason, by developing better plants we are stopping the consequences before they emerge, like the effects of pesticides.

*Keywords: student education, green biotechnology, biological engineering*

**32. PHARMACOECONOMIC ANALYSIS OF ANTINEOPLASTIC AGENTS CONSUMPTION IN REPUBLIC OF SRPSKA DURING THE PERIOD FROM 2011 TO 2015**

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Abstract – INTRODUCTION Cancer is a leading cause of death and disability worldwide. Furthermore, chemotherapy has significant financial burden to the health system, and also the patient. AIM The aim is to show hospital consumption of antineoplastic agents during the period from 2011 to 2015 in the Republic of Srpska, and to determine what financial burden brings cancer treatment. METHODS The data were obtained from the Public Health Institute of Republic of Srpska, from the report on drug consumption and report on analysis of population health. RESULTS During the period from 2011 to 2015, the largest number of patients in hospitals in the Republic of Srpska, had been patients treated for cancer. Antineoplastic agents consumption during the observed period is about 13.5 million KM, which makes 38% of the total hospital drug consumption. Of this, the consumption of monoclonal antibodies is 44% and protein kinase inhibitors 34%. CONCLUSION During the observed period, most funds are allocated to chemotherapy with monoclonal antibodies and protein kinase inhibitors. This indicates the need for more detailed analyses in order to improve the prevention and early detection of these diseases, and to reduce morbidity and mortality caused by cancer, and thus the financial costs in health care.

*Keywords: antineoplastic agents, cancer, consumption, Republic of Srpska*

**33. ARTIFICIAL NEURAL NETWORK: GAS RECOGNITION**

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Abstract - The objective of this paper is to describe development of gas recognition tool based on Artificial Neural Network (ANN). This recognition tool has capability to recognize five different gases: ammonia, acetaldehyde, acetone, ethylene, and ethanol. Developed ANN is trained using data from the UC Irvine Machine Learning Repository database from October, 2013. The implemented system for gas recognition uses following input parameters: concentration of gas (ppmv), flammability, constant pressure (kJ/kgK), constant volume (Kj/kgK), specific heat capacities (cp/cv) and molecular weight (g/mol). Developed neural network consists of 30 neurons distributed in a single hidden layer. For purpose of training 174 samples were used. Testing dataset contained 64 samples, 38 of which were used as a testing set. With 36 samples correctly classified resulting in accuracy and specificity were 97.37%. These results were obtained after adjusting neural network using several different parameters which is explained in this paper.

*Keywords: Artificial Neural Network, human olfactory system, electronic nose, gas recognition, ammonia, acetyl aldehyde, acetone, ethylene, ethanol*

**34. DETERMINATION OF CLINICAL TARGET VOLUME TO PLANNING TARGET VOLUME MARGIN WITHOUT SETUP CORRECTION PROTOCOL FOR LOCALIZED HIGH-RISK PROSTATE CANCER IRRADIATION**

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Abstract - Prostate cancer is the second most common cancer in men, fourth most common cancer in both sexes overall, and the fifth leading cause of death from cancer in male population. Radiotherapy plays important role in treatment of prostate cancer, alongside with surgery, hormonal and chemotherapy. In patients with localized high-risk prostate cancer, radiotherapy with longterm androgen suppression therapy is more effective than radical prostatectomy. External beam radiotherapy for these patients is conducted in three phases. We aimed to investigate an appropriate clinical target volume (CTV) to planning target volume (PTV) margin during first phase,

without setup protocol. Methods. External beam radiotherapy was delivered to twenty patients with localized high-risk prostate cancer. According to American Urological Association and European Association of Urology, localized high-risk prostate cancer group includes patients with stage ≥T2c disease, or Prostate Specific Antigen (PSA) > 20 ng/ml, or Gleason score 8-10. Total prescribed dose was 78 Gy in 39 fractions; first phase 46 Gy in 23 fractions, second phase 14 Gy in 7 fractions, and finally third phase 18 Gy in 9 fractions. CTV for first phase includes prostate, 2 cm bilateral seminal vesicles (proximal to prostate or whole seminal vesicles if they are grossly involved) and pelvic lymph nodes. Lymph node irradiation is included in patients with > 15% risk of lymph node involvement by Partin. PTV is a geometrical concept that takes into account all possible geometric variations and is used for treatment planning to ensure that the prescribed dose is delivered to CTV. These geometric uncertainties include organ delineation, setup errors, organ motion and intrafraction motion that occur throughout the planning and treatment process. For no setup correction protocol patient's skin markers were aligned to the laser system in the treatment room without correction. Everyday kV imaging was made during first phase and we have collected 744 orthogonal images. Systematic (Σ) and random (σ) setup errors were evaluated based on the 2D/2D matched kV images in the longitudinal (lng), lateral (lat) and vertical (vrt) direction. The values for CTV to PTV margins were calculated using ICRU Report 62 recommendations, Stroom's and van Herk's formulae. Results. Group of twenty patients included males with a mean age of 68.9 years. The standard deviations of systematic (Σ) setup errors were in range from 2.52 to 2.91 mm while the standard deviations of random (σ) setup errors fell in between 0.8 and 3.21 mm. Calculated CTV to PTV margins were between 2.84 and 9.19 mm according to ICRU, Stroom's and van Herk's models. Conclusion. CTV to PTV margin of 15 mm, should ensure that 90% of the patients treated with no setup correction protocol during first phase of localized high-risk prostate cancer irradiation, will receive a minimum cumulative CTV dose greater than or equal to 95% of the prescribed dose. Treating patients with image-guided radiotherapy (IGRT) decreases CTV to PTV margin to 7 mm and decreases volume of PTV 1.8 times (SD=0.04). Conflicts of Interest Notification This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

*Keywords: Margin, CTV, PTV, high-risk, prostate, cancer, radiotherapy*

## 35. DNA IDENTIFICATION OF PLANE CRASH VICTIMS AT THE AIRFIELD "ZALUŽANI" BANJA LUKA

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Abstract - On May 20, 2012 at sports airfield „Zalužani" Banja Luka during sport manifestation – air show, a sports airplane „Cessna" crashed down killinng the pilot and four parachuters. The plane was completely burnt, and four out of five bodies were charred beyond recognition.

*Keywords: Identification, DNA analysis, plane crash*

## 36. MEASURING THE FEELING

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Abstract - Sensory features of cosmetic products are one of their most important characteristics for consumer acceptance. Consumers preferably choose one product among many based on their perceptions: first of its packaging, and then of its smell, appearance and texture (touch and feel). When optimizing a product, in order to adapt it to the needs and desires of consumers, cosmetic companies use sensory evaluation methods, like the Quantitative Descriptive Analysis and Spectrum™ Descriptive Analysis, among others. They require trained panels making them time-consuming and expensive. On the other hand, rheological measurements, used to study in-bulk flow properties of a material and textural analysis are instrumental methods that offer fairly simpler, less expensive and much less time-consuming means of analysis, at the same time giving more objective and repeatable results. Finding correlations between sensory assessments and instrumental analyses, and being able to use instrumental instead of sensory analyses would have great benefits in the development of cosmetic products. However, this is not an easily accomplished task. In the available literature there are examples of these kind of studies on cosmetic emulsion systems (creams and lotions), but also on gels, foundations and raw materials. Statistical analysis usually involves ANOVA for comparison of chosen samples' data and principal component analysis (PCA) for finding correlations between sensory and instrumental data. The prediction models are rarely developed and validated for having instrumental in lieu of sensory assessments. These studies are very versatile in terms of chosen sensory attributes and, even more so, in terms of studied instrumental methods and chosen parameters. Therefore, it is very difficult to compare them and find matching correlations. As sensory analyses are being developed and new instrumental analytical techniques introduced with supporting sophisticated softwares, the number of studied parameters increases and new correlations are being made. It is still a worthy goal, however, to be able to instrumentally predict at least basic sensations associated with the use of cosmetic products to be used for screening in developmental phases of their making.

*Keywords: sensory analysis, rheology, texture analysis, psychorheology*

## BIOMECHANICS, ROBOTICS AND MINIMALLY INVASIVE SURGERY

### 1. MECHANICAL TESTING STRATEGIES FOR DENTAL IMPLANTS

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Abstract - Dental implants, which are utilized for substituting missing teeth are appealed in clinical applications for decades. Moreover, they also are used for supporting craniofacial reconstructions and for orthodontic appliances. Besides having esthetically similar view to natural tooth, dental prostheses have no harmful effect to neighboring teeth and non disturbing nature for the patient during mastication. On the other hand, the dental implant can result in bone resorption, biocompatibility problems and high costs. There are four main types of dental implant designs, which are developed and employed in clinical dentistry entitled as subperiosteal form, blade form, ramus frame, and endosseous form. From the beginning of this technic, a great evolution not only on implant design and surgical technologies of dental implants, but also on the classification of clinical success, failure and different surface treatments of dental implants is done. The failures are generally influenced on the mechanical properties of dental implants. Therefore, it is critical to estimate possible failures in a specific design of dental implant, which could protect the patients' health and comfort. For this purpose, the experimental methods for the dental implants provide precise data for clinicians and engineers. Maximum allowable stress

and strain, resonance frequency and resistance to fracture are key parameters to determine long term durability of dental implants. In this study, current status of frequently utilized mechanical tests to measure these properties, such as tensile, resonance and fracture tests are summarized. Test procedures with related standards, their strength and weaknesses are briefly discussed. This review is prepared to inform the tester about mechanical testing methods of dental implants in the light of recent advancements.

*Keywords: Dental implant, Mechanical analysis*

## 2. NON-INVASIVE ESTIMATION OF RESPIRATORY DEPRESSION PROFILES DURING ROBOT-ASSISTED LAPAROSCOPIC SURGERY USING A MODEL-BASED APPROACH

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Abstract - Robot assisted laparoscopic surgeries are becoming the standard procedure for radical prostatectomies (RALRP). General anesthesia, Trendelenburg positioning and capnoperitoneum during RALRP affect patient' gas exchange, leading to possible complications in the postoperative phase, such as hypoxemia. The aim of this paper is to examine the changes in pulmonary gas exchange through the perioperative period for RALRP using a mathematical model approach. Measurements were performed with the Automatic Lung Parameter Estimator (ALPE) system, which include a mathematical model of pulmonary gas exchange capable of quantifying shunt and ventilation to perfusion ($\dot{V}$ A/$\dot{Q}$ ) mismatch. In total, 20 patients (ASA physical status I-III) with a mean age of 63.8 ± 6.6 years scheduled for elective RALRP at Aalborg University Hospital, where included in this study. Local procedures for anesthesia, ventilator settings and operation were followed throughout the study. Intraoperative measurements were performed before (T1) and during 30◦ Trendelenburg position and capnoperitoneum (T2-T3), as well as after exsufflation when the patients were returned to the supine position (T4).Patients with ASA-score >1 had significantly higher shunt during and after surgery (T2-T4) compared to T1 (P<0.001). In the ASA=1 group there was no statistically difference between the levels. Moreover, the level of shunt at the end-point of surgery (T4) was significantly higher in the ASA>1 group compared to ASA=1 (P=0.02). At T1 there was no statistically differences in shunt between the groups. The level of $\dot{V}$ A/$\dot{Q}$ mismatch did not increase significantly in the two groups, although when analyzed together in one group, there was a significant increase from T1 to T3 and T4 (P=0.002). There was no differences between the level of $\dot{V}$ A/$\dot{Q}$ mismatch between the groups at any timepoint. In this a mathematical model approach was used to describe the perioperative development of shunt and $\dot{V}$ A/$\dot{Q}$ mismatch for RALRP patients. The results showed an increase in both shunt and $\dot{V}$ A/$\dot{Q}$ -mismatch throughout the intraoperative period, with different patterns of development of shunt with the ASA score. This concurs with previous findings of oxygenation during anesthesia. This study provides an indication for the use of intraoperative interventions, such as increased PEEP and/or lung recruitment for patients with intraoperative $\dot{V}$ A/$\dot{Q}$ mismatch and shunt, guided by a model-based quantification of the problems.

*Keywords: robot-assisted laparoscopic surgery, minimal invasive surgery, ventilator management, pulmonary gas exchange, mathematical models*

## 3. LONG-LATENCY INTRACORTICAL INHIBITION DURING UNILATERAL MUSCLE ACTIVITY

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Abstract - The aim of the present study was to investigate the effect of co-activation of antagonist muscles on long-latency intracortical inhibition (LICI) in comparison to isometric index finger abduction. EMG signals were recorded from the first dorsal interosseous muscle (FDI) in response to single-pulse and paired-pulse transcranial magnetic stimulation (TMS). In 10 healthy right-handed volunteers, TMS was used to estimate LICI at 3 different interstimulus intervals (ISIs) – 50, 100 and 150 ms. The intensity of the conditioning and test stimuli was 130 % of the motor threshold in relax. The stimulation procedure was repeated at rest and during tonic isometric index finger abduction and co-activation of antagonist muscles. At rest, LICI was significant at ISIs of 100 and 150 ms and not evident at ISI of 50 ms. During isometric index finger abduction and co-activation of antagonist muscles, LICI was evident at all used ISIs and was even better pronounced at 50 ms. At ISIs of 50 and 100 ms during abduction, LICI was significantly stronger in comparison to co-activation. During abduction and paired-pulse TMS, the mean values of cSP at all used ISIs were significantly shorter compared to single-pulse TMS. The shortening of cSP recorded in response to paired-pulse TMS was gradual, with increasing of ISI from 50 to 150 ms. In contrast, during co-activation, the duration of cSP was almost independent of the value of ISI and similar to the duration of cSP in response to single-pulse TMS.

*Keywords: transcranial magnetic stimulation (TMS), long-latency intracortical inhibition (LICI), co-activation of antagonist muscles, isometric index finger abduction*

## 4. CONTACT FORCE PROBLEM IN THE REHABILITATION ROBOT CONTROL DESIGN

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Abstract - Physical interactions between patients and therapists during rehabilitation have served as motivation for the design of rehabilitation robots, yet there is a lack in fundamental understanding of the principles governing such human-human interactions. Review of the literature posed important open questions regarding sensorimotor interaction during humanhuman interactions that could facilitate the design of human-robot interactions and haptic interfaces for rehabilitation. The goal is to use the leading principles of the human-human interaction in order to define a way in which people could be in contact with robots in a more intuitive and biologically inspired way. The proposed hybrid impedance control solves the robot – environment contact problem and offers a possible solution for the rehabilitation robot interaction problem.

*Keywords: contact task, cooperative robotics, human-machine interface, impedance control*

## 5. IMPLEMENTATION AND VALIDATION OF HUMAN KINEMATICS MEASURED USING IMUS FOR MUSCULOSKELETAL SIMULATIONS BY THE EVALUATION OF JOINT REACTION FORCES

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Abstract - The gold standard for the analysis of human kinematics and kinetics is a camera-based motion capture system in combination with force measurement platforms. Alternatively, inertial measurement units can be utilized to obtain human kinematics, while ground reaction forces are computed from full body dynamics. This setup represents a system independent from the spatial confinement of a gait laboratory. The aim of this study is the comparison of the two methods by the investigation of lower limb kinematics and the resulting joint reaction forces within the ankle-, knee- and hip joints. For this purpose, human motion during gait was captured simultaneously by both measurement techniques. 13 trials from 8 different test subjects were evaluated in total. IMU data was processed with a quaternion based Kalman Filter. The data sets were implemented into a musculoskeletal simulation program in order to drive a virtual human body model. Each sensor was aligned to the gravitational and magnetic field vectors of the earth. The angles of flexions, extensions and rotations were analyzed to determine kinematic differences. Joint reaction forces defined kinetic dissimilarities. The overall kinematic differences of both models yielded root mean square errors of 7.62°, 6.02°, 4.95°, 2.79°, 2.38° and 3.56° for ankle flexion, subtalar eversion, knee flexion, hip external rotation, hip abduction and hip flexion, respectively. The proximo-distal differences in force peaks between the models yielded overall for the ankle, 57.33 %Bodyweight(BW) ± 46.86%BW (16.66 %(Maximum peak to peak) ± 13.62 %) for the knee 37.09 %BW ± 29.33 %BW (17.65 % ± 15.44 %) and 32.03 %BW ± 24.33 %BW (15.6 % ± 12.54 %) for the hip. The overall outcome of this work investigated an approach independent of the common setup of the gait laboratory, thus enabling a cheaper and more flexible technology as an alternative. However, kinematic and thus kinetic differences remain rather large. Future work aims to improve the contact criterion for the calculation of the ground reaction forces and the implementation of a full-body calibration algorithm for the IMU system in order to counteract magnetic field disturbances.

*Keywords: Inertial Measurement Unit, IMU, Multibody Simulation, Musculoskeletal Simulation, AnyBody, Ground Reaction Force Prediction, Joint Reaction Forces, Gait, Motion Capture*

## 6. FEA OF THE TRANSILIACAL INTERNAL FIXATOR AS AN OSTEOSYNTHESIS OF PELVIC RING FRACTURES

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Abstract - Common Schanz screw systems can be used to stabilize pelvic ring fractures. In order to accommodate for different patient's requirements, implants can be placed in cranio-caudal direction into the os ilium (T1), or into the supraacetabular bone canal, and thus, in dorso-ventral direction (T2). Whereas both techniques are currently used, no data of the biomechanical behavior is available up to this date. The aim of this

study is to analyze, whether T2 shows biomechanical advantages with respect to tissue and implant stresses due to the enlarged bone-implant interface. Forces acting on the pelvis were analyzed using motion capture data of a gait cycle obtained by the utilization of a musculoskeletal simulation program. A three dimensional finite element (FE) model of the pelvis with grayscale-based material properties was generated. The muscle and joint reaction forces at toe-off were applied to the FE model and instable pelvis fractures were implemented. The osteosynthesis systems were positioned within the model in order to enable the comparison between the two different surgical techniques. Stresses and displacements were analyzed for bone tissue, fracture zone and implant. T2 lead to approx. 30% larger displacements in the fracture zone. Von-Mises stresses were larger for T2 in the implant (80 MPa vs. 227 MPa), whereas T1 leads to larger stresses in the bone tissue (200 MPa vs. 140 MPa). Both implantation techniques showed a good biomechanical behavior. Differences could be found with respect to tissue strains and deformations in the fracture zone. If bone quality or fracture healing are of concern, T2 or T1 should be used, respectively. However, both techniques seem to be applicable for cases with no special requirements. Further analyses aim to investigate the behavior under cyclic loading.

*Keywords: finite element analysis, musculoskeletal simulation, internal fixator, pelvic ring fracture*

### 7. OVERVIEW OF THE DEVELOPMENT OF HYDRAULIC ABOVE KNEE PROSTHESIS

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Abstract - This paper presents research and development of hydraulically powered above-knee prosthesis (HAKP) and novel prosthetic foot, in order to enable transfemoral (TF) amputees perform stair ascent and other daily activities in as much as possible natural manner. Functions that need exertion of large forces and moments during locomotion such as walking up stairs and slopes cannot be naturally accomplished by commercially available microprocessorcontrolled above-knee (AK) prostheses. Also, such prosthetic devices are expensive and unaffordable for major part of amputee population, so mostly used commercial prostheses are energetically passive devices. Deficiency of passive prosthetic devices is the lack of externally powered joints that could substitute a large number of missing muscles and provide a gait with the kinematics and dynamics similar to that of non-amputees.

*Keywords: Above-knee prosthesis, actively powered joints, motion recognition*

## BIOINFORMATICS AND COMPUTATIONAL BIOLOGY

### 1. CLASSIFICATION OF METABOLIC SYNDROMEPATIENTS USING IMPLEMENTED EXPERTSYSTEM

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Abstract - This paper presents the development of an Expert System for the classification of metabolic syndrome (MetS). Two-layer feedforward Artificial Neural Network (ANN) with sigmoid transfer function is used for MetS classification. In accordance with international guidelines NHBL/AHA, classification is performed based on following input parameters: waist circumference, blood pressure, glucose level, HDL cholesterol and triglycerides. Samples for training of developed Expert System are obtained from 1083 patients at hospitals in Bosnia and Herzegovina. Testing of developed system is performed with 300 samples, also acquired from patients in hospitals in B&H by medical professionals. Out of 300 samples, 155 samples were of MetS while the rest was of healthy subjects. Developed Expert System correctly classified 283 MetS samples, therefore the sensitivity of 96% is achieved and specificity is 92,7%.

*Keywords: Expert System, Metabolic Syndrome, Artificial Neural Network*

## 2. PRE-CLASSIFICATION PROCESS SYMPTOM QUESTIONNAIRE BASED ON FUZZY LOGIC FOR PULMONARY FUNCTION TEST COST REDUCTION

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Abstract - In the past few years, developing of computer-aided systems for disease classification has been investigated more extensively. Medical professionals use these systems as assistance in diagnosis since they perform the diagnosis based on larger, more complex set of new and previously stored information. Those computer-aided systems are equipped with graphical user interface that makes application in everyday situations more convenient. Disease classification in most computer-aided systems is based on expert systems. Beside the Artificial Neural Networks (ANNs), fuzzy logic (FL) or some other tools are often used for this purpose. This study presents the results of disease pre-classification process and determining the need for conducting respiratory function tests such as spirometry (SPIR), Impulse Oscillometry (IOS), or Body plethysmography and running the Fuzzy Logic – Artificial Neural Network (FL-ANN) Expert System for classification of respiratory diseases. This pre classification algorithm optimizes time resources as well as reduces the costs of medical device use needed for testing of patient and costs of medical professional attending the measurement. Questions and symptoms used in pre-classification are based on Global Initiative for Asthma (GINA) and Global Initiative for Chronic Obstructive Lung Disease (GOLD) guidelines. The pre-classification algorithm is validated on 5000 reports acquired from subjects prospectively enrolled in the Hospital in Sarajevo during the period of two year and CareFusion Database for the last 10 years. Sensitivity of 97.26% and specificity of 90.74% is achieved. It is shown that saving around 97% on pulmonary functions tests can be achieved by introducing these automated systems in everyday practices.

*Keywords: Fuzzy logic, Artificial Neural Network, COPD, Asthma, Disease, Classification, Expert System, Artificial intelligence, Decision support system, Computer-aided, Automated classification*

## 3. ARTIFICIAL NEURAL NETWORK AND DOCKING STUDY IN DESIGN AND SYNTHESIS OF NEW XANTHENE DERIVATIVES

*Elma Veljović[1], Selma Špirtović-Halilović[1], Samija Muratović[1], Amar Osmanović[1], Almir Badnjević[2, 3,] Lejla Gurbeta[2, 3], Berina Tatlić[1], Zerina Zorlak[1], Selma Imamović[1], Đenana Husić[1], Davorka Završnik[1]*

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Abstract - The aim of the study was to investigate the efficiency of artificial neural networks and docking studies in prediction of antimicrobial activity for new compounds. For that purpose, two multilayer neural networks with feedforward architecture were developed. Also, docking studies were performed to investigate the hypothetical binding mode of the target compounds. A series of *2,2,5,5-tetramethyl-9-aryl-3,4,5,6,7,9-hexahydro-1H-Xanthene-1,8 (2H)* dion derivatives have been synthesized, characterized and evaluated for their in vitro antimicrobial activity. They were tested against Escherichia coli and Candida albicans strains. According to results of in vitro investigation, new *2,2,5,5-tetramethyl-9-(3,5dibromophenyl)-3,4,5,6,7,9-hexahydro-1H-Xanthen-1,8(2H)* dion possess better antimicrobial activity against tested microorganisms and correlated with results of docking studies.

*Keywords: Xanthenes, artificial neural network, docking study, antimicrobial activity, prediction, compound, synthesis*

## 4. MATHEMATICAL AND COMPUTATIONAL MODELS OF CELL CYCLE IN HIGHER EUKARYOTES

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Abstract - The cell cycle is an ordered sequence of coordinated biological processes that enable cells to grow and divide, to check for certain abnormalities whenever it is appropriate, to regulate the different stages of growth and division in the predefined order, and to respond to DNA damage and other dysfunctions by arresting progression through the cell cycle so that to allow the regulators to repair DNA damage and recover from dysfunction before DNA is completely replicated. Mathematical and computational modeling and simulation is a well-known approach to explore biological systems. The main idea behind this approach is to create the closest approximation of a biological system based on wet lab results, and predict its dynamic behavior through measuring the amounts of biological components. Mathematical and computational approaches implemented to cell cycle regulation have the following benefits. Firstly, it makes possible to provide a detailed qualitative and quantitative structure of the biological system describing the cell cycle regulation. Secondly, modeling allows us to conjecture a hypothesis regarding the biological system and then check consistency of the hypothesis to desired deep by extrapolating the parameters involved into the model.

*Keywords: cell cycle, mathematical model, computational model, Petri nets.*

**BIO-MICRO/NANO TECHNOLOGIES**

## 1. APPLICATION OF ARTIFICIAL NEURAL NETWORK IN MODELLING OFPHOTO-DEGRADATION SUSPENSION OF MANGANESE DOPED ZINCOXIDE NANOPARTICLES UNDER VISIBLE-LIGHT IRRADIATION

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Abstract - The usage of Artificial Neural Networks (ANN) for the prediction of water pollution has been investigated more extensively over the past few years, and the reason is due to the ANNs efficiency at approximating complex functions. One particular way of designing an ANN used for treatment of water is to use the characteristics of the waste and pollution sources as inputs (water parameters) and to use the appearance of pollutants as ANN outputs. This way, the designed ANNs are able to determine the waste load from different sources of water environments. This paper presents the design and testing of a feedforward neural network for the prediction of photo-degradation in suspension of manganese doped zinc-oxide nanoparticles under visible-light irradiation. The developed ANN was trained and validated using 210 samples by means of the Levenberg–Marquardt algorithm. The accuracy of true predictions, based on the testing dataset, was 93.78%. The developed system proved to be robust and simple for the prediction of photo-degradation, and can be implemented for the development of systems used for educational purposes.

*Keywords: Nanoparticles, Artificial neural network, Prediction, Photo degradation, Visible-light irradiation*

## 2. DEVELOPMENT OF THE METHOD FOR QUANTIFICATION OF AMINO ACID ADSORBED ON NANOPARTICLE SURFACE

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Abstract- Bio-functionalization of nanoparticles with amino acids increases their biocompatibility and make them more efficient in delivery systems, especially in drug delivery and gene therapy. This can lead to development of new detection methods, in the field of clinical diagnostics, biosensors and DNA receptors. Alongside, understanding of the mechanism of amino acid adsorption on nanoparticle surface contributes to the evaluation of complex interaction between nanoparticles and proteins. Thus, development of methods for amino acid quantitation and characterization is very important. Still, the number of methods is very limited. We report a strategy for the quantification of cysteine adsorbed on gold, silver and silica nanoparticles by modified ninhydrin method. In order to obtain the most suitable ratio for amino acid adsorption, optimized parameters were: amino acid concentration, ratio of amino acids to nanoparticles, and nanoparticle concentration. Values of absorbance

were measured by UV-Vis spectrophotometry and used for calculating the mass of adsorbed amino acid. The size of nanoparticles lacked an effect on amino acids whereas the ratio of amino acid to nanoparticles was revealed as a critical parameter. The method suggests 9:1 ratio as the most suitable for amino acid-nanoparticle interaction in case of both, gold and silica nanoparticles.

*Keywords: Gold nanoparticles, Silica nanoparticles, Amino acids, Ninhydrin method, Spectrophotometry*

## 3. QUANTIFICATION OF PROTEIN CONCENTRATION ADSORBED ON GOLDNANOPARTICLES USING ARTIFICIAL NEURAL NETWORK

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Abstract - Protein-nanoparticle conjugation provides unique interactions between biological systems and synthetic materials used for analytical, diagnostic and therapeutic applications. This paper presents the development of Artificial Neural Network (ANN) for quantification of proteins concentration adsorbed on gold nanoparticles (Au NPs). Single hidden layer feedforward ANN is based on concentration of free proteins as input parameters, while concentration of conjugated proteins is desired output. Totally, 210 samples were used, 200 of them derived from experiment and 10 additionally added as blank samples. Training data sets contain 120 samples, out of which 108 samples are used for estimation and 12 for validation. The ANN system is subsequently validated with 90 samples, 80 samples from experiment and 10 additionally added. From 80 of samples with known protein concentration, 74 are successfully quantified as proteins adsorbed on nanoparticles, which gives sensitivity of 92.5%. Out of experiment data, 10 blank samples are correctly classified as free of proteins giving the specificity of 100%. Developed system can be used in laboratory conditions and further validated on new experimental samples.

*Keywords: Adsorption, Artificial Neural Network, Nanoparticles, Proteins, Quantification*

## 4. DESIGN AND FABRICATION OF A PDMS MICROFLUIDIC DEVICEFOR TITRATION OF BIOLOGICAL SOLUTIONS

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Abstract - This paper presents microfluidic device, constructed from polydimethylsiloxane and glass, which is designed to perform on-chip microtitration of biological solutions. The chip is composed of several mixing microchannels that measures 100×100μm2 in extent and that automatically dilute an oxidizing agent in order to determine the amount of reducing agent present in biological solution. Concept of the diffusion as a dominant process for fluid mixing and achieving gradient of dilution, is analysed and reviewed. Types of biological samples, length of the mixing channel, input flow rate and applied pressure are discussed as main design parameters. Experimental results of utilizing the chip in microtitration studies are presented.

*Keywords: microtitration, diffusion, polydimethylsiloxane*

## 5. BEAUTY OF FINE DOTS-DETECTION AND TREATMENT OF ALZHEIMER'S DISEASE USING QUANTUM DOTS

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Abstract - This paper presents a review on available researches, when it comes to the usage of quantum dots in detection and treatment of the most common form of dementia, and that is Alzheimer's disease (AD). Quantum dots (QDs), as an essential material of nanotechnology, give unique approaches and solutions for preventing and curing AD. In this paper, CdSe/ZnS quantum dots and their application features are analyzed and proposed as the possible solution for inhibition of events in the organism, that occur before the patients show visible symptoms. Scientists around the world truly believe, that nanotechnology in fact is the future of medicine and that this emerging technology, although still in a "newborn" state, would provide answers for the treatment of many to this date incurable disease, as AD itself. Discussed approaches are still in an experimental phase, because the possible toxicology of many nanomaterials isn't fully investigated.

*Keywords: Nanotechnology, Quantum Dots, Alzheimer's Disease*

## 6. EFFECT OF CHEMICALLY-SYNTHESIZED SILVERNANOPARTICLES (AG-NP) ON GLYCEMIC ANDLIPIDEMIC STATUS IN RAT MODEL

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Abstract - The aim of present study was to investigate the effects of chemically synthesized of silver nanoparticles (Ag-NP) using citrate on selected blood biochemical parameters includes glucose, total cholesterol, triglyceride and total protein in rats model. In this study Ag-NP was synthesized with the usage of chemical reduction method. Laboratory rats were divided into four groups; control, placebo, and groups received 100 and 200 mg/kg BW of Ag-NP. Blood samples were taken, 15 days after administration, and separated serum was used for determination of biochemical measures. Greater dosage of Ag-NP (200 mg/ kg BW) causes mortality in experimental group, due to possible toxic effect of chemically synthesized Ag-NP. In serum biochemical measures infusion of AgNP had decreases serum glucose level (92 and 91 ml/dl in compared with control: 109 ml/dl), and total cholesterol and triglyceride had increases following Ag-NP administration ($P< 0.01$). In conduction, peripherally administration of chemically-synthesized Ag-NP in 100-200 mg/Kg of BW dosages, cause hypoglycemic and hyper-lipidemic effects, due to increases peripheral glucose and decreases total cholesterol and triglyceride levels in rat model. The administration of greater dosage may cause mortality of experimental animals.

*Keywords: Biochemical effect, Chemically-synthesis**,** Lipid profile, Nanomaterials, Metabolism*

## 7. TOWARDS GREEN NANOTECHNOLOGY: MAXIMIZING BENEFITS AND MINIMIZING HARM

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Abstract. The ultimate goal of any economic, technological and social development is to improve human health and well-being. Thus, the society brings new requirements to new technologies, moving towards clean and green technology development. Green nanotechnology, as a branch of green technology, significantly contributes to environmental sustainability by producing nanomaterials and nanoproducts without harming human health and the environment, and by producing nanoproducts that provide solutions to environmental problems as well. Green nanotechnology is based on the existing principles of green chemistry and green engineering – it uses less materials and renewable inputs wherever possible, and thereby saving energy and fuel. The main benefits of green nanotechnology are: increased energy efficiency, reduced waste and greenhouse gas emissions, and minimized the consumption of non-renewable raw materials.

*Keywords: green nanotechnology, benefits, harm, environment, health*

**8. APPLICATION OF BIOLOGICAL SURFACE ADSORPTION INDEX APPROACH (BSAI) IN CHARACTERIZATION OF INTERACTIONS BETWEEN GOLD NANOPARTICLES AND BIOMOLECULES**

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Abstract- The biological surface adsorption index approach (BSAI) presents a novel approach for characterization of nanoparticles (NPs) in biological systems. It is used for identification and quantitation of intermolecular forces that govern the adsorption properties of biomolecules on NPs surface. BSAI presents very important step in characterization of NPs-biomolecules interactions. Knowledge about the mechanism of interactions could help in prediction of NPs eventual toxicity in biological systems. Gold NPs are very often used in medicine, cosmetics and pharmacy thus evaluation of potential toxicity of gold NPs is extremely important prior its application. In this paper BSAI approach was applied on gold NPs with three different size (5 nm, 15 nm and 30 nm). The results showed that interactions of gold NPs and biomolecules vary in dependence of the size of NPs. The results contribute in toxicity assessment of gold nanoparticles in combination with other analytical tools for toxicity assessment.

*Keywords: gold nanoparticles, interactions, characterization, adsorption, nanodescriptors.*

**CARDIOVASCULAR, RESPIRATORY AND ENDOCRINE SYSTEMS ENGINEERING**

**1. SUBCLINICAL INFLAMMATION: THE LINK BETWEEN INCREASED CARDIOVASCULAR RISK AND SUBCLINICAL HYPOTHYROIDISM IN POSTMENOPAUSAL WOMEN**

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Abstract - Introduction: Increased inflammatory markers correlate with progressive hypothyroidism. The link between subclinical hypothyroidism, subclinical inflammation and cardiovascular disease in postmenopausal women still remains unclear. Objective: To evaluate the association of subclinical hypothyroidism with inflammatory biomarkers and their impact on cardiovascular risk in postmenopausal women. Materials (subjects) and methods: Prospective clinical study included 140 postmenopausal women in the outpatient and diagnostic department of the Clinic for endocrinology in a tertiary university hospital. Sociodemographic and anthropometric data, thyroid hormonal status, inflammation markers (CRP, homocysteine, acidum uricum, IL-6, TNF-α) were obtained for all subjects. They were followed for 30 months and the incidence of cardiovascular disease was determined. Results: Subclinical hypothyroidism was associated with elevated CRP, acidum uricum, homocysteine, and TNF-α. The incidence of cardiovascular disease was significantly higher in postmenopausal women with subclinical hypothyroidism compared to euthyroid women ($p<0.001$). Subclinical hypothyroidism was associated with higher cardiovascular risk regardless of age and duration of postmenopause ($p=0.0007$). Conclusion: Subclinical hypothyroidism is associated with elevated CRP, homocysteine, acidum uricum and TNF-α, and increases cardiovascular risk in postmenopausal women.

*Keywords: Subclinical hypothyroidism, Cardiovascular risk*

## 2. COMPUTATIONAL VASCULAR SURGERY PLANNING AND PREDICTING FOR ABDOMINAL AORTIC ANEURYSM

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Abstract - Treatment of Abdominal Aortic Aneurysm (AAA) is a challenge in vascular surgery. Latest methods used for treatment requires implantation of stent graft - particular synthetic blood vessel (graft) combined with armature (stent). We developed our software for surgical planning of implantation of stent graft for AAA. Material properties of the aortic wall were determined using the bubble inflation test method. Hardware-software system for acquisition of the tissue specimen displacement was developed. A specific image processing procedure for determining the relation between shear stress and drag force distribution was implemented for specific patient. Blood flow in the lumen as simulated with Navier-Stokes and continuity equation. Fluid–structure interaction procedure for nonlinear deformation of the wall is used. Computational methods could be very helpful for patient-specific analyses and better understanding of the progression of AAA in a particular patient. Future clinical diagnostic system could use these complex computational surgical planning and AAA analysis.

*Keywords: Abdominal Aortic Aneurysm, Vascular surgery, Predicting*

## 3. DETERMINATION OF PROBABILISTIC NEURAL NETWORK'S ACCURACY IN CONTEXT OF CARDIAC STRESS TEST

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Abstract - In the last several decades the development of informationcommunication technology (ICT) and related fields has assisted medicine in many aspects. This paper tends to contribute to this ongoing trend by testing the accuracy of probabilistic neural network (PNN) trained to determine the results of cardiac stress test used for diagnosis of coronary/ischemic heart disease (CHD). The obtained results show that the network can determine the patients who really need immediate diagnosis treatments in the shortest time with the satisfactory accuracy. Therefore, the proposed simulations can be used for the physicians in the training process and additionally ease the work to cardiologists and improve the treatment of cardiac patients.

*Keywords: accuracy, cardiac, networks, neural, probabilistic, stress, test*

## 4. EFFECTS OF ELECTRICAL STIMULATION AS A NEW METHOD OF TREATING DIABETES ON ANIMAL MODELS: REVIEW

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Abstract - Diabetes is a group of metabolic diseases characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both. It is proven that electrical stimulation could accelerate wound or fracture healing and also decreases pain. Because of numerous benefits on cell function, it is assumed that electrical stimulation can have positive effect on diabetes. Aim of this article is to summarize results of different studies which analyzed effect of electrical stimulation on most important parameters of diabetes mellitus in animal models. Unilateral electrical stimulation of dorsal motor nucleus of the vagus nerve resulted in rapid rise in plasma insulin levels >200%, and stimulation of the nucleus tractus solitarius, also produced 50% increase in insulinemia, in Wistar rats. Mild electrical stimulation (MES) combined with heath shock treatment (HS), significantly decreased fasting blood glucose and insulin levels, and improved insulin sensitivity in C57BL/6J, db/db mice as well as in KKAy mice. Peripheral electrical stimulation (PES) increased hepatic glucose output during the basal state in insulin-resistant Wistar-Han rats. PES improved tissue sensitivity to insulin, improved suppression of hepatic glucose production, and significantly elevated rate of glycogenesis compared with controls. Hepatic electrical stimulation was effective in reducing blood glucose by 27-31%, in Sprague-Dawley rats, streptozocin induced diabetic rats and Fa/Fa diabetic fatty rats. The present studies indicate that electrical stimulation treatment of very short duration is very potent to stimulate glucose uptake and improve insulin sensitivity. Electrical stimulation may directly affect major insulin target tissues or leading to secondary effects in other tissues. Low intensity current showed no observable adverse effects, but electrical conductance in cells

should be measured. Electrical stimulation has very positive impact on diabetes in animal models, so it should be subject of further examinations for human use.

*Keywords: diabetes mellitus, insulin, electrical stimulation, animal models*

**MULTIDISCIPLINARY SESSION**

## 1. ALTERNATIVE APPROACHES FOR TOTAL PROTEIN ISOLATION FROM HUMAN BLOOD LEUKOCYTES

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Abstract - White blood cells, also called leukocytes, are present in peripherial blood as a part of the human immune system against foreign invaders and different diseases. Studying the role of proteins within various types of leukocytes is cruical for understanding their mechanisms of action such as transendothelial migration during inflammation and the immune cell signaling. Proteomic analysis of leukocyte proteins requires a sufficient amount of total cellular proteins that must be isolated from a blood test sample. There are only a few studies dealing with the analysis of the total protein extract from human blood leukocytes, and many questions regarding the leukocyte signaling are still unanswered. In our study we investigated and optimized the best optimal method for total protein extraction from human blood leukocytes that allows preparation of large quantities of leukocyte proteins from the blood sample. Our study included human blood from 50 test individuals of different gender, age and blood groups.

*Keywords: Leukocytes, Protein extraction, Proteomic analysis, Immunity*

## 2. DEVELOPING ELECTRONIC HEALTH RECORDING SYSTEM FOR TELEMONITORING CHRONIC PATIENTS

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Abstract - Introduction: While the world's population is growing, average life expectancy is increasing. As a result, the growing elderly population is profoundly affecting the delivery of healthcare for everyone and in particular for those with chronic diseases. It is necessary that the patients with a chronic disease must be under observation because they are higher risk of health crisis. Some kind of chronic patients are lower risk group and they not have to waste their precious time on hospital beds, but they are also must be under observation. Telemonitoring

is one of the solution for undesirable states and it is giving hope to solve hospital bound problem. The proposed end-to-end telemedicine system includes medical sensors, Body Area Network (BAN), low-power mobile communication system, secure communication protocols and electronic health recording system involving clinical decision system.

Aims and objectives: A part of this project is to develop an electronic health recording system (EHRS) which will gather chronic patients data, store and process them, and then serve hospital facilities and staff anywhere. The system considers web services based secure methods, so it has capability of Health Level Seven (HL7) compatible standard recommended by World Health Organization (WHO), and fast and secure transfer. Moreover, it will have a wireless solution, so Electronic Health Records will collect via sensors wirelessly.

Methods: In this project, the ECG, pulse oximetry, and lung function measurements will be recorded as time series. Also blood sugar, weight and blood pressure measurements will be acquired by portable equipment. The collected measurements will be converted to IEEE 802.15.6 network packets. The packets will be wirelessly sent PC at home, and then will be transmitted to a remote health center via internet. The electronic health recording system will operated at the server located the health center. It will 1) involve patient information and treatment data, 2) extract each signal and measurements, 3) continuously show all recorded signals and parameters on a screen at health center, and PC at home 4) will generate alarm prompts and send them to related health staff, and 5) govern a decision support system.

Results: The project is now in developing phase. Conclusion: Telemonitoring systems are growing day by day and become promising innovation. Chronic patients need long time period observation because of their high risk group. Hospital bound problem of chronical patients can be resolved by using telemonitoring system. Developing a Electronic Health Records System at both the PC at home and the main computer at the remote health center will allow monitoring of patient physical signals and measurements, treatment data, and patient response as well as provide alarms and reports care providers. Consequently, the system will make care for chronic patients becomes safer, faster and more efficient.

*Keywords:telemonitoring,oximetry*

**3. DNA VACCINES**

*Dženana Klepo*

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Abstract - Given the the fact that it is increasingly evident that the molecular approach is the only possible way to prevent and treat certain diseases, role of DNA vaccine in their prevention and therapy is very important. The main goal of DNA vaccination is induction of effective T and B immune response, enhancement of immunogenicity and prevention of the immunotolerance in the light of safety and efficiancy. The nucleic acid–based vaccine works on the principle of encoding intracellular antigens, and this production results in triggering the vaccinated's immune response. One of the most important advantages of DNA vaccines is that immunization has identical reaction as the organism's natural reaction to the infectious agents. DNA vaccination is composed of two related processes: delivery of DNA into the host cells and stimulation of immune response. In this context, the key step is selection of adequate vector for safe and effective DNA delivery into the host cell. Considering the advantages, poxviruses are great vector's candidate in DNA vaccines and gene therapy in general. Here, we discuss about working mechanism, current status and possibilities for improvement in this area of immunogenetic.

*Keywords: DNA vaccine, Plasmid, Vector, Immunotherapy, Immunogenicity, Poxviruses*

## 4. ROLE OF IMAGERY IN PREOPERATIVE EVALUATION OF PARATHYROID LESIONS IN HYPERPARATHYROIDISM

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Abstract - Hyperparathyroidism (HPT) is an endocrine disease characterized by a hypercalcemic state due to hypersecretion of parathyroid hormone. Imaging in parathyroid disease(hyperparathyroidism) is aimed at localizing enlarged parathyroid glands after a biochemical diagnosis of hyperparathyroidism has been made. By precisely identifying the number and location of abnormal parathyroid glands, surgical parathyroidectomy can be considered and planned.

*Keywords: neck sonography, CT, IRM, hyperparathyroidism*

## 5. BIOPHYSICAL AND STRUCTURAL CHARACTERIZATION OF DIPEPTIDYL PEPTIDASE III FROM *PORPHYROMONAS GINGIVALIS*

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Abstract – *Porphyromonas gingivalis* is a gram-negative human pathogenic bacterium. It is found in the oral cavity and is able to break through human gingival fibroblasts causing difficult and painful diseases like gingivitis and periodontitis [1]. It also contains a group of enzymes which belong to the dipeptidyl peptidase III (DPP III) family. This group of enzymes, also known as enkephalinase B, is an enkephalin-degrading enzyme that cleaves dipeptides sequentially from the N-termini of its substrates. All DPPs III described thus far contain the unique zinc binding motif HEXXGH characteristic for the metallopeptidase family M49. DPP III play important role in the mammalian pain modulatory system. This is supported by the finding that low levels of DPP III activity were detected in the cerebrospinal fluid of individuals suffering from acute pain [2]. The function of the DPP III homolog from *Porphyromonas gingivalis* is still unknown, but it could be involved in pathogenicity. We aim at determining potential substrates of this enzyme as well as its three-dimensional X-ray structures in order to obtain information about its potential function. Here, we represent and discuss ITC and SAXS data together with predicted structural model. Additionally, we present findings about potential inhibitor of the enzyme using conformational changes calculated from SAXS measurements.

Keywords: *Porphyromonas gingivalis,* dipeptidyl peptidase III, characterization

## 6. DETECTION OF 3-DIMENSIONAL KINETIC TRAJECTORY OF MEDIAN NERVE BY ULTRASOUND IMAGES AND 3D MOTION TRACKING TECHNIQUE

*Shyh-Hau Wang, Kuan-Yu Liu*

Abstract - Different from typical diagnostics of carpal tunnel syndrome (CTS) by palpation examination, ultrasound image has been shown to be capable of in situ detecting the morphological variations of median nerve (MN) in the wrist for the assessment of CST. Further investigation demonstrated that the kinetic trajectory of MN in response to the palm movement could be a better means for assessing the CTS quantitatively. In the present study, 3-dimensional (3D) correlation coefficient-based motion tracking algorithm (CCMTA) was derived and applied to extensively detect the 3D trajectory motion of MN. The 3D CCMTA was verified by a series of phantom experiments with ultrasound images acquired from a scanner using 12 MHz linear array transducer. Subsequent measurements were performed at the right wrist of 10 asymptomatic volunteers (average age of 24.8). The palm of each participant was placed on a holder and then the movement of palm from 0 degree was extended to 90 degree translated by a stepping motor. Per each flexion angle at 2 degrees, the transducer was translated at 3 cm along the arm direction and the corresponding B-mode ultrasound images were acquired. Furthermore, 3D images associated with different flexing angles of palm movement were reconstructed. 3D CCMTA was applied to detect the trajectory motion of MN. Results showed that median nerve tended to move toward to ulnarpalmar-proximal direction following the palm's flexion. The maximum displacements of median nerve were estimated to be 4.54, 0.51, and 3.24 mm corresponding to ulnar-radial, palmar-dorsal, and proximal-distal directions, respectively. Kinetic trajectory generally followed sigmoidal tendency in the ulnar-radial direction. Consistent results obtained from another estimation using Bayesian-based motion tracking algorithm were also found. In addition to large computation efforts, current study has demonstrated that 3D CCMTA is feasible to be applied to detect the 3D trajectory motion of MN for the CTS assessment.

*Keywords: carpal tunnel syndrome, median nerve, 3D motion tracking, correlation coefficient*

## CLINICAL ENGINEERING AND HEALTH TECHNOLOGY ASSESSMENT

## 1.THE ELECTRODE SETUP FOR VIBRATORY EVOKED POTENTIALS

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Abstract - The difficulties related to the sense of vibration could be characteristics of the specific neurological disorders, so there is a need for measurable and quantifiable information about its functionality. Currently used methods for testing the sense of vibration do not provide appropriate information, and new method of vibratory stimulation was introduced in the area of the neurophysiological research. Method provides repeatable and quantifiable information about the evoked cortical activity, but there was a need for information about the functional integrity of the whole vibratory sensory pathways. The result of this research was the electrode setup that provides information from the Erb's point through the levels of the cervical spine to the contralateral sensory area at the cortex. Also, the setup consists only of four electrodes for each side of the stimulation (six electrodes all together, because electrodes positioned on the cervical spinal cord are common for both sides of the body), which reduce time necessary for preparation and allows better use for clinical purposes.

*Keywords: the sense of vibration, vibratory evoked potentials, vibratory stimulation, number of electrodes*

## 2. A TESTBED EVALUATION OF MAC LAYER PROTOCOLS FOR SMART HOME REMOTE MONITORING OF THE ELDERLY MOBILITY PATTERN

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Abstract - Unobtrusive data collection in a smart home environment can help with performing automated health monitoring and assessment. For instance, changes in mobility patterns which can be related to changes in cognitive abilities or an early sign of depression. In this paper, a system, using paired passive infrared (PIR) sensors at each entry of the house, observes the collective activities of a single resident individual, to model his or her mobility patterns. This system is designed in a manner that, while ensuring reliability and accuracy, reduces possible impacts on the individual's privacy and does not add additional complications to the installation phase. Based on a mobility pattern data collection over a period of three weeks in our smart home testbed, analysis of well-known medium access control (MAC) protocols applicable to the scenario under study is reported. While most of the researches have simulated the existing MAC protocols, we focus on using a real system and traffic pattern. In this research, we set up a testbed which employs PIR sensors to accurately record movements and the activities of our case study for 21 days. Furthermore, to emphasize on the inaccuracy of simulation analysis, we compare our collected data to three suitable MAC protocols, namely X-MAC, RI-MAC and A-MAC, with respect to duty cycle and packet delivery ratio. The acquired results indicate that, by applying real data, the performance of MAC layer protocols is similar. While the simulation analysis of A-MAC shows a higher duty cycle rate to RI-MAC and X-MAC protocols by 16.8 and 23.5 percent, respectively, our real data does not show a similar performance of the three MAC protocols. Additionally, we apply the well-known CASAS project dataset to run further analysis, which shows a similar output to our reported results.

*Keywords: Smart home· Dataset· Testbed· Sensor· MAC layer protocols· PIR.*

## *3. PROPOSAL OF INTEGRATED SOFTWARE SYSTEM FOR SIMULATION AND GIS VISUALIZATION OF ACCIDENTS CAUSED BY EMISSION OF HAZARDOUS GASES*

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Abstract-This paper presents the proposal of integrated software system for simulation and GIS visualization (Geographic Information System) of accidents caused by emission of hazardous gases from industry plants or storage facilities. Two software solutions for modeling, simulation and visualization of the propagation of hazardous gases through the simple (XY) and complex (XYZ) terrain are proposed. Software solution named "XY plume" is based on the use of free and reliable ALOHA and SCREEN3 software's for modeling and simulation of the dispersion of hazardous gases. Proposed solutions use Google Earth, Google Maps and Open-Street Maps Web GIS browsers for visualization and marking. When estimating the zones of air pollution, different types of sources broadcasting are taken into account as well as meteorological conditions at the site of the incident. Calculated danger zones are displayed on Web GIS browser and used in risk assessment and action planning, according to the adopted plans to react in crisis situations. As a mechanism for connecting the dispersion models and Web GIS browsers, Keyhole Markup Language (KML) protocol is used because it can

be activated via any Internet browser. In this way, the simulation results can be used over any computer that has an internet connection as well as through smartphones, tablets, and other devices that have mass application.

*Keywords: software, system, GIS, visualization, simulation, accidents, gas emission, hazardous gases, ALOHA, SCREEN3*

## 4. QUALITY CONTROL OF ANGULAR TUBE CURRENT MODULATION

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Abstract - Automatic exposure control (AEC) techniques in computed tomography (CT) have been defined as automatic modulation of tube current in the *x–y* plane (angular AEC), along the *z*-axis (*z*-axis AEC) or both (combined AEC), according to the size and attenuation characteristics of the body region being scanned. These techniques should provide constant image quality while lowering the radiation dose to patients. Although AEC is an important feature of all modern CT units, standard methodology for quality control of AEC does not exist. Aim of the paper was to provide reliable quality control (QC) method for AEC techniques used in CT. Change of tube current during the CT examination happens only if the scan projection radiogram (SPR) shows different size and attenuation characteristics of the object being scanned. In order to maintain repeatability of the modulation we used standard polymethyl methacrylate (PMMA) dosimetry phantom, placed with flat side along the *z*-axis. After SPR was taken, phantom was removed, and CT solid-state detector was placed in the isocenter. Measurements were performed in axial mode, one slice only, for different positions along the *z*-axis. Dose rates measured in the isocenter, that are proportional to tube current, were found depending on the phantom geometry. In the phantom center the width of rectangle is the same as the diameter of the cylindrical phantom (32 cm), while height corresponds to the cylinder thickness (15 cm). Results show that during the rotation the current is highest when the tube is positioned at the x-axis, and lowest when tube is crossing the *y*-axis. However, when the detector is moved to position *z* = 14.1cm, tube current (air kerma rate) does not change during the rotation. The methodology presented in this study could be used as a basis for defining the QC procedure for TCM. The results are consistent with the expected outcomes.

*Keywords: quality control, tube current modulation, computed tomography, dosimetry, radiation*

## 5. LEGAL METROLOGY: MEDICAL DEVICES

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Abstract - Medical devices with measuring function are regularly used in healthcare systems all over the world with the aim of prevention, diagnosis, and treatment of diseases. Considering the importance of these devices in daily activities of medical professionals and impact of their measurements on the health of patients, safety and accuracy of their measurements is becoming the topic of interest. Numerous international guidelines define how healthcare institutions should perform these conformity assessment but in some countries, where those

guidelines are not adopted, it is necessary to implement directives of new approach for various groups of medical devices. Directives of new approach in terms of medical devices and their conformity assessment can be implemented in the area of legal metrology, as it is done in Bosnia and Herzegovina. This paper presents achievements and activities of Institute of Metrology of Bosnia and Herzegovina (IMBIH), the competent state authority for metrology in Bosnia and Herzegovina, in the area of legal metrology for the particular group of medical devices with measuring function. These achievements and activities refer to the adoption of appropriate legislation for type approval, verification, and creating an adequate legal framework for controlling medical devices after they are sold on the market. In addition, considering complexity and variety of medical devices related to measuring characteristics, and also due to the problem of inadequate or not defined traceability routes, the medical devices will continue to be in focus of metrological practice and science. Establishing the comparative approach to the type approval for these devices in the area of the legal metrology is the final aim.

*Keywords: conformity assessment, legal metrology, medical devices, type approval, verification*

## 6. DIAGNOSIS OF CHRONIC KIDNEY DISEASE BY USING RANDOM FOREST

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Abstract - Chronic kidney disease (CKD) is a global public health problem, affecting approximately 10% of the population worldwide. Yet, there is little direct evidence on how CKD can be diagnosed in a systematic and automatic manner. This paper investigates how CKD can be diagnosed by using machine learning (ML) techniques. ML algorithms have been a driving force in detection of abnormalities in different physiological data, and are, with a great success, employed in different classification tasks. In the present study, a number of different ML classifiers are experimentally validated to a real data set, taken from the UCI Machine Learning Repository, and our findings are compared with the findings reported in the recent literature. The results are quantitatively and qualitatively discussed and our findings reveal that the random forest (RF) classifier achieves the near-optimal performances on the identification of CKD subjects. Hence, we show that ML algorithms serve important function in diagnosis of CKD, with satisfactory robustness, and our findings suggest that RF can also be utilized for the diagnosis of similar diseases.

*Keywords: Chronic kidney disease (CKD); Machine learning; Artificial Neural Networks (ANNs); Support Vector Machines (SVM); k-Nearest Neighbour (kNN); C4.5 Decision Tree; Random Forest (RF).*

## 7. GLOBAL SURVEY ON BIOMEDICAL ENGINEERING PROFESSIONALS IN HEALTH TECHNOLOGY ASSESSMENT

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Abstract - One of the projects of the Health Technology Assessment Division of the International Federation for Medical and Biological Engineering is a global survey on biomedical engineering (BME) professionals in health technology assessment (HTA). The data used in this work were derived from the main findings of the 2015

Global Survey on Health Technology Assessment by National Authorities carried out by the World Health Organization, and from the web data provided by the Croatian national authorities or Official Gazette publishing Croatian legislation. Globally, the numbers and proportions of professionals grouped as biomedical and/or clinical engineers, lawyers and librarians/information specialists involved in HTA reporting and decision making appear unacceptably low, even in case of medical devices (~20%). The situation at the national level seems to be worse. Crucial importance of medical devices and other substantially engineeringrelated health technologies in modern biomedicine and healthcare urges further surveying on BME professionals in HTA.

*Keywords: biomedical engineering, medical device, health technology, health technology assessment, World Health Organization, International Federation for Medical and Biological Engineering, Health Technology Assessment Division , project, survey*

**HEALTH INFORMATICS, E-HEALTH AND TELEMEDICINE**

## 1. USING INFORMATION AND COMMUNICATIONS TECHNOLOGY AS AN ENABLER FOR DESIGNING AN EFFICIENT NATIONAL LEVEL VACCINATION PLANNING AND DISPENSING SYSTEM

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Abstract - This paper presents a system that enhances the effectiveness of a national vaccination planning and dispensing system for countries where the Government has been spending huge resources with not much success in out reaching vaccination programs to remote places and to all inhabitants. This study focuses on finding the shortcomings and gaps being faced during vaccinating children in Pakistan. The case study for Pakistan has been done by performing requirement engineering and considering many factors relating to people behavior and attitude and based on the study designing a system by using Information and communications technology as an enabler to address all gaps and shortcomings while ensuring human factors are tackled by the technology. The design guarantees proper scheduling, execution and monitoring of every child's vaccination schedule as well as events generation to ensure it is enforced right from its birth hence resulting in clean sweep of infectious diseases and making Pakistan an example for other developing countries to follow. The system also gives visibility to the decision makers for gauging the efficacy of the system. It helps them to take managerial decisions and steps to ensure that vaccination programs are executing with maximum benefits in response to the immunization improvement program.

*Keywords: Child vaccination, Healthcare, Health informatics, Electronic medical record, ICT*

## 2. WIRELESS BODY AREA NETWORK STUDIES FOR TELEMEDICINE APPLICATIONS USING IEEE 802.15.6 STANDARD

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Abstract-Wireless communication is becomming a part of our life at every step. But widespread use in medical applications is yet to come. We are developing a wireless communication system based on 802.15.6 MAC and 802.15.4 PHY for use in transmitting ECG data from a remote patient monitroing device which is used for home

based telemedicine applications. The paper concentrates on explaning the stack program development phases of the standard IEEE 802.15.6 and it is flexible access features. It is believed that the subjected standard is going to provide a medical data highway in its reserved bands.

*Keywords: Wireless, Network, Telemedicine*

## 3. REAL-TIME MONITORING OF ST CHANGE FOR TELEMEDICINE

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Abstract - Modern medical breakthroughs and general improvements in environmental and social conditions have raised the global life expectancy. As the world's population is aging, the incidence and prevalence of chronic diseases increases. Dramatic increase in the numbers of chronically ill patients is profoundly affects the healthcare system. Care at home provides benefits not only to patients but also the community and the health care providers. A telemedicine system utilizing today's information and mobile communication technologies plays a crucial role in providing care at home. Currently, diverse telemedicine projects are progress in the most countries. A telemedicine project is supported by The Scientific and Technological Research Council of Turkey (BK under rant 11E52 in Turkey. This project aims end to end remote monitoring of patients with chronic diseases such as heart failure, diabetes, asthma, and high blood pressure. A clinical decision support system integrated to telemedicine improves prognosis and quality of life in patients. The mainstay of a decision support system is early detection of important clinical signs and prompts medical intervention. Cardiovascular diseases are the leading cause of death globally. People with cardiovascular disease need early detection. An effective decision support system is needed to detect ECG arrhythmia before a serious heart failure occurs. One of the aims of the project is to develop decision support system which will detect whether a beat is normal or arrhythmia. The ECG signals in MIT-BIH arrhythmia database and Long Term ST Database are used for training and testing the algorithm. A total of 103026 beat samples attributing to fifteen ECG beat types are selected for experiments in MIT-BIH arrhythmia database. 103026 RR intervals with ST segment change were selected from the Long Term ST Database. ST segment changes detection is just based on the signal between two consecutive R peaks. The features are obtained from Wigner-Ville transform of this signal. The classification algorithms provided by the MATLAB Classification Learner Toolbox were tested. The Cubic SVM achieved best results with accuracy of 98.03%, sensitivity of 98.04%, specificity of 98 % and positive predictive value of 98%.

*Keywords: Telemedicine, Electrocardiography(ECG), ST Segment, Wigner-Ville Distribution, Myocardial ischemia*

## 4. ANTIHYPERTENSIVE THERAPY DOSAGE CALCULATOR

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Abstract - Hypertension is defined as values 10mmHg systolic blood pressure andor 0 mmHg diastolic blood pressure. Pharmacological and non-pharmacological therapy is used in treatment of hypertension. Non-pharmacological therapy (lifestyle changes) is extremely important and represents the foundation for the treatment of hypertension. Pharmacological therapy refers to the administration of antihypertensive drugs, which, however, includes a large group of drugs. In internist everyday practice, in revisions of patients therapy, and in the work of physicians, family medicine specialist, on a daily basis a need for modification of therapy occurs (primarily due to unregulated pressure, then due to side effects that can happen in use of certain treatment, or because of drug interactions, which can lead to poor quality of treatment). In this modification of therapy or switching one drug to another there is a need for knowledge of equivalence doses of certain drugs. Individualization of therapy for the patient is a trend that will certainly in future even more come to the fore. Number of mobile clinical decision support systems is on the rise due to availability and ease of use. The antihypertensive therapy dosage calculator would be modeled as a cross platform mobile application targeting the two predominant mobile platforms, iOS and Android.

*Keywords: hypertension, antihypertensive therapy, mobile application*

## 5. STROKE CENTER HEART RATE DATA ACQUISITION

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Abstract.-The advancement of embedded system technologies, sensing techniques and wireless technologies provide new possibilities to monitor human activities at all times. This paper focuses on Heart Rate Data acquisition and management as a part of the Stroke Center project which is currently being developed. Non-intrusive wearable heart rate sensors monitor patients and detect abnormal situations. Data is analyzed and sent in real time in order to provide necessary help when it is needed. The Stroke Center framework is briefly described in this paper with guidelines for future work.

*Keywords: Stroke Center; heart rate; telemedicine; wearable sensors; internet of things; photoplethysmograph; gps; gsm;*

## 6. HEALTH SERVICE QUALITY MEASUREMENT FROM PATIENT REVIEWS IN TURKISH BY OPINION MINING

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Abstract - Measuring the customer satisfaction is one of the most important aspects for every successful enterprise trying to improve its service quality, so accumulating reviews is highly encouraged. However, as the

number of reviews expand it is crucial to develop effective sentiment analysis systems capable of classifying the comments to accomplish further analysis. This is one of the rare studies analyzing health service contentment, especially in Turkish. Positive and negative comments collected from patients were used to train and test a classification system by using machine learning methods such as Naive Bayes, Support Vector Machine (SMO) and J48 tree algorithms, resulting in instantaneous and high average prediction rates varying between 90.4% to 95.8%.

*Keywords: Text classification, Turkish, sentiment analysis, opinion mining, health care reviews classification*

### 7. E-MEDICAL TEST RECOMMENDATION SYSTEM BASED ON THE ANALYSIS OF PATIENTS' SYMPTOMS AND ANAMNESES

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Abstract - This paper demonstrates an e-medical test recommendation system based on the analysis of patients' symptoms and anamneses. The exact test selection for a specific patient can be time consuming and error-prone due to the huge amount of information to be considered like: the number of tests, patients, long working hours, exceptional cases, etc. The redundant or missing tests can cause serious loss of money, time and more seriously delay in the initiation of the therapy. The study aims to provide a fast and cost effective system for the medical experts and patients. The data are collected from the patient records of a private hospital, preserving anonymity, from all departments. Only the internal medicine department data are utilized. The patients' age, gender and the words used in the anamneses and symptoms as plain text are the input for the system. The texts are analyzed and various methods have been applied for selecting the effective words for recommending a specific medical test. These terms, along with the demographic information, are used as the features of the well-known machine learning algorithms of WEKA [5], namely Sequential Minimal Optimization (SMO), J48, Random-Forest (RF), Bagging (Bagg), ADTree (ADT) and AdaBoostM1 (ABoost). The number of medical tests that are applicable in the hospitals is too high, therefore only 20 most frequently required ones are selected. The promising results of the study indicated that the symptoms given as plain text can be efficiently utilized by the experts for medical test selection.

*Keywords: e-Medical Test Recommendation, Natural Language Processing, Morphological Analysis, Machine Learning*

## PHARMACEUTICAL ENGINEERING

### 1. EFFECTS OF VARIOUS METAL AND DRUG AGENTS ON EXCRETION OFENZYME ASPARTYL PROTEINASE IN *CANDIDA ALBICANS* AND ITSROLE IN HUMAN PHYSIOLOGICAL PROCESSES

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Abstract - *Candida albicans*, the polymorphic fungus that colonizes mucosa of mouth and gastrointestinal tract, is a member of normal microbiota. However, under special circumstances, this microorganism can switch from harmless, commensal into invasive, opportunistic pathogen, causing even life-threating infections in humans. Aspartyl proteinase is an enzyme that acts as one of the cruical virulence determinants of *Candida albicans* and is involved in tissue degradation and dissamination of infection characteristic for oropharyngeal or vaginal candidasis. In our study we investigated influence of different agents, metals and drugs, on fungal excretion of aspartyl proteinase. We could see that already know degradation of human proteins caused by microbial proteinases can be enhanced due to stimulatory effect of iron metal ions and analgesics. These agents significantly increased secretion of aspartyl proteinase and enhanced virulence mechanism of *Candida albicans.*

*Keywords: Candida albicans, Aspartyl proteinase, Virulence, Metal and drug agents, Human diseases.*

## 2. PASSIVE ABSORPTION PREDICTION OF TRANSDERMAL DRUG APPLICATION WITH ARTIFICIAL NEURAL NETWORK

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Abstract -The modernization of IT leads to an improvement in numerous segments of the pharmaceutical activities. Thus, new field, pharmaceutical engineering was formed. Drug design is segment of it. Within that, the artificial neural network (ANN) possibility to determine the most suitable drug molecule for a transdermal administration is tested. Transdermal preparations industry is predicted to be worth cca 81.4 billion US dollars by 2024. This approach to drug design should be increasingly used due to convenience and costeffectiveness of the method. The ANN was developed and trained by inserting over 500 dataset. The set included physiochemical parameters of drug molecule (molecular mass, melting point and partition coefficient), pharmacokinetic parameters (elimination half-time, dose and bioavailability) and biological parameters (skin permeability and coefficient of skin permeability). These parameters endeavored drug classification in one out of two success categories, respectively whether transdermal administration is possible or not. Various types of ANN were tested in order to acquire best accuracy and reliability. Types of ANN that resulted with accuracy above 95% have been considered. Sensitivity analysis of output variables related to input, suggested that certain parameters are more significant. Lastly, selected ANN had highest accuracy and least input parameters. Effect of overfitting was avoided while training selected ANN with highest accuracy. Based on the results of this study, ANN could be successfully used for predicting passive absorption of drug molecule through transdermal application. In addition, ANN could be used in order to facilitate processing large number of data. Hence, predicting mode of application for drug administration.

*Keywords: neural networks, transdermal drugs, passive absorption, coefficient of permeability of the skin, the pharmaceutical engineering.*

## 3. PRACTICAL TRANSPORT OPTIMIZATION METHOD AND CONCEPT IN PHARMACEUTICAL INDUSTRY

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Abstract - The application of computer skills and technologies in modern business is essential in modern society, therefore different methods and algorithms are used for the business optimization. This paper primarily focuses on solving the transportation problem of the linear programming for the purpose of the transport optimization, which ultimately leads to the competitive advantage for any institution which performs any type of transport as a part of its business. Therefore, specially implemented Java program for the purposes of pharmaceutical institutions will be presented. The need to optimize the product transport from the producer to the consumer is of a great importance for any company, including pharmaceutical one. The aim for solving the transportation problem is the application of algorithms over real data from the appropriate database of the merchandise management in order to optimize the transport of medicines and other pharmaceutical products from the factory to pharmacies or other institutions.

*Keywords: Transport optimization, Pharmaceutical industry, Linear programming, Java programming*

**4. ANTIPROLIFERATIVE EVALUATION AND DOCKING STUDY OF SYNTHESIZED BISCOUMARIN DERIVATIVES**

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Abstract - The coumarin derivatives are quite interesting objects for both synthesis and pharmacological screening. Major problems in medicine today include resistance to drugs, where a number of enzymes and receptors important for the tumour cell cycle progression may be considered as potential targets for new drugs. Presented study was aimed to evaluate *in vitro* antiproliferative effects of previously synthesized benzylidene-bis-(4-hydroxycoumarin) derivatives and fused benzopyranocoumarin derivatives. Compounds were tested on HeLa, SW620, MiaPaCa-2, MCF-7, HepG2 and WI-38 cell lines. The most potent compounds were subjected to molecular docking simulations in order to reveal binding modes and mechanism of interaction of synthesized compounds with target receptors. Furthermore, physicochemical properties included in Lipinski's rule of 5 and polar surface area were calculated to determine compounds' solubility properties and their appropriateness for oral intake in humans.

*Keywords: benzylidene-bis-(4-hydroxycoumarin) derivatives, fused benzopyranocoumarin derivatives, antiproliferative evaluation, docking study, bioavailability*

**5. BLOOD GROUP, HYPERTENSION, AND OBESITY IN THE STUDENT POPULATION OF NORTHEAST BOSNIA AND HERZEGOVINA**

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Abstract - The ABO and Rh blood group are the most important systems with various distributions reported for different populations. The ABO and Rh are known also to be associated with various diseases. Obesity is a complex chronic disease involving environmental, genetics, physiologic, metabolic, behavioral, and psychological components. The present study is aimed to explore the association and distribution of the ABO/Rh blood type and the risk of hypertension and obesity among students population. The study group consisted of 100 examinees, 14 males and 86 females, students aged 18 – 23. The blood group A was found to be the most prevalent (46 %), while the blood group AB was found to be the least prevalent (6%). The highest average value of the BMI was found in subjects with the blood group AB/Rh+ 22.36 ± 2.49 kg/m2 where the lowest value was in the blood group B/Rh+ 20.13 ± 2.64 kg/m2. The highest average value of systolic blood pressure was measured in subjects with A/Rh- 138.88 ± 16.63 mm Hg, while the lowest was in the blood group B/Rh- 118.50 ±7.55 mm Hg.

*Keywords: ABO, Rh, blood groups, body mass index (BMI), hypertension*

## 6. THE ROLE OF POPULATION PHARMACOKINETIC ANALYSIS IN RATIONAL ANTIBIOTIC THERAPY IN NEONATES

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Abstract - Due to dynamic maturational changes in neonatal life, changes in pharmacokinetic (PK) and pharmacodynamic (PD) processes of drugs administered to neonates are expected. However, children are mostly treated off-label, i.e. without testing the drug in children but based on the extrapolation of data from adults. For the optimisation of dosage regimens in neonates, besides Therapeutic drug monitoring (TDM) and a Bayesian feedback algorithm, population PK approach became relevant. Population PK modeling is a stepwise approach with building of structural and covariate models, model evaluation and simulations resulting in estimation of the population mean values of PK parameters such as clearance and volume of distribution, their inter- and intra-individual variabilities, covariates as well as on simulation-based optimised dosing proposals. The relevance of those approaches in overcoming gaps between realistic and feasible in-practice situations while

performing PK studies in children, and taking into account ethical requests to minimise the number of studies in children and to minimise the number of children recruited to studies is also recognised by the authorities. In this article, we aimed to emphasise the importance of the research and of the population PK approach in the improvement of rational antibiotic therapy in neonates and to illustrate this with some specific compounds. For this reason, we gave a short overview of the population PK studies of the most frequently used antibiotics in European neonatal intensive care units. As final results of performed population PK analyses, optimised dosing regimens were proposed for rational antibiotic treatment and prophylaxis of neonates.

*Keywords: Drugs, Population pharmacokinetics, Neonates, Antibiotics, Drug dosing guidelines*

## 7. THE RATIO OF HEMATOLOGICAL PARAMETERS AND MARKERS OF INFLAMMATION IN PATIENTS WITH IRON DEFICIENCY AND PERNICIOUS ANEMIA

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Abstract-Pernicious anemia is an autoimmune megaloblastic and macrocytic anemia, characterized by a deficiency of vitamin B12 and the absence of internal factors in gastric juice. In this type of anemia values of red blood cells and hemoglobin are reduced, and it is followed with a slight decrease in the number of leukocytes and platelets, and granulocyte nucleus hypersegmentation. Observations of the peripheral blood smear clearly show: microcytosis, hypochromia, anizocytosis, poikilocytosis. Iron deficiency anemia (IDA) is a condition in which blood lacks adequate healthy red blood cells due to insufficient iron. In the peripheral blood smear of IDA patients, following is clearly observed: microcytosis, hypochromia, anizocytosis, poikilocytosis.The number of red blood cells is reduced, disproportionate in relation to the reduction of hemoglobin, while the values of leukocytes and platelets is usually normal.

*Keywords: anemia, microcytosis, hypochromia, anizocytosis, poikilocytosis*

## 8. TYROSINASE RELATED ACTIVITY OF 2,2'-(ARYLMETHYLENE)BIS(3-HYDROXY-5,5-DIMETHYLCYCLOHEX-2-ENONES) – DOCKING STUDY

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Tyrosinase is a glycosylated and copper-containing oxidase, which catalyzes the first two steps in mammalian melanogenesis (formation of the melanin from tyrosine). Melanin is important biological pigment for protection against ultraviolet irradiation (UV) and responsible for the color of the skin. However, with increase of melanin it is possible to generate melanoma, a form of the skin cancer. Therefore, tyrosinase inhibitors are widely used in dermatological treatments and also applied in cosmetics. The specific tyrosinase inhibitors should be catalyzed by tyrosinase and form covalent bond with the enzyme, thus irreversibly inactivating the enzyme during catalytic reaction. Also, some chemical compounds reversibly bind to tyrosinase and reduce its catalytic capacity, and

they could also be recognized as specific tyrosinase inhibitors. Seven 2,2'-(arylmethylene)bis(3-hydroxy-5,5-dimethylcyclohex-2-enones) were previously synthesized and evaluated in vitro as tyrosinase inhibitors or activators. This study simulated docking affinities of synthesized derivatives as ligands to tyrosinase, providing binding energies and sites of interaction. Additionaly, docking study was performed for new 2,2'-(2-chloro-6-fluorophenylmethylene)bis(3-hydroxy-5,5-dimethylcyclohex-2-enone) revealing site of interaction and binding energy, suggesting that this derivative could have similar effects on tyrosinase. Synthesis and further biological in vitro evaluation of this derivative are needed to confirm finding of the docking study. Conflict of Interest: The authors declare no conflict of interest.

*Keywords: tyrosinase, docking, inhibitors, activators*

**GENETIC ENGINEERING**

## 1. FREE FATTY ACID PROFILE IN TYPE 2 DIABETIC SUBJECTS WITH DIFFERENT CONTROL OF GLYCEMIA

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Abstract - Type 2 diabetes (T2D) as a multifactorial disease is characterized not only by chronic hyperglycaemia but also with defects in lipid and protein metabolism. These defects impact the utilization of glucose and non-esterified —free— fatty acids (NEFA) by muscle, liver, and adipose tissue. Free fatty acids (FFA) represent an important link between obesity, insulin resistance, and T2D. Eleveted plasma concentration of FFA (especially saturated FFA) is associated with impaired insulin secretion and sensitivity and glucose intolerance. The major objective of the present study was to investigate association of plasma free fatty acid profile in Type 2 diabetic subjects with different control of glycemia. This study involved 40 patients with T2D and 40 healthy subjects. Preparation of samples for FFA analysis was done by extraction and methanolysis of plasma lipids while detection and quantification of FFA concentrations was done by gas chromatography/mass spectrometry. Other biochemical analyses, including glucose, glycated hemoglobin (HbA1c), cholesterol, and triglycerides were done according to standard IFCC methods. A significant difference between T2D and control subjects was demonstrated only for palmitic acid (C16:0). There was a significant correlation of C16:0 with HbA1c levels ($p$<0.001) in patients with both adequate and poor T2D control. Also, a significant correlation was obtained at a level of plasma C18:1(p<0,05) and HbA1c level, only in patients with inadequate diabetes control. Thus, our data suggested that palmitic fatty acid (C16:0) and (C18:1 ) could serve as a potential biomarkers in optimal T2D management.

*Keywords: free fatty acid, Type 2 diabetes, control of glycemia*

## 2. A DISSIMILAR APPROACH TO ASSOCIATING ANGIOTENSIN CONVERTING ENZYME POLYMORPHISMS

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Abstract - Angiotensin I converting enzyme (ACE) gene, as a component of Renin-Angiotensin System (RAS), regulates blood pressure as it converts somatic isozyme Angiotensin I into physiologically active peptide Angiotensin II and simultaneously brakes down bradykinins. Over 100 polymorphisms are reported for ACE gene. Most of these polymorphisms having no phenotypic effect relay the attention towards polymorphisms based on insertions (I) or deletions (D) of a 287 bp Alu repeat sequence in 16th intron. There are three possible genotypes for the stated polymorphism: DD, DI or II. There have been a lot of studies searching for direct associations between ACE polymorphisms and performance phenotypes along different sports requiring power or endurance. The previous experiments are based on the performance criteria but direct associations of ACE polymorphisms are not fully understood until today. We believe different approaches may aid scientist to plot the big picture. A sample population of 101 individuals from Bosnia and Herzegovina contributed to sample pool of the initial project. Buccal swabs from 101 samples were collected along with a phenotypic structure and environmental characteristic survey which was filled by each individual himself/herself. Genotypes of the individuals were obtained after isolation, amplification and gel electrophoresis of biological samples collected as buccal swabs. A total of 165 artificial neural network (ANN) models were developed considering the input parameters, possible genotype outputs, applied algorithm and sample size. The aim of developing various ANNs was to validate a possible ACE polymorphism genotype prediction algorithm based on phenotypic and environmental characteristics of individuals, in other words, without any biological testing. A two-layered feedforward network, with sigmoid hidden neurons was designed to perform the classification of input data. Trainscg (Scaled Conjugate Gradient) activation function was used in hidden layer since classification of data was non-linear. All ANN models were trained with scaled conjugate gradient backpropagation. ANN models differing in the parameters has shown different accuracy in the results. Most outstanding result was observed in the ANN build composed of 2 distinctive layers with 500 neurons in the first and 3 neurons in the second layer. Trained with 70% of samples and verified with 15% of samples and validated with an additional 50 samples. Training set was composed of the following subject parameters; gender, eye color, hair color, height, weight, presence of hypertension in family and presence of cardiovascular diseases in family. The highest prediction accuracy was obtained as 86,6 % training score, 78,6 % testing score and 80,2 % overall score in genotype prediction for ACE polymorphisms. With further development of data collection and high resolution analysis, overall score could be boosted. Also, phenotypical data can be applied as markers of genotypes in ACE polymorphisms.

*Keywords: ACE Gene, Polymorphisms, Artificial Neural Networks, Genotype Prediction*

## 3. CLONAL SELECTION OF AUTOCHTHONOUS GRAPE VARIETY VRANAC IN MONTENEGRO

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Abstract - Vranac is very important grape variety within Montenegrin autochthonous assortment and it is one of the most significant for viticulture and winemaking sector in Montenegro. Grape of this variety is used for production of top quality red wine which is much appreciated at domestic and foreign market. Old grape varieties that have been cultivated for a long time on a specific area, such as Vranac, are characteristic by their heterogeneity in term of manifesting their features that gradually lead to degradation of grape variety. Because

of that, within those appreciated grapevine varieties, there was a need for clonal selection in aim of certain vines separation which have positive mutations of some economically important traits. Work on clonal selection has started in 2004 in order to separate the best vines within population of grape variety Vranac. During multi-year (2004-2014) work on clonal selection of grape variety Vranac in Montenegro it was selected and recognized seven clones of this variety (Vranac clone 1, Vranac clone 2, Vranac clone 3, Vranac clone 4, Vranac clone 5, Vranac clone 6 and Vranac clone 7). Paper presents agro-biological, economic and technological features of Vranac clones comparing to population of variety. Selected clones surpassed population of variety in some of parameters of yield and grape and wine quality and based on that were recognized.

*Keywords: grapevine variety, Vranac, population, clonal selection, clone, yield, quality, wine*

## 4. SUCCESSFUL COLLECTION OF STEM CELLS IN ONE DAY IN THE PROCESS OF AUTOLOGOUS STEM CELL TRANSPLANTATION

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Abstract - Autologous stem cell transplantation (ASCT) is an established treatment for patients with hematologic malignancies. The minimum CD34+ cell dose needed to ensure hematopoietic recovery following ASCT is 2x106 cells/kg. The aim of this paper is to prove that absolute number of cells (ANC) CD34+>=20,01x106/L in the peripheral blood is confirmation of successful collection. The study was a retrospective-prospective. We analysed 44 patients Myeloma Multiplex 23(33.3%), Hodgkin lymphoma 29 (42.0%), non-Hodgkin Lymphoma 17 (24.6%) with 69 apheresis conducted in the process of autologous stem cell transplantation at Haematology clinic KCUS in the period from April 2013 to October 2016. Patients were divided into two groups: collection of CD34+<2.0x106/kg and >=2.0x106/kg in one day. Independent variables analyzed were: CD34+cell dose in peripheral blood in one collection, age, gender and diagnosis. The average age of patients was 45 ± 16.03 years. Youngest patient was 18 and the oldest was 67 years. There were 52.3% male patients and 47.7% female. Collection of CD34+ <2.0x106/kg occurred in 20 (27.5%) cases and 49 (72.5%) had CD34+≥ 2.0. In the group with CD34+ ≥2.0x106/kg there were 91.8% with ANC CD34+ ≥20.01 x106 /l in peripheral blood. Only three collections of CD34+ >=2.0x106/kg had values in peripheral blood ANC CD34 + from 15.01 to 20.00x106 /l and only one collection ANC CD34+ between 10.01 and 15.00 x106 /l. Displayed difference is statistically significant p=0.0001. We used the c2 test, Kolmogorov Smirnov and MannWhitney U test. P<0.05 was considered significant. Successful collection is guaranteed at ANC CD34+ >= 20.01 x 106/L in the peripheral blood.

*Keywords: CD34+ cells, peripheral blood, collection*

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