BEB
Conference on Biomedical Engineering and Biotechnology

The 11th International Conference on Biomedical Engineering and Biotechnology (ICBEB 2022)

The 5th China Physiological Signal Challenge (CPSC 2022)

The 2nd International Conference on Medical Imaging Science and Technology (MIST 2022)

Abstract Proceeding

November 15-18, 2022

Online via Microsoft Teams

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Part I – Oral Presentations

Oral Session 1: Biomedical Signal Processing and Medical Information

BEB6584: Research on Magneto-Acoustic Imaging under Chirp Current Excitation

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Abstract. Magneto-acoustic signals reflect the electrical properties of tissues, which is meaningful for the diagnosis of tumors, bleeding and other diseases. The low signal-to-noise ratio (SNR) of magneto-acoustic signals limits the image quality of magneto-acoustic imaging. A chirp coded excitation signal processing method for magneto-acoustic imaging is proposed in this paper. The SNR of magneto-acoustic signal is improved. In this paper, magneto-acoustic signals under different pulse widths chirp coded excitation are studied by simulation and experimental measurement. The SNRs of magneto-acoustic signals are increased by 7.5, 16.3, 42.2, and 90.1 times under 10μs, 20μs, 50μs and 100μs chirp excitation respectively, for the beef and copper ring sample. At the same time, the processing time was significantly shortened to 1.2% of the average method under the single pulse excitation. The chirp coded method is of great significance to improve the SNR of magneto-acoustic signals, image quality and imaging efficiency.

Keywords: Magneto-acoustic Imaging; Chirp Signal; Coded Excitation; Pulse Compression; Signal-To-Noise Ratio (SNR).

BEB6973: Classification of Heart Sounds Based on Topological Data Analysis Method

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Abstract. Topological data analysis (TDA) method could catch the rich geometric and topologic information of big data and find subtle differences between different signals. TDA method opens up a new way for biomedical data analysis. In this study, we applied TDA method for heart sound signals (PCG) classification. First, the sliding window method was used to build a point cloud. Then, the persistent barcode is extracted from the point cloud by using the topology technology Vietoris-Rips (VR) filtration. At last, GoogLeNet transfer learning model was applied for classifing. The proposed the model did work well on the 2016 PhysioNet/CinC challenge dataset, $Se = 99.30\%, +P = 99.57\%, F1 = 99.44\%, mAcc = 99.47\%$. The results showed that TDA can be used for the analysis of physiological signals in large quantities. The proposed method in this study has opened a new space for the application of TDA methods in physiological signal analysis.

Keywords: Topological Data Analysis; PCG; VR Filtration; Persistent Barcode

BEB6800: Design and Development of a Novel TCM Medical Music Electroacupuncture Portable Apparatus

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Abstract. Electroacupuncture is an effective therapy method in Traditional Chinese Medicine (TCM), but the monotonic repeatability of stimulus signals may face problems due to the body's tolerance. Music therapy is a widely used method for targeting mental and neurological diseases. Music electroacupuncture combines the advantages of these two therapies by using the variability of music to deal with the tolerance problem. Presently, the stimulus signals of the music electroacupuncture devices are filtered from music, and the frequency of the electric plus is not easy to control. In this pursuit, a new processing circuit of music electroacupuncture signal was proposed using a novel portable music electroacupuncture apparatus based on the Chinese Medical music therapy. Specifically, as the stimulus signal changes synchronously with the music, the frequency of the stimulus plus signal can be flexibly controlled. Using headphones, a selected synchronous intervention music and electrical stimulation worked synchronously to achieve the therapeutic effect of physical and mental harmony. Experiments and measurements confirmed that the stimulation parameters of the proposed electroacupuncture apparatus in this study met the provisions of relevant standards, and the stimulation output was safe and reliable. Furthermore, it offered better and more comfortable body feelings, compared to other music electroacupuncture methods.

Keywords: Music Electroacupuncture; Stimulus Signal Parameters; Needle Tolerance; Synchronous Therapy; TCM Medical Music

BEB6908: Automatic Epilepsy Source Localization from Non-Invasive Scalp EEG Based on Patient-Specific Head Model and Multi-Dipole Model

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Abstract. Epilepsy is one of the five major neuropsychiatric diseases in the world with a prevalence of 0.5%-1%. Among various types of epilepsy, medically intractable epilepsy cannot be controlled with antiepileptic drugs and requires surgical resection of the epileptic onset zone(EOZ). Therefore, precise localization of the EOZ is necessary before the surgery. Due to the advantages of non-invasive and high temporal resolution, scalp electroencephalogram (EEG) is the first choice for the neurosurgeons and researchers in the problem of the epileptic onset localization. In addition, different from other neurological disorders, the causes of epilepsy vary greatly among individuals. The localization results obtained by traditional algorithms will produce errors, which is not conducive to assist doctors in making surgical plans.
We retrospectively collected 15 patients with focal epilepsy and 15 age-matched health controls. The epilepsy patients were eventually implanted stereoelectroencephalogram(SEEG) to determine the EOZ. Firstly, the patient-specific head models were reconstructed from T1 MRI and subdivided by boundary element method(BEM). Due to the characteristic of the focal seizure, the multi-dipole algorithm was selected to locate the EOZ. It was confirmed that the multiple-dipole algorithm with the realistic individual head model may reduce the number of implanted electrodes by 14%. Secondly, we divided the whole brain into 68 areas according to the Desikan-Killiany map to construct the functional connect network. It is obtained that the connectivity of the network is enhanced at the EOZ and the abnormal discharge of the EOZ may involve the surrounding brain area. Meanwhile, the result provides a more intuitive head model and a more accurate EOZ localization for assisting the clinical diagnosis.

Keywords: Inverse EEG Problem; Epileptogenic Focus; Realistic Head Model; Multi-Dipole Algorithm; Functional Connectivity Network; Epilepsy

BEB6957: ECGsound for Human Identification

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Abstract. Novel biometric systems have emerged in recent years as an alternative or complement to traditional identification systems based on passwords (something you know) or tokens (something you have). In this sense, biopotentials signals such as electrocardiograms (cardiac signal) or electroencephalograms (brain signals) have attracted many researchers' attention. This work proposes an innovative identification technique based on electrocardiograms (ECGs) and musical features (e.g., dynamics, rhythm or timbre) commonly used to characterise audio files. In a nutshell, after pre-processing ECG recordings, we transform them into audio wave files, split them into segments, extract features into five musical dimensions and finally fed a classifier with these instances. The proposal's workability is confirmed by experimentation using the MIT-BIH Normal Sinus Rhythm Database with 18 subjets and offering an accuracy of 96.6 and a low error rate with FAR and FRR 0.002 and 0.004, respectively.

Keywords: ECG; Audio; Biometrics; Identification; Artificial Intelligence; Pattern Recognition

Acknowledgements: This work was supported by Leonardo Grant for Researchers and Cultural Creators, BBVA Foundation (P2019-CARDIOSEC); by the Spanish Ministry of Science, Innovation and Universities grant PID2019-111429RBC21(ODIO); and by the Comunidad de Madrid (Spain) under the project CYNAMON (P2018/TCS-4566), co-financed by European Structural Funds (ESF and FEDER).

BEB6958: Force Utilization in Structural Analysis of Human Hand Model Identified from EMG Signal Processing

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Abstract. Hand is one of the primary sense organ of humans and reported as man's outer brain. Man's functional aspect deteriorates when he loses his hand. Study reveals that more than three million people suffer from hand amputation due to accidents, disorders and congenital deficiency. Prosthetic hand revives the confidence of amputees.
This study involves a pipeline consisting of building a hand model and integration of signal processing environment. A hand model using CATIA with exact measurement of the human hand is developed. The kinematics of the prosthetic hand for basic hand actions in MATLAB Simscape toolbox is studied. The model validation is carried out in ANSYS environment by analysing the deformation and strain for the applied force.
The signal-processing domain in this work makes use of the electromyographic (EMG) signal from the upper limb muscle as the prime source of information. A single channel EMG acquisition system with amplifier captures the EMG signal. Detrending fluctuation analysis-based empirical mode decomposition identifies the dominant frequency range of the EMG signal. Force sensitive resistor measures respective force applied to perform each of the hand actions. The measured force that correlates with the EMG features is utilised in the structural analysis of the hand model.
Results inferred from the structural analysis deliberates that the hand model is able to withstand the maximum load with minimum deformation. Thus, this effort in making the hand model is a step forward in the development of an indigenous prosthetic hand.

Keywords: Prosthetic Hand; EMG Signal; Kinematic Analysis; Simscape; Force Sensor; Empirical Mode Decomposition

BEB7001: Dynamics of the 'Cognitive' P3b Brain Wave at Rest for AD Prediction in MCI

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Abstract. Alzheimer's disease (AD) is the most common cause of dementia that involves a progressive and irrevocable decline in cognitive abilities and social behaviour, thus annihilating the patient's autonomy. Among the neurophysiological markers of attention and cognition, one of the sub-components of the 'cognitive brain wave' P300 recordable in an odd-ball paradigm –namely, the P3b is extensively regarded as a sensitive indicator of cognitive performance. Several studies have reliably shown that changes in the amplitude and latency of the P3b are strongly related to cognitive decline and ageing, both healthy and pathological. Here, we used a P3b spatial filter to enhance the electroencephalographic (EEG) characteristics underlying 175 subjects divided into 135 mild cognitive impairment (MCI) subjects, 20 elderly controls (EC), and 20 young volunteers (Y). The Y group served to extract the P3b spatial filter from EEG data, which was later applied to the other groups during resting conditions with eyes open and without being asked to perform any task. The group of 135 MCI subjects could be divided into two subgroups at the end of a month follow-up: 75 with stable MCI (MCI-S, not converted to AD) and 60 converted to AD (MCI-C). The P3b spatial filter was built using a signal processing method called Functional Source Separation (FSS), which increases the signal-to-noise ratio by using a weighted sum of all EEG recording channels rather than relying on a single or a small subset of channels. A clear difference was observed for the P3b dynamics at rest between groups. Moreover, a machine learning approach showed that P3b at rest could correctly distinguish MCI from EC (80.6% accuracy) and MCI-S from MCI-C (74.1% accuracy), with an accuracy as high as 93.8% in discriminating between MCI-C and EC. Finally, a comparison of the Bayes factor revealed that the group differences among MCI-S and MCI-C were 138 times more likely to be detected using the P3b dynamics compared with the best-performing single electrode (Pz) approach. In conclusion, we propose that P3b, as measured through spatial filters, can be safely regarded as a simple and sensitive marker to predict the conversion from an MCI to AD status, eventually combined with other non-neurophysiological biomarkers for a more precise definition of dementia having neuropathological Alzheimer characteristics.

Keywords: P300; P3a/P3b; Aging; Alzheimer's Disease (AD); Mild Cognitive Impairment (MCI); Blind Source Separation (BSS); Functional Source Separation (FSS); Electroencephalography (EEG); Support vector machine (SVM)

Oral Session 2: Medical Imaging Technology and Application

MIST1085: A Deep Network for Tinnitus Classification and Severity Prediction from Structural MR Images

To avoid repeatability issue, this abstract will be available after the full paper is published.

MIST1075: Imaging and Machine Vision for Biomedical Robots

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Abstract. The use of imaging technology, combined with computational intelligence, equips modern medical robots with visual perception to performance tasks intelligently. Medical robots assist or work alongside with medical professionals, and sometime patients, in accomplishing diagnostic and therapeutic tasks.
Motivated by the potential in machine vision in image-guided surgeries, we developed a self-contained 3D ultrasound image mapping framework that does not require external tracking system. This development addresses a practical clinical need for an intuitive navigation of the surgical instruments through effective tracking and visualization of the surgical site.
In the application of image-guided robotics, we developed a vision-guided robotic manipulation platform for cell manipulation. The contributions of the work include a self-initializing workflow that minimizes the need for manual intervention and a unified track-servo framework that facilitates uncalibrated micromanipulation. The former enhances the level of autonomy while the latter make the system self-contained and versatile in deployment. Our work in developing an ultrasound image-guided robot designed for collaborative interventional procedures will also be presented in the talk.

MIST1091: Deep Learning-based Method for the Estimation of Patient's Angles from Lateral Skull Radiographs

To avoid repeatability issue, this abstract will be available after the full paper is published.

MIST1078: In vivo Imaging of Astrocytes in the Whole Brain with Engineered AAVs and Diffusion Weighted Magnetic Resonance Imaging

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Abstract. Astrocytes constitute a major part of the central nervous system and the delineation of their activity patterns is conducive to a better understanding of brain network dynamics. This study aimed to develop a magnetic resonance imaging (MRI)-based method in order to monitor the brain-wide or region-specific astrocytes in live animals. Adeno-associated virus (AAVs) vectors carrying the human glial fibrillary acidic protein (GFAP) promoter driving the EGFP-AQP1 (Aquaporin-1, an MRI reporter) fusion gene were employed. The following steps were included: constructing recombinant AAV vectors for astrocyte-specific expression, detecting MRI reporters in cell culture, brain regions or whole brain following cell transduction, stereotactic injection or tail vein injection. The astrocytes were detected by both fluorescent imaging and Diffusion Weighted MRI. The novel AAV mutation (Site-directed mutagenesis of surface-exposed tyrosine (Y) residues on the AAV5 capsid) significantly increased fluorescence intensity (p<0.01) compared with the AAV5 wild type. Transduction of the rAAV2/5 carrying AQP1 induced the titer-dependent changes in MRI contrast in cell cultures (p<0.05) and caudate putamen (CPu) in the brain (p<0.05). Furthermore, the MRI revealed a good brain-wide alignment between AQP1 levels and ADC signals, which increased over time in most of the transduced brain regions. In addition, the rAAV2/PHP.eB serotype efficiently introduced AOP1 expression in the whole brain *via* tail vein injection. This study provides an MRI-based approach to detect dynamic changes in astrocytes in live animals. The novel in vivo tool could help us to understand the complexity of neuronal and glial networks in different pathophysiological conditions.

Keywords: Astrocytes; Adeno-associated Virus (AAV); Aquaporin-1(AQP1); AAV-PHP.eB; Magnetic Resonance Imaging (MRI); Fluorescence Imaging

MIST1074: Computer Aided Diagnosis System for Cervical Lymph Nodes in CT Images using Deep Learning

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Abstract. Efficient treatment of head and neck cancer requires fast and reliable detection and diagnosis of cervical lymph nodes (CLNs). In current practices, manual methods for detection and invasive onco-pathological tests for diagnosis are considered as the gold standards. These methods suffer from numerous shortcomings which makes them inefficient. This raises the need of a non-invasive and automated computer aided diagnosis (CADx) system. Such CADx system undermines the data for extracting the discriminant information and computed tomography (CT) images are information rich and non-invasive imaging modality for oncological diseases. The design of reliable CADx system demands both accurate detection and classification of CLNs in CT images. The authors have proposed the deep learning based innovative and customized architecture based on

attention mechanism and residual concept with the base UNet model, for the CLNs detection part (LNdtnNet) of the CADx system. While another architecture based on squeeze and excitation network and residual network with the base model of modified VGG, is proposed for the remaining diagnosis part (LNdgsNet) of the proposed CADx System. In first stage, the proposed LNdtnNet for CLNs detection found the best results of sensitivity = 92.78%, and Dice score = 94.18%. In second stage, proposed LNdgsNet attaining an average sensitivity, specificity, accuracy, and area under the curve of 95.62%, 93.88%, 95.28%, and 94.75%, respectively. The proposed both architectures trained offline run on a single platform back to back for testing cases. The overall results confirm the utility of the proposed CADx system.

Keywords: Lymph Nodes; Malignant; Benign; Computed Tomography; Deep Learning; Attention; Squeeze And Excitation

Acknowledgements: The authors want to acknowledge and thank Dr. Vivek Choudhary, Dr. Bhanwar Lal Sharma, Dr. Akhilesh Sahu, and Dr. Vinay Goel from Pt. JNM College Raipur, C.G., India, for their valuable suggestions and kind support in all the directions of this research.

BEB6675: Deep Learning for Differentiating Benign from Malignant Tumors on Breast-Specific Gamma Image

To avoid repeatability issue, this abstract will be available after the full paper is published.

MIST1081: Breast Abnormality Prediction using Broad Learning System

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Abstract. Early detection and diagnosis of breast cancer are vital for a successful course of therapy and complete recovery. The breast has a high metabolism, which causes the proliferation of aberrant cells to produce more heat than healthy breast tissue. The aberrant cell area's localized temperature increase results in a change in the surface temperature of the breast. This can be seen as a hot spot in thermal breast imaging and is very important for determining whether there are any breast abnormalities. Any automated method for detecting breast abnormalities must include a stage for preprocessing thermal breast pictures. The original thermal image has been preprocessed with the help of specialized vendor software, FLIR Tool. It is vital to isolate the background region from the remainder of the image since the background region in a thermal breast image cannot be used to diagnose breast cancer. Automatic segmentation of the region of interest in the thermal breast image is crucial to diagnosing breast abnormalities. However, it needs real images to compare segmentation outcomes against using predetermined assessment measures. The DMR-IR and DBT-TU-JU public thermal breast imaging databases do not have ground-Truth photos for the region of interest and the purpose of experimentation, and those were created.
Here, a unique technique for differentiating healthy and unhealthy breast thermograms is provided. It is based on texture analysis features and the Broad Learning System(BLS) for classification. A hybrid descriptor has been proposed that combines two feature descriptors: the inverse-probability difference extrema and the local instant and center-symmetric neighbors-based pattern. The most

intriguing feature of the BLS that served as the inspiration for this application is that it outperforms other traditional classifiers in terms of performance on low-dimensional data and efficiency. Over the past few years, significant advancements have been made in thermography-based early breast cancer diagnosis. In this regard, developing sophisticated computing methods in machine learning, pattern recognition, and image processing has dramatically aided in resolving some problems. The difficulties still exist, though, and it would be intriguing for young scientists to be able to explore thermography-based breast cancer diagnosis further to advance to the next stage of development.

Keywords: Breast Cancer; Infrared Images; Feature Extraction; Image Segmentation; Classification; Broad Learning System

MIST1082: Development of Human Head Models from Anatomical Medical Images using Deep Learning

To avoid repeatability issue, this abstract will be available after the full paper is published.

BEB6857: Iterator-Net: Sinogram-based CT Image Reconstruction

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Abstract: Computed tomography (CT) image reconstruction technology is extremely important for CT imaging, so it is significant to continuously improve CT image reconstruction technology. The unfolding dynamics method combines a deep learning model with a traditional iterative algorithm. It is interpretable and has a fast reconstruction speed, but the essence of the algorithm is to replace the approximation operator in the optimization objective with a learning operator in the form of a convolutional neural network. In this paper, we firstly design a new iterator network (iNet), which is based on the universal approximation theorem and tries to simulate the functional relationship between the former and the latter in the maximum-likelihood expectation maximization (MLEM) algorithm. To evaluate the effectiveness of the method, we conduct experiments on a CT dataset, and the results show that our iterator network method effectively improves the quality of reconstructed images.

Keywords: Computed tomography (CT); Image Reconstruction; Maximum-Likelihood Expectation Maximization (MLEM)

MIST1084: The Use of Customized Filters and Template Matching for Texture Feature Analysis and ROI Extraction in Imaging

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Abstract. The ability to accurately extract Regions of Interest (ROIs) from any Image is a first major step for any successful Automated Detection Algorithm. This paper explores the use of Customized Filters, Template Matching, and Color Segmentation for Texture Feature Analysis and ROI extraction. Gabor Filters have been applied in both Breast Cancer Detection as customized filters for detecting Architectural Distortions because they often include spiculations radiating from a point. In one case, the application of Gabor Filters for breast cancer ROI extraction yielded a sensitivity of 79% (15 out of 19 cases of Architectural Distortions were detected) with a false positive per image (FPI) of 18. In another case, the application of Gabor Filters yielded a sensitivity of 87.5% with a False Positive per Image (FPI) of 5.2. In Crude Oil Spill Detection, customized crude oil filters were created to perform cross-correlation across Crude Oil Spill Images to identify ROIs. This yielded an efficiency of 92.86% (65 of 70 Crude Oil Spills were detected) with a False Positive Per Image (FPI) of 1.84. In another case, the use of custom crude oil filters yielded a sensitivity of 84% (42 out of 50 Spills were detected) with a False Positive per Image (FPI) of 0.82.The authors strongly believe more customized filters should be developed and tested for detection of Cancer and other abnormalities in Medical Imaging.
Keywords: Gabor Filtration; Template Matching; Color Segmentation.10

Acknowledgements: The authors would like to acknowledge OLAWUYI RACETT NIGERIA LTD., IBADAN, NIGERIA, for investing in Image Analysis Research in Nigeria.

MIST1093: Classification of Brain Tissues of Multispectral MRI using Mixture Models and Independent Component Analysis

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Abstract. The development of automated segmentation approaches, which do not suffer from excessive computational burden and intra- and inter-observer variability, is the holy grail of multispectral MR image classification. Tumors, especially malignant ones have a very heterogeneous architecture with areas of hemorrhage, necrosis, cavitation, calcification and fibrosis. The differentiation of normal and healthy tissues from lesions that have similar MR characteristics such as edema, necrotic, or scar tissue, has proven to be important in the evaluation of response to therapy, and hence, multispectral methods have been employed.
A new segmentation approach to the data set of MR brain images using a combination of Independent Component Analysis (ICA) with a generalized version of the popular Gaussian Mixture Model (GMM) for unsupervised classification is proposed to be superior to conventional methods in this work. It is proposed to optimize the parameters of the mixture model using a meta-heuristic approach like the Particle Swarm Optimization (PSO) to escape the problem of local traps. Experiments were carried out initially on a synthetic MR Brainweb image set as proof of concept and subsequently on 152 sets of clinical MR images with T1w, T2w and FLAIR sequences. The major advantage of the proposed algorithm is the increased accuracy of lesion classification – average of 94.79% (±1.7) against 85.85% (±3.1) without ICA. As a result of the incorporation of ICA, the inherent computational overhead was also lowered as evidenced by faster convergence. Comparative

studies using quantitative and qualitative analysis against conventional algorithms establish the superiority of the proposed approach.

Keywords: Independent Component Analysis; Multispectral; MRI; Particle Swarm Optimization; Finite generalized Gaussian mixtures; Image classification

Acknowledgements: The author would like to thank Medall Diagnostics for providing the necessary medical data and guidance.

Oral Session 3: Cell biology & Medicinal Chemistry

BEB6995: LGR5+/CD44+ Cells Endow Cancer Stemness and EMT Property through WNT/TGF-β Crosstalk Predicting Poor Prognosis in Gastric Adenocarcinoma

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Abstract. Background: Gastric cancer is the fifth most common and the fourth most lethal cancer worldwide. Cancer stem cells (CSCs) account for proliferation, invasion, metastasis and drug resistance with the potential to be an effective target for evaluation, diagnosis and treatment of cancer. Our study evaluated the roles of LGR5 as a valuable marker of CSCs in the diagnosis and prognosis of gastric adenocarcinoma. **Methods:** Transcription profiles and survival information of 1035 patients with gastric adenocarcinoma were obtained from the GEO (Gene Expression Omnibus) and The Cancer Genome Atlas (TCGA) databases. LGR5, CD24 and CD44 expressions were measured by immunohistochemical on pathological specimens of gastric adenocarcinoma patients in our hospital. Diagnostic and survival information was analysed between different LGR5/CD44 expression level groups by $\chi 2$ test and Kaplan-Meier method. The serum-free culture was performed to obtain CSCs from gastric adenocarcinoma cell lines. LGR5, WNT/β-catenin pathway and epithelial-mesenchymal transition (EMT) related expressions were examined by Western-blot and immunofluorescence. **Results:** The co-expression of LGR5 and CD44 is associated with poor differentiation and prognosis in gastric adenocarcinoma patients. Serum-free culture purified CSCs showed upregulated expression of LGR5 and CD44. Further investigation revealed that elevated LGR5 expression was accompanied by the activation of WNT/β-catenin and TGF-β/Smads, except for Smad4 downregulation. Immunofluorescence exhibited an increase of p-Smad3 under GSK-3β inhibition, suggesting the crosstalk between the LGR5/β-catenin pathway and the TGF-β/Smads pathway by activating GSK-3β and inhibiting Smad4 to maintain the stemness and EMT characteristics. **Conclusion:** $LGR5^+/CD44^+$ marks CSCs of gastric adenocarcinoma, indicating poor differentiation and prognosis. LGR5 activates the WNT/β-catenin pathway and forms the crosstalk with the TGF-β/Smads pathway, maintaining the stemness of CSCs. LGR5 can be a diagnostic and therapeutic target of CSCs for the theranostics on gastric adenocarcinoma.

Keywords: LGR5; Gastric Adenocarcinoma; Cancer Stem Cell; EMT; WNT/TGF-β Crosstalk

Acknowledgements: This study was supported by the National Natural Science Foundation of China (NSFC) (81802453), the Key Research and Development Program of Shaanxi Province (2019SF-093), and the Basic Scientific Research Interdisciplinary and Cooperation Project of Xi'an Jiaotong University (1119293853).

BEB6997: Low-Intensity Pulsed Ultrasound (LIPUS) Approach for Modulation of Macrophage Polarization in Acute Kidney Injury

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Abstract. Acute kidney injury (AKI) is a multifactorial disease that results in an acute decline in the renal function. Due to the complex pathophysiological mechanisms underlying the renal impairment, finding novel therapeutic approaches has remained a challenge. Our studies and evidence from the literature suggest that macrophage polarization plays a crucial role in the initiation and progression of AKI. Renal macrophages display diverse phenotypes (M1 pro-inflammatory and M2 anti-inflammatory) in response to the alterations of the renal microenvironment. M1 macrophages express CD86, oxidative and tissue-remodelling proteins (such as inducible nitric oxide synthase) and secrete pro-inflammatory cytokines, and thus may exacerbate inflammation in AKI. M2 suppress inflammation through Fizz1, Arg1and anti-inflammatory cytokines, and subsequently participate in renal recovery. Interfering with the inflammatory gene expression seems to be an attractive approach to modify macrophage polarization. Further interest in Low-intensity pulsed ultrasound (LIPUS) is stimulated by their inhibitory effects on inflammatory response. Herein, we used an in vivo gentamicin-induced AKI model to investigate whether LIPUS could alter the inflammatory gene expression and thus switch macrophage from M1 to M2 phenotype. We found that LIPUS mitigate the renal injury via shifting macrophages to M2 phenotype.

Keywords: Acute Kidney Injury; Macrophage; Polarization; Heat Shock Protein; Ultrasound

Acknowledgements: This paper is based upon work supported by Science Technology & Innovation Funding Authority (STDF) under grant (N ?26276).

BEB6754: Preoperative and Postoperative Risk Classification in Synchronous Oligometastatic Non-Small Cell Lung Cancer

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Abstract. Background: Patients with oligometastatic Non-Small Cell Lung Cancer (NSCLC) do not have a typical therapy strategy, and however, aggressive surgery appears to give a favourable prognosis in selected oligometastatic NSCLC. This retrospective study aimed to examine the long-term outcomes of patients with synchronous oligometastatic NSCLC treated with curative intent, identify factors associated with improved outcomes, and propose a risk stratification system for classifying synchronous oligometastatic NSCLC. **Methods:** The authors conducted a retrospective review of patients recruited prospectively. The following criteria were used to determine inclusion: synchronous oligometastatic NSCLC (five extrapulmonary metastases), radical surgical resection of the primary tumour and all metastatic sites (2005–2018). Palliative surgery, recurrent lung cancer, impaired performance status, and inability to obtain follow-up information were all considered exclusion criteria. The Kaplan – Meier methodology assessed median overall survival and progression-free survival. A stratified backward stepwise Cox regression model was used for multivariable survival analysis. **Results:** The study enrolled 281 patients. Four variables were utilised to create a risk preoperative classification: age ≤65 years, metastatic organ, clinical nodal

status, and induction treatment. Age ≤65 years, a single metastasis, and the existence of contralateral lung metastases were related with a favourable outcome postoperatively. The existence of pathological N2 metastases harmed survival. These predictive variables were utilised to develop a framework for postoperative risk stratification. **Conclusions:** Patient selection is crucial for finding the appropriate subsets of oligometastatic NSCLC. Following clinical validation, these risk classifications may aid decision-making during multidisciplinary team assessments and patient selection for the necessary future randomised studies.

Keywords: Lung Cancer; Thoracic surgery; Oligometastatic; Biostatistics

Acknowledgements: This work was partially supported by the Italian Ministry of Health with Ricerca Corrente and 5x1000 funds.

BEB6780: Toward Diseases Therapy through Targeting the Cation-Chloride Cotransporters and their Upstream Kinase Signalling of WNK-SPAK/OSR1 Pathway

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Abstract. The SLC12 family of cation-chloride-cotransporters (CCCs) comprises of potassium chloride cotransporters (KCCs)-mediated Cl- extrusion and sodium potassium chloride cotransporters (N[K]CCs)-mediated Cl- loading. The CCCs play vital roles in cell volume regulation and ion homeostasis. In recent years, there have been considerable advances in our understanding of CCCs control mechanisms, particularly via the pathway containing the with-no-lysine [K] (WNK) and its downstream target kinases, SPS/Ste20-related proline-alanine-rich kinase (SPAK) and oxidative stress responsive 1 (OSR1) and their upstream E3 ubiquitin ligase complex comprising Kelch-like 3 (KLHL3) and Cullin 3 (CUL3), which has led to the discovery of novel inhibitory molecules. Our work has subsequently led to the development of a drug-like molecules targeting WNK-SPAK kinases, for the treatment of human diseases, e.g. Hypertension, Stroke etc..

Keywords: Cation-chloride-cotransporters; CUL3/KLHL3-WNK-SPAK/OSR1; Kinase Inhibitors; Hypertension and Stroke

BEB6885: Challenges for Machine Learning in RNA-Protein Interaction Prediction

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Abstract. RNA-protein interactions have long been recognised as crucial regulators of gene expression. Recently, the development of scalable experimental techniques to measure these interactions has revolutionised the field, leading to the production of large-scale datasets which offer

both opportunities and challenges for machine learning techniques. In this presentation, we will discuss some of the major stumbling blocks towards the use of machine learning in computational RNA biology, focusing specifically on the problem of predicting RNA-protein interactions from next-generation sequencing data. As a first step to address these challenges, we use large-scale CLIP-seq experiments to construct a *de novo* predictor of RNA-protein interactions based on graph neural networks (GNN). We show that the GNN method allows not only to predict missing links in an RNA-protein network, but to predict the entire complement of targets of previously unassayed proteins, and even to reconstruct the entire network of RNA-protein interactions in different conditions based on minimal information. Our results demonstrate the potential of modern machine learning methods to extract useful information on post-transcriptional regulation from large data sets.

Keywords: RNA-Protein Interactions; Graphs; Noisy Data; Higher-Order Interactions; Graph Neural Networks

BEB7012: Novel Approach to Meniscus Regeneration

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Abstract. The knee meniscus plays an indispensable role in articular surface protection, shock absorption, and stress transmission. Meniscus injuries are extremely prevalent, with an annual incidence of 66 to 70 per 100,000 people. Due to limited vascularization, the regenerative capacity of the meniscus is relatively low and restricted to the most vascularized outer regions. The most commonly performed treatment involves suturing or removal by partial or total meniscectomy. However, meniscectomy significantly increases the incidence of osteoarthritis (OA) later in life by elevating the contact pressure on the tibial plateau. Approximately 50% of patients with meniscal injuries develop OA between 10 and 20 years after the injury. Therefore, optimal treatment options should preserve or mimic the mechanical properties of the meniscus.
3D bioprinting belongs to the family of additive manufacturing (AM) processes that utilize computer-aided design (CAD) for the generation of 3D models through layer-by-layer deposition. The constructs are printed with bioink comprised of viable cells, biomaterials, and additional biological substances. These artificial, cell-laden scaffolds promote and support new tissue formation by providing a suitable environment for cell migration, proliferation, differentiation, and ensure a proper extracellular matrix (ECM) secretion [6,7].
During the presentation a novel approach (based on 3D bioprinting) of regenerative medicine towards the meniscus will be shown.

Keywords: Applied Biotechnology; Bionanotechnology; 3D Bioprinting; Tissue Engineering

Acknowledgements: This work was supported by the National Centre for Research and Development TECHMATSTRATEG-III/0027/2019-00 grant.

BEB6869: Artificial Intelligence for Detection of Subtle Morphological, Physiological and Pathophysiological Changes in Cell Nuclei

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Abstract. Rapid development of machine learning and artificial intelligence in recent years has led to the development of fast, sensitive and accurate biosensors in the field of experimental physiology and pathology. Some of the new and innovative technologies can be successfully used to detect and identify discrete structural and functional changes in nuclear chromatin. It is possible that certain artificial intelligence algorithms can be trained to recognize early changes associated with programmed cell death, oxidative stress or some other aspects of DNA damage. Approaches based on random forest, support vector machine, logistic regression and principal component analysis may also be used to detect and quantify certain aspects of cellular senescence. Hereby we present our recent research on the application of machine learning in experimental physiology and pathophysiology. We particularly focus on computational approaches based on fractal analysis, gray level co-occurrence matrix analysis and discrete wavelet transform. We present the recent findings indicating that these innovative computational strategies can be applied for measurement of changes in chromatin distribution after induction of cell damage by exposure to different chemical agents.

Keywords: Artificial Intelligence; Machine Learning; Physiology; Pathophysiology; Chromatin

Acknowledgements: This research was supported by the Science Fund of the Republic of Serbia, grant No. 7739645 "Automated sensing system based on fractal, textural and wavelet computational methods for detection of low-level cellular damage", SensoFracTW.

BEB6832: Novel Microfluidic Approach for Phenotypic Antimicrobial Susceptibility Testing

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Abstract. Antimicrobial resistance (AMR), a phenomenon where microbes become resistant to antibiotics, is greatly sped up by misusing antibiotics in modern healthcare system, as well as in the environment by overusing antibiotics in animal husbandry, etc. By measuring the resistance of pathogens in a sample to different drugs, antimicrobial susceptibility tests (ASTs) can effectively reduce the misuse/overuse of antibiotics. However, AST is not widely adopted in practice because of the significant limitations of current methods, such as low speed and low efficiency of conventional methods, and high cost of advanced methods, not to mention the infeasibility in polymicrobial AST and drug combinations. Herein, we present a two-stage culture-based AST strategy based on microfluidic technology. For the first stage, we developed a "barcode" microfluidic system which can perform rapid AST at low cost with minimal requirement on facility environment. This method can be used to screen samples onsite within 3 hours to report suspected samples containing

drug-resistant bacteria, which can be sent to advanced laboratory for further analysis. For the second stage, we developed a "cell-on-gel" technology for advanced AST. This design generates a stable linear 2D gradient of drugs along a hydrogel chip surface, which can be used to test the synergistic effect of drugs and perform polymicrobial AST of mixed bacteria without pre-isolation. Based on single-cell imaging analysis, AST can be completed within 3 hours. In this way, our two-stage platform can realize both on-site mass screening of AMR at low cost, and advanced AST in testing laboratories.

Keywords: Antimicrobial Resistance; Antimicrobial Susceptibility Test; Barcode; Microfluidic Device; Point-of-Care.

Acknowledgements: This work was supported by NSFC (81973288, 51773173), HKRGC (12301720, T12-201/20-R, RMGS 2020_4_01), and SZSTC (SGDX20190816230207535).

BEB6838: Pharmacological Effect and Molecular Mechanism of Chuanzhitongluo Capsule on Promoting Blood Circulation and Removing Blood Stasis Based on Metabolomics and Network Pharmacology

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Abstract. Ischemic stroke is a leading cause of mortality and disability worldwide, and Chuanzhitongluo capsule (CZTL) has a curative effect during the recovery period of ischemic stroke, as a blood circulation-promoting recipe. However, the molecular mechanism of CZTL on promoting blood circulation and removing blood stasis remains unclear. In this study, we investigated the pharmacological effect of CZTL on blood circulation and its underlying mechanism based on metabolomics and network pharmacology. Firstly, a rat model of acute blood stasis was established by stimuli of adrenaline and ice water. The microcirculatory damage in model rats and the efficacy of CZTL were assessed by detecting laser speckle contrast imaging, coagulation function, hemorheology, vasomotor factor and microcirculation function. The results showed that CZTL significantly increased local blood flow, rescued the excessive coagulation, reduced blood viscosity and up-regulated NOS, vWF and VE-cadherin expression in model rats. The potential mechanism of CZTL action was explored by the untargeted metabolomic analysis based on ultra-performance liquid chromatography-quadrupole-time of flight-mass spectrometry and network pharmacology. Integrated analysis indicated that CZTL might regulate sphingolipid metabolism and arachidonic acid metabolism to reduce inflammatory reaction and exert protective effects on blood circulation. Our study elucidated that CZTL was highly effective against acute blood stasis syndrome and its potential mechanisms related with the modulation of sphingolipid and arachidonic acid metabolic pathways. The present study provided a new perspective on the clinical application of CZTL, and it contributes to explore novel therapeutic drug against blood stasis syndrome.

Keywords: *Chuanzhitongluo* Capsule; Blood Stasis Syndrome; Laser Speckle Contrast Imaging; Efficacy Outcome; Mechanism Exploration

BEB6939: Investigation of Novel Halogenated Cinnamanilides

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Abstract. One of the basic strategies in the search for new bioactive agents is inspiration from natural compounds such as cinnamic acid. It is an aromatic acid with a long history of use as an additive in plant fragrances and spices. Its derivatives are important promising substances with great potential in the search for new pharmacologically active agents. Cinnamic acid and its derivatives have attracted the attention of scientists in recent decades due to low toxicity and a wide range of biological activities such as antibacterial, antiviral, anti-inflammatory, cytotoxic, antidiabetic, hepatoprotective, antioxidant, neuroprotective, anxiolytic, and antituberculotic. Recent studies investigating the antimicrobial activities of an extensive series of variously substituted cinnamic anilides have revealed compounds with promising anti-infective potential. Since the introduction of a halogen into the molecule structure is known to increase the anti-invasive activity, new halogenated series of anilides were designed and their properties are discussed in this contribution.

Keywords: Multi-Target Compounds; Rational Design; Cinnamic Acid Derivatives

Acknowledgements: This study was supported by grant projects UK/289/2022, UK/320/2022 and APVV-17-0373.

BEB6985: Structural Characterization of Mushroom Polysaccharides and its Neuroprotection Related to Inhibition on Oxidative Stress

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Abstract. The Flammulina filiformis, belongs to the Basidiomycota, Agaricomycotina, Agaricomycetes, Agaricomycetidae, Agaricales, and Flammulina. Fungi polysaccharides,a class of active constituents isolated from fruiting bodies, mycelium or fermentation broth of fungi, have the

biological activities including antioxidant, anti-tumor and immunomodulatory activity, which is recognized an important natural drug resources. In this study, two homogeneous polysaccharides, FVP-1 and FVP-2, were obtained by water extraction, alcohol precipitation and column chromatography. The molecular weight of FVP-1 was 2.44×10^4 Da, and the molecular weight of FVP-2 was 2.65×10^5 Da. The main monosaccharides of the two components are fucose, galactose, glucose and mannose, both of which are furanosaccharides linked by β-glycosidic bonds. The reducing power, superoxide anion radical scavenging ability, hydroxyl radical scavenging ability and DPPH radical scavenging ability of FVP-1 and FVP-2 polysaccharides were determined to explore the antioxidant capacity of the two polysaccharides in vitro. The scavenging activity of FVP-2 was higher than that of FVP-1 in a dose-dependent manner. Then the antioxidant and anti-aging activities of Flammulina filiformis polysaccharides in vivo were investigated. Through the oral administration of FVP-1 and FVP-2, the activities of SOD, GSH-Px and T-AOC in liver and brain tissues of the mice induced by D-galactose, and the content of water content and hydroxyproline (HYP) in skin increased, reversely, the level of MDA in liver and brain tissues decreased. Moreover, Flammulina filiformis polysaccharides treatment, especially the high dose of FVP-2, significantly reduced the damage of liver, brain, thymus and skin tissue by pathological section analysis. This study provides a basis for the development and utilization of Flammulina filiformis polysaccharide.

Keywords: *Flammulina Filiformis* Polysaccharide; Structure Identification; Free Radical Scavenging; Antioxidant; Anti-Aging

Acknowledgements: The study was supported by China Agriculture Research System (CARS-20), National Key Re-search and Development Program of China (2021YFD1600401), the National Natural Science Foundation of China (32072648) and the Science and Technology Program of Jilin Educational Committee (JJKH20210328KJ).

BEB7000: Crosstalk between the Liver Microenvironment and Metastatic Colorectal Cancer

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Abstract. Patients with metastatic colorectal cancer (mCRC) have substantially worse outcomes than those with primary and localized CRC. Over 80% of CRC metastases occur in the liver, which has a unique endothelial cell (EC)-rich microenvironment. Distinct from precedent EC studies focused on angiogenesis and vascular remodeling, we pioneered the discovery that liver ECs secrete soluble factors to promote CRC growth and chemoresistance in a paracrine fashion. Specifically, we found that human epidermal growth factor receptor 3 (HER3, also known as ErbB3) is a key mediator of EC-induced mCRC growth in the liver. However, we found that liver ECs activate HER3 independent of the only known HER3 ligand, neuregulins. Here, we made the paradigm-shifting discovery that leucine rich alpha-2-glycoprotein 1 (LRG1) secreted from liver ECs is a novel HER3 ligand that activates CRC-associated HER3 and promote CRC growth. neutralizing or depleting secreted soluble LRG1 attenuates CRC tumor growth in xenograft tumor models and prolonged overall survival in mic with syngeneic orthotopic CRC liver metastases. Mechanistically, LRG1-HER3 activates the PDK1-RSK2-eIF4 axis, distinct from neuregulins and independent of AKT, to promote protein synthesis and CRC cell growth. This line of investigation determined a pro-tumor role of the surrounding EC microenvironment in the liver, and identified a key mediating

signaling axis that can be targeted by novel therapeutics for treating patients with mCRC.

BEB6982: Exploring the Scope of Plants in Photodynamic Therapy of Cancer

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Abstract. With increasing disease forms, resistance to existing drugs and challenge of developing effective drugs with fewer side effects, the demand to explore newer paradigms of treatment is increasing. Plants and plant-derived compounds are considered one of the most trusted sources of drug development due to their decade-long therapeutic efficacy. They have been proven to be successful in combination therapies too. Photodynamic therapy is presenting promising solutions to tackle cancer, increasing life expectancy in patients. This is due to its ability to target the cancer cell population with minimal side effects on normal cells. Photosensitizers (PSs) are compounds of natural or synthetic origin that, when exposed to light at a specific wavelength, excite electrons and generate free radicals. Interestingly, these PSs form the basis for Photodynamic Therapy (PDT) and the treatment of cancer. PDT has benefited greatly from a few PS derived from plants. Plants in their raw, extracted, and purified compound forms have known anticancer properties. Our research focuses on this property of plants to use in combination therapy with light of different wavelengths to enhance cancer therapy. Different plant species are being studied for this purpose, exploring their photodynamic properties. Moreover, to overcome cancer recurrence, these sources are combined with nanoparticles and antibodies for targeted therapy. This includes eradicating hidden, resistant cancer stem cell populations within the total cancer cell mass. Considering safety and enormous anticancer reports, phytocompounds are being tested for their photosensitizing property. However, identifying plant-based compounds for PDT with specific physiochemical and biological properties is a challenging task.

Keywords: Phytocompounds; Photodynamic Therapy; Photosensitizer; Cancer

Acknowledgements: This research was funded by the South African Research Chairs Initiative of the Department of Science and Technology and National Research Foundation of South Africa (SARChI/NRF-DST), grant number 98337.

Oral Session 4: Biomechanical Engineering & Biotechnology

BEB6924: The Effects of Progressive Resistance Exercise in Experimental Models of Induction of Cerebral Ischemia and Parkinson's Disease in Rats

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Abstract. Ischemic stroke (CVAi) and Parkinson's disease (PD) are important neurological conditions with high incidence and severity. In this sense, therapeutic strategies for rehabilitation, such as physical exercises, have been tested for prevention. The present study aimed to investigate the effects of progressive resistance exercise on induction models of CVAi and PD in rats. Two experiments were performed. In the first, 40 male wistar rats had brain ischemia induced through the Bilateral Occlusion of the Common Carotid Artery (BCACA) method for 15 minutes. In the second, 70 rats had PD induced with electrolyte injury in the substantia nigra of the mesencephalon (stereotaxic coordinates: AP= -4.9; ML= 1.7 and DV= 8.1). Both groups of rats underwent progressive resisted physical exercise on the vertical staircase for 4 weeks, 5 days a week, for 45-60 minutes before surgeries to investigate the neuroprotective effect. At the end of the experiments, nerve tissue was removed for Nissl staining, cresyl violet dye, to mark neurons and count neuronal density. In experiment 1, we observed a lower density of neurons in the dentate and striatum gyrus in the exercised group compared to the sedentary group ($p<0.05$). In experiment 2, a greater density of neurons was observed in the substantia nigra and striatum of animals that exercised before the induction of PD ($p<0.05$). It is concluded that high intensity progressive resistance exercise is neuroprotective in the brain of rats with PD, while in cerebral ischemia it may increase the area of brain damage, worsening the condition of the animals.

Keywords: Parkinson Disease; Brain Ischemia; Neuron; Exercise; Neuroprotection; Substantia Nigra; Corpus Striatum

Acknowledgements: Postgraduate Program in Morphofunctional Sciences at the Federal University of São João del-Rei and the Department of Medicine.

BEB6960: Creating a Real-World Data, United States Healthcare Claims-based Adaptation of Kurtzke Functional Systems Scores for Assessing Multiple Sclerosis Severity and Progression

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Abstract. This talk describes the development of a unique mapping of the Kurtzke Functional Systems Scores (KFSS) from International Classification of Diseases, 9th revision, Clinical Modification (ICD-9-CM) codes among multiple sclerosis (MS) patients within a US Integrated Delivery Network (IDN). Valid identification of increasing disability may allow deeper insight into MS progression and possible treatments. Methods: This cohort study identified MS patients in the IDN, Intermountain Healthcare. Experienced clinicians and informaticists mapped electronic health record ICD-9-CM codes to KFSS components generating a modified Kurtzke Expanded Disability Status Scale (EDSS). Modified EDSS scores were used to assess disability progression by calculating means, medians, ranges, and changes in KFSS and modified EDSS scores. Results: Overall, 608/2960 (20.5%) patients were identified as having MS progression and presented a wide range of scores on the EDSS 10-point scale. The median (range) first and second EDSS scores were 0 (0–6) and 5 (1–8), respectively. The median (range) change from first to second score was 5 (1–7.5). The median first KFSS score for all systems was 0, and the mean differed among components. The highest mean first KFSS score (1.06) was measured for sensory function and lowest (0.12) for cerebellar functions. Of the 544 patients with their first EDSS scores in the ≤2.5 group, 75.2% and 15.1% had their second EDSS scores in group 3–5.5 and ≥6, respectively. Of the 62 patients with their first EDSS score in the 3–5.5 group, 58.1% had their second EDSS scores in group ≥6. Conclusion: This innovative mapping technique is a promising method for future comparative effectiveness and safety research of Disease-Modifying Therapy in Real-World Data repositories. Future research to validate and expand on this method in another healthcare database is encouraged.

Keywords: ICD-9 Mapping; KFSS; EDSS; MS Disability; Algorithm; Real-world Data

BEB6901: A Study on Deriving Physical Properties of Cold-Heat Pattern of Traditional East Asian Medicine through Abdominal Examination

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Abstract. Abdominal examination (AE) in Traditional East Asian medicine (TEAM) is to diagnose health condition by identifying non-invasive abdominal characteristics. Much information is

obtainable directly from an abdomen near to internal organs, but AE is performed non-quantitatively by TEAM doctor's senses. We tried to quantitatively identify the characteristics of cold-heat pattern, which is a major symptom of TEAM, by using devices for abdominal physical properties. The abdomen was measured using a 3D camera for geometry and color, an algometer for pressure and depth at the onset of pain, and DITI for thermographic images. We collected 120 subjects and measured them by the devices. They were divided into cold and non-cold groups, and heat and non-heat groups through the agreement of more than 2 out of 3 TEAM doctors. Consequently, they were classified into 69 and 31 people with cold and non-cold pattern, 62 and 38 ones with heat and non-heat pattern, and the pressure and depth during pain were smaller in the cold group than in the non-cold group, the CIE a* was smaller, and the abdominal height was lower, and there was no significant value in the thermography image interestingly. The abdomen was sensitive to pain and sagged and had poor color in cold group. There were no significant features between the heat and non-heat groups. Interestingly, abdominal surface temperature was not significant in both groups. Since classification of heat pattern is required, it will be necessary to study further abdominal physical characteristics for heat pattern and health care.

Keywords: Abdominal Examination; Cold-Heat Pattern; Quantitative Physical Properties; Cold And Non-Cold Groups

Acknowledgements: This study was supported by the Korea Institute of Oriental Medicine (project Nos. KSN2022130).

BEB6977: miR-142a-3p is a Potential Target for Therapies to Improve the Physiological Function of Skeletal Muscle

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Abstract. Ion channels are critical to the function of excitable cells. MiRNAs have been found to regulate ion channels in many organs, including skeletal muscles, and it’s reasonable to speculate that miR-142a-3p, which is highly expressed in skeletal muscle after denervation according to our previous work may affect the cell excitability through similar mechanism. MiR-142a-3p and many ion channel coding genes have been found highly differently expressed in skeletal muscle after denervation. In this study, the miR-142a-3p mimics or inhibitor was transfected into C2C12 cells by lentivirus method. Whole cell currents were recorded after 7-day differentiation. The results showed that miR-142a-3p overexpression group had smaller membrane capacitance, higher potassium currents density and lower L-type calcium currents density; miR-142a-3p knockdown group had greater membrane capacitance and lower sodium ion channel currents density. In summary, we have studied the regulatory effect of miR-142a-3p on C2C12 ion channels. We used C2C12 cell line, whose physiological characteristics may be slightly different from real skeletal muscle cells, but the results are still suggestive to the function of microRNAs regulating ion channels. In addition, the specific channel subtypes and regulatory mechanisms of miR-142a-3p regulating whole-cell sodium, potassium and calcium channels need to be further studied, and this is also the direction of our follow-up efforts.

Keywords: miR-142a-3p; C2C12; Ion Channels; Patch Clamp; Denervation; Muscle; MicroRNA

MIST1087: Recent Developments in the Orthopedic Surgical Training Simulators

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Abstract. The virtual reality based simulators in the orthopedic surgery are extensively used to assist in the surgical training. Due to the constraints in the physical and advancement in the software and hardware technologies, there is rapid growth in the use of such simulators in the medical field. A sustained development happened in the development of VR-based orthopedic simulators such as laparoscopic surgery, heart surgery and arthroscopic surgery. Research also led to the creation of a drilling simulator with haptic interaction, hip surgical processes and medical surgical training. In this presentation the milestones achieved in the development of VR-based orthopedic simulators in the recent days are discussed and the opportunities in the field of orthopedic simulator development would be presented.

BEB7003: Design of Microvascular Trees using Generative Adversarial Networks and Constrained Constructive Optimization

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Abstract. The design of physiologically functional microvascular trees is of crucial relevance for bioengineering of functional tissues and organs. Yet, currently available methods are poorly suited to replicate the morphological and topological heterogeneity of real microvascular trees because the parameters used to control the tree generation are too simplistic to describe results of the complex angiogenetic and structural adaptation process. Here, we propose a method to overcome this limitation by integrating a conditional deep convolutional generative adversarial network (cDCGAN) with a local vessel density-oriented constrained constructive optimization (LVDO-CCO) strategy. The cDCGAN learns the patterns of real microvascular bifurcations allowing for their replication in artificial bifurcations. The LVDO-CCO strategy connects the generated bifurcations hierarchically to form microvascular trees aimed at optimizing tissue perfusion. The generated artificial microvascular trees show characteristics such as fractal dimension, vascular density, and coefficient of variation of diameter, length, and tortuosity consistent with real microvascular trees. These results support the adoption of the proposed strategy for the generation of artificial microvasculatures in the engineering of functional tissues, as well as for computational modeling and simulations of microcirculatory (patho)physiology.

Keywords: Generative Adversarial Network; Constrained Constructive Optimization; Microvascular Tree; Tissue Engineering

Acknowledgements: This study was supported by the National Natural Science Foundation of China (Grant Nos. 31870938, 81871454), the Zhejiang Province Key Research & Development Program (No. 2020C03073).

BEB6911: Computational Structural Analysis of a Modified Knee Implant Design for Total Knee Replacement

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Abstract. Total knee replacement (TKR) is a surgical procedure in which an artificial joint or prosthesis replaces a damaged knee joint. TKR is one of the most increasingly utilized surgical procedures in the world. The main objective of this study was to compare the contact pressures of a modified concentric tibial insert with that of a standard TKR design and compare the results with the biomechanics of an actual knee joint. This study employs a technique of reverse engineering 3D scanned implant data, to generate an accurate implant model with ±0.001 mm geometric accuracy of the primary articulating surfaces. Computational structural analysis was conducted on the generated CAD model with the femoral component and tibial insert material of Cobalt Chromium Molybdenum Alloy (CoCrMo), and Ultra High Molecular Weight Polyethylene (UHMWPE), respectively. The model was loaded statically under a normal load of 1767.56 N corresponding to the maximum normal load during the patient gait cycle. The results of the computational analysis conclude the maximum tibial contact pressures of CoCrMo-UHMWPE standard knee implant, under a normal static load of 1767.56 N, to be 15.28 MPa, while that of a modified knee implant to be 3.369 MPa. The comparison of results for both designs shows that the modified TKR decreased the contact pressure by 78%. A lower value of contact pressure under the same loading conditions, means a lower wear rate and consequently a longer lifespan. Comparison of results with strain map of an actual tibial cartilage confirms that the modified TKR contact area is in greater agreement with an actual knee joint.

Keywords: Total Knee Replacement; Computational Analysis; Reverse Engineering; Knee Implant

BEB6934: Sonographic Assessment of The Efficacy of Essure Hysteroscopic Sterilization

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Abstract. Essure (Bayer AG, Leverkusen, Germany) is a hysteroscopic sterilization procedure. The efficacy of the sterilization procedure is assessed by a confirmation test, which is performed to evaluate the micro-insert position or tubal occlusion. Of all different imaging techniques, a confirmation with hysterosalpingography (HSG) is the reference standard. 2-dimensional (2D) transvaginal ultrasonography was proposed to be an adequate noninvasive method for assessment of micro-insert position, however when sterilization is complicated or when the confirmation with 2D transvaginal ultrasonography is unsatisfactory, HSG is still indicated. A few years ago, hysterosalpingo-foam sonography (HyFoSy) was introduced and was suggested to be a possible less invasive alternative to HSG. Our prospective study included patients, who underwent three different

confirmation tests after Essure hysteroscopic sterilization. The purpose of our study was to evaluate the accuracy of sonographic imaging techniques for assessment of the efficacy of Essure.

Keywords: Hysteroscopic Sterilization; 2D Transvaginal Ultrasonography; Hysterosalpingo-Foam Sonography; Hysterosalpingography

Acknowledgements: We would like to thank the University Medical Centre Maribor for help and support.

BEB6989: The Characteristics of BOLD-fMRI in the Brain during under Free and Resistant Flexion Resistant Flexion Tasks

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Abstract. Blood oxygen level dependent magnetic resonance imaging (BOLD-fMRI) is an effective means to study the higher activity of human brain ,which can reflect activity in various brain regions. In this study, eight volunteers were enrolled for the task activity during free and resistant elbow flexion tasks. The results showed that some brain areas, including the contralateral sensorimotor area, bilateral supplementary motor area and ipsilateral cerebellum, were activated during both free and resistant elbow flexion. However, the activation of the sensorimotor area, supplementary motor area and premotor cortex during the free elbow flexion task was greater than that during resistant elbow flexion. This suggests that resistance exercise is more conducive to the study of brain function of single functional muscle groups and provides a new way to study the brain activity of single functional muscle group.

Keywords: BOLD-fMRI; Functional Plasticity; Elbow Flexion

MIST1092: The Role of Lutetium-177 in Radionuclide Therapy

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Abstract. Cancer is still one of the major health issues all around the world. Although treatment options mainly comprise chemotherapy, surgery and external radiotherapy, radionuclide therapy possesses a critical role in the improvement of life quality for patients with metastatic and advanced-stage cancer. Lutetium-177 (^{177}Lu) is a theranostic radionuclide with a physical half-life of 6.7 days, emitting beta (β^-) particle (0.133 MeV) and gamma (γ) ray (113 keV and 208 keV). It is one of the most commonly used radionuclides to develop therapeutic radiopharmaceuticals for imaging and treatment of different diseases especially for cancer. The lower β^- emmision energy and shorter maximal tissue penetration of ^{177}Lu provide lesser damage on neighboring healthy tissues compared with other radionuclide therapies such as Yttrium-90 (^{90}Y) based one. Besides, the progression of diseases can be followed up by single-photon emission tomography or γ camera thanks to γ ray ^{177}Lu. $^{177}Lu^{+3}$ can conjugate with various molecules (e.g., antibodies, peptides, antigens, antibiotics, glycoproteins, hydroxyapatite minerals) with or without using chelating agent due to its empty s, p,

and d orbitals. Therefore, numerous studies regarding ^{177}Lu labeled different molecules or drug delivery systems (e.g., gold nanoparticles, microspheres, zirconia particles) have been performed in the literature. In the light of this information, this presentation summarizes the current clinical or preclinical studies regarding ^{177}Lu radiopharmaceuticals as cancer theranostic agents.

Keywords: Lutetium-177; Theranostic; Radionuclide Therapy

BEB6966: The Mitral Valve Architecture: a Mix of Golden Ratio, Fibonacci Sequence and Fractal Geometry. A Twist of Fate or a Planned Natural Project?

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Abstract. The Mitral Valve is undoubtedly the most studied cardiac valve. It shows a unique architecture and is usually referred to as a very complex anatomical entity: Annulus, Leaflets, Scallops, Commissures, Subvalvular Apparatus are only some of the elements used to describe its structure.
The tremendous progress in imaging techniques has made them a foundation for valve analysis. The number of retrievable measurements can now describe a wide series of anatomical and geometrical aspects. Moreover, the huge number of studies published in the last decades has also allowed identifying normality ranges and led to an enormous improvement in anatomical description, particularly when diagnosing or treating a diseased valve.
Golden Ratio, Fibonacci Sequence and Fractals are peculiar mathematical and geometrical entities, which appear ubiquitous in Nature, show a strong connection one another and present astonishing aspects, often crossing over into philosophy.
Our research has raised the suspect that a fractal structure, based on Golden Ratio and following the pattern of Fibonacci Sequence, could define the whole spatial architecture of the normal Mitral Valve. According to this, a 3D geometrical model has been obtained, putting these elements toghether and through very simple calculations.
This 3D a model, used as a reference for imaging studies on normal valves, has allowed leading to the same normality ranges described in literature.
Similarly, even if results are still under investigation, the same model has also shown encouragingly useful for surgical Mitral repair in children, where normality ranges are yet to be defined and available devices not suitable.

Keywords: Mitral Valve; Golden Ratio; Fibonacci Sequence; Fractal Geometry

BEB6827: Use of Indocyanine Green Fluorescence Imaging in the Extrahepatic Biliary Tract Surgery

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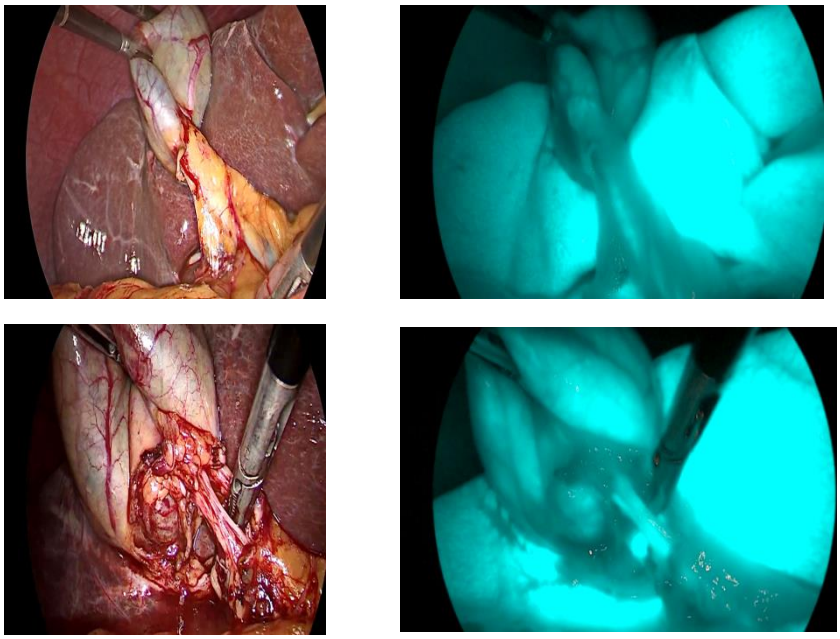
Abstract. Cholelithiasis presents in approximately 20 % of the total population, ranging between 10% and 30 %. It presents one of the most common causes for non-malignant surgical treatment. The cornerstone therapy is laparoscopic cholecystectomy, urgent of elective. Laparoscopic cholecystectomy is nowadays the gold standard surgical treatment method, however bile duct injury occurred to as high as 0.4-3% of all laparoscopic cholecystectomies. The percentage has decreased significantly to 0.26-0.7% because of increased surgical experience and advances in laparoscopic imaging the past decade which have brought to light new achievements and new methods for better intraoperative visualization such as HD and 3D imaging system. However, bile duct injury remains a significant issue and indocyanine green fluorescence imaging, mainly cholangiography but also angiography, can further enhance the safety of laparoscopic cholecystectomy as it allows the earlier recognition of the cystic and common bile duct, even in several times before dissecting the Callot triangle. Fluorescence cholangiography could be an ideal method in order to improve bile tree anatomy identification and enhance prevention of iatrogenic injuries during laparoscopic cholecystectomies and also it could be helpful in young surgeons training because it provides enhanced intraoperative safety, but however this method does not replace CVS. Finally, our ongoing current study results comparing intravenous to direct administration of ICG in the gallbladder will be presented.

Keywords: Indocyanine Green (ICG); Fluoresence; Image Guided Surgery



Part II – Poster Presentations

BEB6744: Couplings Analyses between Functional and Structural Brain Networks in Alzheimer's Disease

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Abstract: The couplings of functional and structural networks are difficult to address due to the complicated alternations in Alzheimer's disease (AD). A cohort of 112 cases [normal control group (NC, 62 cases), mild cognitive impairment group (MCI, 31 cases), and AD group (19 cases)], was recruited, and the brain networks of rsfMRI-function connectivity (rsfMRI-FC), diffusion tensor imaging (DTI)-structure connectivity (DTI-SC), and sMRI-SC were constructed. The FC-SC couplings were evaluated with Pearson correlation coefficient and Bonferroni multiple comparison correction. Further, the associations between the FC-SC couplings and the neuropsychological scores of the Mini-Mental State Examination (MMSE), Clinical Dementia Rating-sum of boxes (CDR-SB), Functional Activities Questionnaire (FAQ), and Montreal Cognitive Assessment (MoCA) were inferred by partial correlation analyses. The results showed significant correlations between rsfMRI-FC/DTI-SC and rsfMRI-FC/sMRI-SC (P<0.05), and no significant correlation for DTI-SC/sMRI-SC (P>0.05). Moreover, the coupling strength of rsfMRI-FC/DTI-SC showed a negative correlation with the MMSE score, a positive correlation with the CDR-SB and FAQ scores (P < 0.05), and no correlation with the MoCA score (P>0.05). However, the coupling strength of rsfMRI-FC/sMRI-SC was not correlated with any neuropsychological scores (P>0.05). It was concluded that distinct couplings for FC-SCs, except for the noncoupling of SCs, and inconsistent FC-SC couplings existed with the AD progress.

Keywords: Alzheimer's Disease (AD); Function Connectivity (FC); Functional Magnetic Resonance Imaging (fMRI); Structural Magnetic Resonance Imaging (sMRI); Structure Connectivity (SC)

BEB6747: GSEnet: Feature Extraction of Gene Expression Data and its Application to Leukemia Classification

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Abstract. Gene expression data is highly dimensional. As disease-related genes account for only a tiny fraction, a deep learning model, namely GSEnet, is proposed to extract instructive features from

gene expression data. This model consists of three modules, namely the pre-conv module, the SE-Resnet module, and the SE-conv module. Effectiveness of the proposed model on the performance improvement of 9 representative classifiers is evaluated. 7 evaluation metrics are used for this assessment on the GSE99095 dataset. Robustness and advantages of the proposed model compared with representative feature selection methods are also discussed. Results show superiority of the proposed model on the improvement of the classification precision and accuracy.

Keywords: Deep Learning; Gene Expression; Feature Extraction; Resnet; SEnet

BEB6772: Anthropometry, Motion Range, and Muscle Strength Measurements of Amputees for Designing Large-Scale Agricultural Equipment

To avoid repeatability issue, this abstract will be available after the full paper is published.

BEB6947: Dual-Task Mutual Learning for Weakly-Supervised COVID-19 Lesion Segmentation from Chest CT

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Abstract. In this study, we designed a dual-task mutual network for weakly supervised the new coronavirus pneumonia (COVID-19) lesions segmentation based on gradient-weighted class activation mapping (Grad-CAM) [1] for coarse labels and multi-instance learning [2] for fine labels. This is a dataset of 100 axial CT images from more than 40 patients with COVID-19 to verify the effectiveness of the framework. The coarse-to-fine strategy could achieve the highest weakly supervised segmentation accuracy only relying on the classification label.

COVID-19 has broken all over the world. Detection and diagnosis are very important basis for the control of COVID-19. The reverse-transcription polymerase chain reaction (RT-PCR) test still is the gold standard for diagnosis, but the test is high false-negative rate and low sensitivity. It poses a great challenge to the prevention and treatment of infectious diseases.

Various deep learning-based methods for COVID-19 image segmentation have also been proposed, but manual labeling is time-consuming and prone to label noise due to the low contrast boundary of lesions. Hence, we designed a dual-task COVID-19 image segmentation network that only needed classification labels and verified it on 100 CT image datasets. The network is divided into four parts shown in Figure1. First, to avoid interference with the surrounding tissue, we used threshold segmentation to obtain the lung region. Second, we trained a classification network with and without the lesions and visualized the location of lesions through Grad-CAM. In this way, the coarse label for segmentation is obtained. Then, the coarse labels are subdivided into 5*5 patches, which are used as instances for MIL tasks by gradually training the tasks from easy to difficult. The network has a high classification accuracy. Finally, we used fine labels to refine the segmentation results using supervised methods. Figure 1 illustrates the dual-task mutual algorithm. We adopt typical metrics in COVID-19 lung infection quantification on the 100 CT datasets, i.e. the Dice Score, Intersection over Union (IoU), Positive Predicted Value (PPV), Sensitivity, and Specificity for evaluation in table1. The main contribution of this work is to propose a new weakly supervised segmentation model, which combines grad-cam and MIL-based measurements. The coarse-to-fine strategy could

improve the segmentation performance. Finally, we demonstrate the feasibility and effectiveness of our proposed method by comparing it with published weakly supervised image classification methods. Further work will focus on :(1) increasing the number of training samples to avoid overfitting; (2) not only using the area of lesions as multi-classification labels but also adding other features such as location and texture as multi-classification labels lesions.

Keywords: Weakly-Supervised Learning; COVID-19 Lesion; Image Segmentation

Reference:

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[3]Wang X, Deng X, Fu Q, et al. A weakly-supervised framework for COVID-19 classification and lesion localization from chest CT[J]. IEEE transactions on medical imaging, 2020, 39(8): 2615-2625.

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Table1. Quantitative results of COVID-19 segmentation on the datasets.

	Dice	IoU	PPV	Sensitivity	Specificity
DeCov[3]	0.72	0.56	0.73	0.70	0.98
AD3D-MIL[4]	0.68	0.51	0.56	0.85	0.99
Ours	0.74	0.57	0.65	0.85	0.97

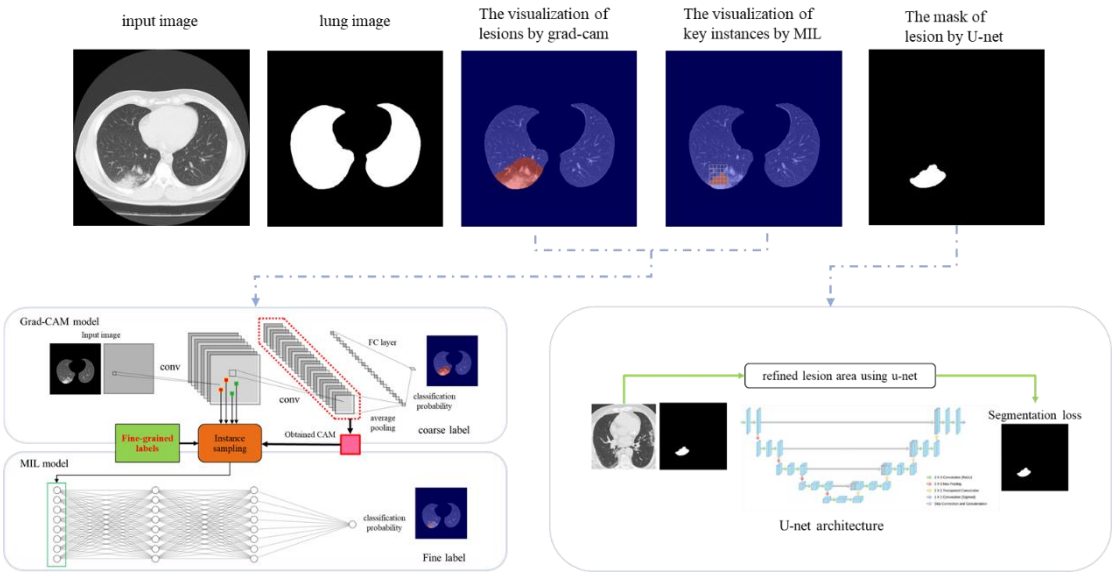

Figure1. The pipeline of weakly-supervised lesion localization.

BEB6773: Sleep Monitoring for Individuals with Spinal Cord Injury using Contact-Free Bed Sensors

To avoid repeatability issue, this abstract will be available after the full paper is published.

BEB6899: Preliminary Study on Multimedia Animation for Methadone Maintenance Therapy Supplemented by Traditional Chinese Medicine Acupuncture

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Abstract. Heroin addiction may cause physical and emotional trauma. In addition, because they share needles to inject drugs, heroin abusers are at higher risk of developing acquired immunodeficiency syndrome, and 70 to 90% of them have been infected with the hepatitis C virus. This study, in collaboration with a Chinese medicine hospital in Taipei, aims to design a multimedia animation for methadone maintenance therapy. The existing sheets, forms, presentations, videos, and data related to drug rehabilitation plans and assessment questionnaires for shared decision-making were collected. The information was presented in 2D and 3D animation through such multimedia content as images, voice, text, and animation. It was mainly created using 3ds Max and chosen for its camera lens and angles capable of showing scenes and characters in detail, thus making the animation more realistic. The primary purpose of this study is to make 3D animation easier for the viewer to understand. It discusses the choice of lens, images, and angles and how the filming techniques are applied in 3D animation to make the information easier to obtain. The animation created by this study will help clinicians to explain the whole methadone maintenance therapy process and provide relevant information about methadone, traditional Chinese medicine acupuncture, and mental health clinics. The study will help heroin abusers feel at ease with the treatment and succeed in quitting their addiction.

Keywords: Heroin Addiction**;** Methadone Maintenance Therapy; Traditional Chinese Medicine Acupuncture; Multimedia Animation

Acknowledgements: Author thanks the Linsen Chinese Medicine and Kunming Branch of Taipei City Hospital for their supports.

BEB6803: A Multiprocessing Framework for Heterogeneous Biomedical Embedded Systems with the Proposal of a Finite State Machine-based Architecture

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Abstract. The applications of heterogeneous embedded systems for biomedical engineering are promising, as quick response of biomedical systems is often required due to the life-saving nature of biomedical engineering, and multiple devices with completely different cores and designs can be

involved in a single patient. In this paper, we propose a multiprocessing framework and then, with regard to the framework, we propose an architecture for heterogeneous embedded systems that uses finite state machines (FSMs). A multithreading method on an electrocardiogram (ECG) software is implemented as the verification of our framework.

Keywords: Multiprocessing Framework; Heterogeneous Embedded Systems; Finite State Machine

BEB6811: Ixazomib Combined with Autologous Stem Cell Transplantation for POEMS Syndrome: a Case Report and Meta-analysis

To avoid repeatability issue, this abstract will be available after the full paper is published.

BEB6843: An Intraoperative Correction Method of Maxillofacial Surgery Based on Laser Scanner

To avoid repeatability issue, this abstract will be available after the full paper is published.

BEB6867: The Effect of Nutrition Education on Self-Care of Patients with Gastric Cancer undergoing Chemotherapy

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Abstract. The purpose of this research was to investigate the effect of nutrition education on self-care of patients with gastric cancer undergoing chemotherapy.In a randomized controlled study before and after, 40 patients with gastric cancer undergoing chemotherapy surgery were selected as a group and divided into two interventions (20) and control (20 patients). Both groups were given a questionnaire for daily dietary patterns and individual characteristics. The intervention group then participated in 3 sessions of 1 hour at the time of admission according to the designed program. Daily diet training and more familiarity of the patient with the side effects of chemotherapy, the effect of nutrition in preventing their side effects, diet to control pain and symptoms to the patient. At the end of the training sessions, educational materials were presented to patients in the form of booklets. They were then given two months to apply new nutritional patterns to their daily lives. After the questionnaires were completed again by both groups and tested using Chi-square, t-test and Spss software. This study showed that there was a significant relationship between proper nutrition and improvement of cancer symptoms. Dietary pattern improved significantly in the intervention group after the intervention but in the control group the mean score of the dietary pattern decreased. (p=0/001)Findings show the effect of educational program on improving the nutritional knowledge of cancer patients. Nutritionists can help improve the health and eating habits of people at risk and those with cancer through training and counseling.

Keywords: Gastric Cancer; Proper Nutrition for Cancer Patients; Self-Care; Risk Factor

Acknowledgements: I would like to thank the 2 dear professors, Dr. Ali Sabouri and Dr. Ziauddin Mazhari., for their efforts and support in this project.

BEB6844: Designing a Novel Cost-Effective Device to Prevent Perineal Tears during Labor

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Abstract. 9 in 10 first-time births result in some form of perineal laceration. Such an injury can generate long-term challenges to a mother's mental and physical health. The goal of this project is to design a device that can decrease the risk of perineal tears during childbirth. Several designs and materials were tested on a CAD model of the female pelvic anatomy (the vaginal opening, perineum, and anal opening) until the optimal design was produced. First, the model was stress-tested without the device at forces of 22.3 N, 37.8 N, and 31.3 N. The model was then tested again with the device attached to determine the effectiveness of the design in reducing the stress at each level. Multiple stress tests were administered to ensure authentic results. Statistical analysis was then conducted between the mean stress values of each group. All three t-tests yielded a p-value less than the declared alpha value of 0.05, thereby indicating that the device significantly reduced the amount of strain placed on the perineum, and ultimately, minimized the risk of a perineal tear. Further testing and modifications will be continuously made to improve this device.

Keywords: CAD Model; Mechanical Simulation; Optimal Design

BEB6859: Treadmill Exercise Attenuates Tau Hyperphosphorylation via Activation of the PI3K/Akt/GSK-3β Signaling Pathway in the Streptozotocin-induced Alzheimer's Disease Rats Model

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Abstract. Exercise has been found to be beneficial in the treatment and prevention of cognitive impairments in Alzheimer's disease (AD), although the mechanism is not completely understood. The purpose of this study was to examine the effects of treadmill exercise on tau phosphorylation in the hippocampus of streptozotocin (STZ)-treated rats, and investigate whether or not these effects were mediated through the PI3K/Akt/GSK-3β pathway.Rats were divided into three groups as Sham-con group (n = 10), STZ-con group (n = 10) and STZ-exe group (n = 10). Exercise group underwent treadmill exercise (30 min/day, 5 days/week) for 12weeks after bilateral STZ intracerebroventricular injection (2.4 mg/kg). The ability of learning and memory of rats were

detected by Morris water maze. Rat hippocampal CA3 region was observed histologically and through Nissl staining .The expression levels of tau protein and the related protein in the PI3K /Akt /Gsk3β signal pathway were detected in STZ-con group by Western Blot method. Results show that STZ-exe group has improved cognitive function compared to STZ-con group. In STZ-exe group, the hippocampal CA3 region had a regular pattern of neural cells, pyramidal cells, and a larger number of Nissl bodies. In STZ-exe group, the expression of tau (ser202) protein was significantly reduced (P ＜0. 01) , PI3K, p-Akt/Akt, p- Gsk3β /Gsk3β were found to be significantly upregulated (P＜ 0.05) in STZ-exe group. **Conclusion:** Treadmill exercise decreased tau phosphorylation via PI3K / Akt / GSK3β signaling pathway.

Keywords: Alzheimer′s Disease; Tau Phosphorylation; PI3K/Akt/GSK-3β Signaling Pathway

Acknowledgements: Natural Science Foundation of Shandong Province,china(ZR2016HM61)

BEB6866: Evaluation of Safety and Efficacy of IMFLUNA Herbal Compound on Improving the Symptoms and Complications of Patients with COVID 19

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[2]*Medicinal Plants Research Center, Institute of Medicinal Plants, ACECR, Karaj, I.R.Iran*
[3]*Infectious Diseases Department, Mashhad University of Medical Sciences, Mashhad, Iran*

Abstract. The current pandemic of Coronavirus disease 2019 (COVID-19) and severity of the infection and high mortality have almost unprecedented challenges in the health systems of most countries around the world. The present study aimed to evaluate the effect of traditional Iranian polyherbal formulation (Imfluna) on symptoms of COVID-19 infected patients. The herbal remedy for Imfluna had a significant effect on pulmonary involvement and reduced pulmonary involvement, the severity of shortness of breath, alanine aminotransferase (ALT), sodium (Na) in the post-test phase. Also, the average CBC count and percentage of blood oxygen saturation increased in both experimental and control groups. In addition to, the mean CBC count and percentage of blood oxygen saturation of the control group increased significantly.

Keywords: Clinical Trial; COVID-19; Polyherbal Medicine; Imfluna

Acknowledgements: We thank Dr. Morteza Khairabadi, head of Homapharmad Pharmaceutical Company, for financially supporting this study, Hadi Khairabadi for coordinating the collection of plants and seeking the extraction and preparation of medicine, and Mehdi Khairabadi to bring together the research team and group liaison, Reza Mirzaei for consulting in the selection and dosage of medicinal plants and botanist Dr. Gorbani to identify medicinal plants. We also thank Baqiyatallah University of Medical Sciences for conducting this clinical trial and the ACECR Institute of Medicinal Plants for providing herbal medicine and placebo.

BEB6900: A Paradox of Immersion: The Role of Flow In Short-form Video Problematic Use

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Abstract. With the limited hardware resources of the smartphone, will people enter into the state of flow when using short-form video (SFV)? The present study examines whether the flow can help explain user SFV problematic use while interactivity and interest are operated as the antecedents of flow. We propose a problematic use framework based on flow theory. Specifically, flow serves as a second-order formative construct with four reflective dimensions: curiosity, focused immersion, heightened enjoyment, and temporal dissociation. Partial least square structural equation modelling was applied to analyze the data collected from 327 TikTok users. The results showed that flow, fueled by interactivity and interest, is positively related to SFV problematic use. More, interactivity and interest themselves were also significantly associated with problematic use. Surprised, curiosity and focused immersion do not formative flow of SFV. To the best of our knowledge, we are the first study to posit that users still enter into the state of flow when using SFV on the smartphone, which using contexts are drastically different from fixed desktop. It indicates that flow theory popular in the desktop-based software age can still apply and serve as a basis for more studies in the smartphone context. As interactivity and interest are conducive to flow, leading to problematic use, an SFV App can be more popular if the two factors are incorporated.

Keywords: Flow; Problematic Use; Second-Order Construct; TikTok

Acknowledgments: Authors thank the Far Eastern Memorial Hospital for all support.

BEB6948: A Highly Accurate and Robust Mouse Pose Estimation Pipeline Based on Maze Experiment

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Abstract. In this study, we design an analysis pipeline and develop a highly accurate mouse pose estimation system based on the maze experiment, then validate it against a dataset of 60w experimental images. The accuracy rate of our pipeline improves for almost 10%, relative to the previous results on the maze experiment.Accurate quantification of behavior is essential for understanding the brain. However, dealt with data manually is time-consuming and error-prone that is prohibitively inefficient at today's high rates of data acquisition. An automatic identification method with high accuracy is urgently needed to analyze the mouse pose. Although previous attempts have been made in pose estimation of humans and mice using deep features, the low resolution, light changes, and posture variation are still challenging to identify the key points. We design an analysis pipeline for the mouse pose estimation system based on the maze experiment, then validate it against a dataset of 60w experimental images.In this study, we proposed a pipeline to the mouse pose estimation as shown in Fig.1.The pipeline included centroid identification, key-points estimation, and results verification.
Firstly, the mouse moved in the fixed area and the ROI was picked to be as small as possible while containing the behavior for computational efficiency. Subsequently, we used particle filter to localize

the mice centroid. According to the centroid, the target region size was reduced to avoid the interference of other factors such as the surrounding objects. Furthermore, we manually labeled various body parts and trained a ResNet-50 neural network architecture to predict the body-part locations on the basis of the corresponding image. Finally, we developed auxiliary tools to support the process for browsing and verifying results easily as shown in Fig2.

The pipeline we proposed has a good performance in the maze experiment. The accuracy reached 97.0% (which is less than the 20 pixels radius) when tested on 60w data sets (the size of image 1024×1280 pixels), which was much higher than the average level of the network. These results are presented in Table 1.

The main contribution of this pipeline is to provide a complete system with high accuracy and high robustness for the identification of the mouse key-points, including the centroid, snout, and tail, and then the revision and presentation processes. This is a complete system that can be used for standardized batch processing.

Keywords: Pose Estimation; Object Detection; Computational Behavior Science

References:

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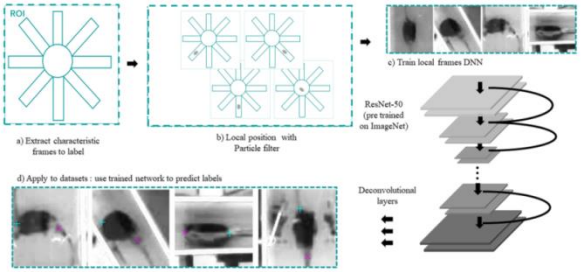

Figure 1. The pipeline flow diagram of the quantitative measurement of mouse pose estimation. a) Extract images with distinct postures characteristic of animal behavior and select the region of interest. b) Local mouse position with particle filter. c)Train a Resnet-50 neural network (DNN) to predict the body-part locations and the weights are adjusted in an iterative fashion such that for a given frame the network assigns high probabilities to labeled body part locations and low probabilities elsewhere .d)the trained network was applied to new and unlabeled data to produce a probabilistic estimate of the position of each tracked body part. The images show the most likely body part locations for the snout and tail parts of a mouse

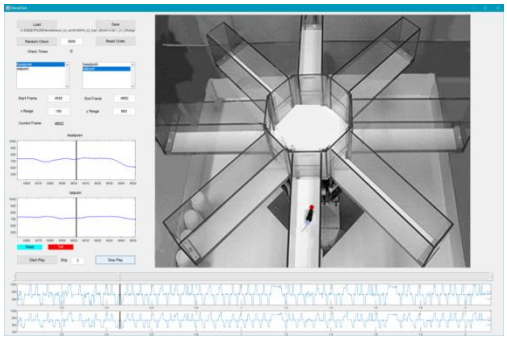

Figure2.The graphical user interface provides browsing and verifying capabilities for the results.

BEB6903: Research on Magnetically Mediated Thermoacoustic Imaging Based on B-Scan

To avoid repeatability issue, this abstract will be available after the full paper is published.

BEB6904: A Simulation System Design on Radiography: a Preliminary Study

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Abstract. Most radiologic technology programs teach students positioning and radiation dose techniques in a traditional X-ray laboratory. Virtual simulation provides a safe and convenient learning environment where students can practice techniques without the risk of irradiating patients. Instructors can foster deep learning in virtual simulation laboratory environments by designing the software around specific course outcomes and engaging in sound educational strategies and theory. This study aimed to design a virtual reality based simulation system to assist radiography staff and related professionals improve their operational skills and, as a result, promote the development of precise radiography. Autodesk 3ds Max and Unity 3D were used to develop a VR simulation model, followed by programming in the C# language and Visual Studio compiler. This study focused on developing VR scenes, learning prompts, quizzes, virtual software pages, and action-triggered content. This study sequentially models the pre-planned simulation scenes before importing the completed model into Unity. The light source is subsequently adjusted to make the scene more realistic. Once the scene is constructed, the VR device is connected to Unity through the API. After the compilation is executed, the API will immediately judge and process the tracking information of the locator, output it as an image through operations in Unity, and send it back to the helmet to achieve the final visual feedback effects. This study applied virtual reality technologies to the design and development of a virtual reality radiography situation simulation system, thereby making the end product both feasible and applicable in real-world scenarios.

Keywords: Radiography; Simulation System Design; Virtual Reality; Unity

Acknowledgements: Author thanks the Radiation Oncology Division of Far-Eastern Memorial Hospital for their supports.

BEB6949: A Mouse Pose Estimation Method Based on Contour Curvature

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Abstract. In this paper, we propose a high accuracy and no-learning algorithm to estimate mouse key points based on curvature space for images with low spatial resolution, which is to achieve a higher accuracy than the convolutional neural network (CNN) approach.

Connecting neural activity with behavior requires methods to parse what an animal does into its movements of body parts, which can then be connected with the neuronal activity that generates each action. Human classification of behavior is extremely slow and subject to bias and automatic identification is dynamic, complex and seemingly noisy for natural behavior. Although previous attempts have been made in pose estimation of human and mice using deep features, the low spatial resolution for the maze experiment dataset and the adaptability and generalization of the machine learning model are still challenging to identify the key points. We implement a recognition algorithm for mouse pose estimation, then validated it against a dataset of 2w experimental images.

In this study, we proposed the no-learning algorithm to the mouse pose estimation as shown in Fig.1. Firstly, the region of interest (ROI) was determined manually for computational efficiency. Subsequently, we used the particle filter to localize the mice centroid. And then we used the active contour model to define the mouse profile in the part image containing the target. The binary map was obtained by using the mouse profile. As we all know, the mouse profile is approximately ellipse, but ellipse fitting parameters is complex and hardly find the best solution. So we used principal component analysis (PCA) to obtain the eigenvectors and corresponding eigenvalues for the mouse profile matrices and transform the datasets onto the new subspace. And then the largest eigenvalues were choosen which is the mouse two body parts (head and tail) according to the projection. The process is shown in Fig.2. Finally, we distinguished the specific position of head and tail by the distance of adjacent frames.

The method we proposed has a good performance in the low spatial resolution image. The accuracy reached 87.4% (which is less than the 20 pixels radius) when tested on 2w datasets (the size of image 1024×1280 pixels), which achieved a higher accuracy than the convolutional neural network (CNN) approach. Moreover, our method is no-learning which avoids training models and makes it flexible to adapt to different experiment environments. These results are presented in Table 1.

The main contribution of this method is to provide a no-learning approach with a higher accuracy than the convolutional neural network for the identification of the mouse key-points in the low spatial resolution dataset.

Keywords: Pose Estimation; Contour Curvature; Convolutional Neural Network

Reference:

[1] Pereira, Talmo D., et al. "Fast animal pose estimation using deep neural networks." Nature methods 16.1 (2019): 117-125.

Tabe l. Detection results on the 2w maze datasets.

	CNN[1]	Particle filter +CNN[1]	**Ours**
Accuracy (~20pixels)	0.6699	0.8568	**0.8743**

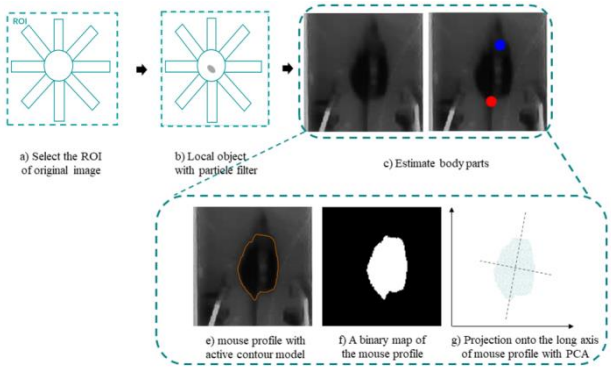

Figure1. Overview of the pose estimation workflow. a) Select the region of interest of the original image to avoid object interference. b) Local the mice centroid with particle filter. c)estimate body parts. mouse profile is obtained with the active contour model and PCA was used to find the long axis of the mouse contour(e-g). d) Convert the local point coordinates back to the original image

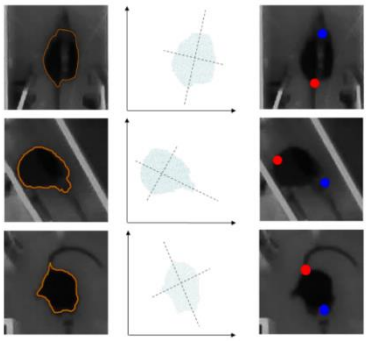

Figure2. Examples showing the typical recognition result with active contour model and PCA. The left three images are contour segmentation results, and those in the middle show the eigenvectors computed with the dataset. The right images are the final recognition results.

BEB6956: Spatiotemporal Patterns of Cutaneous Leishmaniasis in the District Upper and Lower Dir, Khyber Pakhtunkhwa, Pakistan: A GIS-based Spatial Approaches

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Highlights

- Cutaneous leishmaniasis is a neglected tropical disease and has been sharply expanding from CL endemic to non-endemic regions.
- Clinico-epidemiological and spatio-temporal patterns of CL were assessed in this study using CL documented data (2014-2018).
- Based on ArcGIS software, the concealed CL hubs were determined located in the least elevated central regions (948-1947m elevation) with a proximal distribution of CL in the nearby villages.
- Hot spot and Cluster and Outlier analysis revealed that Tehsil Khal was the high-risk CL foci which need proper control strategies to restrict future epidemics.

Abstract. While Cutaneous leishmaniasis (CL) is not a life-threatening disease, it leads to devastating effects on local community. CL is widely scattered manifesting a noticeable epidemiological pattern around the globe. The present study was planned to address the role of Geographic Information System (GIS) using CL clinico-epidemiological data to determine the high-risk areas of CL. Recorded data (2014-2018) of 3630 positive individuals was collected from Basic Health Units of the Upper and Lower Dir Districts, Khyber Pakhtunkhwa, Pakistan. Descriptive and statistical analysis was used for clinico-epidemiological characterization. For spatial analysis, ArcGIS V.10.3 was used and the CL average incidence was tagged on the proportional, choropleth, and digital elevation model maps. For focal transmission and high-risk zones, Inverse Density Weight (IDW) spatial interpolation, focal statistics, hot spot, cluster and outlier, and

Bayesian geostatistical analysis were used. The trend of CL cases was elevated from 2014 to 2016 except for 2017 and 2018. Individuals of both genders younger than 20 years old were highly susceptible. Single lesions were more prominent (56%) and frequently affected facial parts (51%). The size and pretreatment duration of the CL lesion was significantly associated. Spatially, a choropleth map displayed the maximum CL incidences in Tehsil Balambat, Khal, and Termergara (31%-13%) located within a range of 948-1947m elevation in the central regions with proximal CL transmissions. Hot spot and cluster and outlier analysis affirmed that Tehsil Khal was the high-risk CL foci. The Bayesian geostatistical analysis revealed high temperature, less altitude, and annual precipitation as important risk factors. An increasing trend in CL transmission has become evident, affecting both genders and <20 years old children. GIS resolute the concealed CL hubs in the least elevated central regions which warrant the control strategies to restrict future epidemics.

Keywords: Cutaneous Leishmaniasis; Clinico-Epidemiology; Spatiotemporal; Spatial Analysis.

BEB6959: The Filum Disease and the Neuro-Cranio-vertebral Syndrome: Definition, Clinical Picture and Imaging Features

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Abstract. Background: We propose two new concepts, the Filum Disease (FD) and the Neuro-cranio-vertebral syndrome (NCVS), that group together conditions thus far considered idiopathic, such as Arnold-Chiari Syndrome Type I (ACSI), Idiopathic Syringomyelia (ISM), Idiopathic Scoliosis (IS), Basilar Impression (BI), Platybasia (PTB) Retroflexed Odontoid (RO) and Brainstem Kinking (BSK). **Methods:** We describe the symptomatology, the clinical course and the neurological signs of the new nosological entities as well as the changes visible on imaging studies in a series of 373 patients. **Results:** Our series included 72% women with a mean age of 33.66 years; 48% of the patients had an interval from onset to diagnosis longer than 10 years and 64% had a progressive clinical course. The commonest symptoms were: headache 84%, lumbosacral pain 72%, cervical pain 72%, balance alteration 72% and paresthesias 70%. The commonest neurological signs were: altered deep tendon reflexes in upper extremities 86%, altered deep tendon reflexes in lower extremities 82%, altered plantar reflexes 73%, decreased grip strength 70%, altered sensibility to temperature 69%, altered abdominal reflexes 68%, positive Mingazzini's test 66%, altered sensibility to touch 65% and deviation of the uvula and/or tongue 64%. The imaging features most often seen were: altered position of cerebellar tonsils 93%, low-lying Conus medullaris below the T12L1 disc 88%, idiopathic scoliosis 76%, multiple disc disease 72% and syringomyelic cavities 52%. **Conclusions:** This is a paradigm shift that opens up new paths for research and broadens the range of therapeutics available to these patients.

Keywords: Arnold-Chiari Syndrome; Syringomyelia; Scoliosis; Filum Terminale

Acknowledgements: We thank all the other staff at the Institut Chiari & Siringomielia & Escoliosis de Barcelona that have contributed to patient care and data collection, preparation and analysis. We thank all our patients and caregivers, without whom this work would not have been possible.

BEB6950: A Screening System for Recognition Results of Animal Pose Estimation Based on Deep Learning

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Abstract. In this study, we designed a suspicious error recognition image screening system based on deep learning, which was verified in 5000 frames of images. Only 25% of the data needed to be checked to achieve 100% accuracy, providing a feasible scheme for the stability and interpretability of deep learning results.

With the brilliant performance of deep learning in the field of image classification, more and more tasks are using deep learning methods, such as image classification, image segmentation, object detection, and other tasks. However, due to deep learning being a black box, it cannot predict the stability of the output results of data, nor can it give the results of identifying errors. Therefore, a method with a clear causal relationship is urgently needed in the medical and financial fields. In the pose estimation task of 2000 frames of animals, we propose a precision inspection expert system based on the combination of network confidence and prior knowledge, which can locate and narrow the range of false frames, help manually correct the number of false identified frames, improve the efficiency of work, and also provide a guarantee for the stability of deep learning results.

The system is divided into two parts, Rejection Expert and Recall Expert. The first part uses the confidence of the neural networks and the prior belief of the coordinates to find out the suspicious frames from the results of the ResNet-50. The suspicious frames include two parts: the true positive part and the false positive part. The second part is further identified from the suspicious frames and retrieved the correct sample as the false positive part by Recall Expert. Here we use ten unsupervised tracing and matching methods, which are unsupervised and inexpensive to implement, including multiple instance learning, kernel correlation filter, boosting, tracking learning detection, median flow, generic object tracking using regression networks, minimum output sum of squared error, pixel-matching method, histogram matching method, and hash matching method. Based on the principle of majority, a more stable tracker is selected and the tracking result is obtained. The tracking results are compared with the detection results. If the two results are similar, we consider the detection results to be credible, as false positive samples. The remaining unrecovered samples need to be manually corrected.

The main contribution of this work is to propose a new interpretable expert system, which can obtain nearly exact identification results with a small amount of checking cost.

Keywords: rejection expert, recall expert, interpretability of deep learning

Reference:

[1] He K, Zhang X, Ren S, et al. Deep residual learning for image recognition[C]// Proceedings of the IEEE conference on computer vision and pattern recognition. 2016: 770-778.

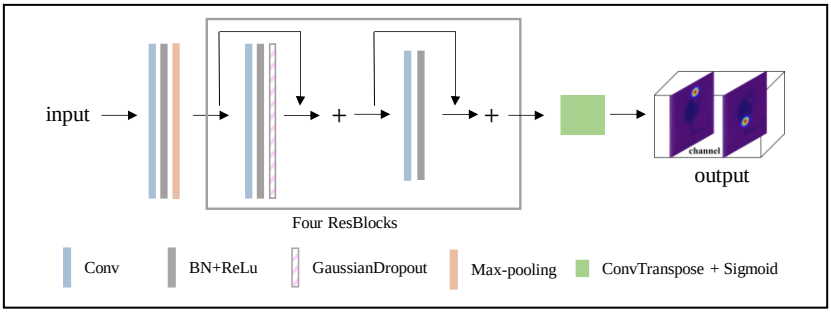

Figure1. Architecture of ResNet50 including MC-dropout layers. Different from the standard ResNet50, it used MC-dropout layers for estimating model uncertainty. Mc-dropout is equivalent to training a bunch of models with shared parameters but different structures.

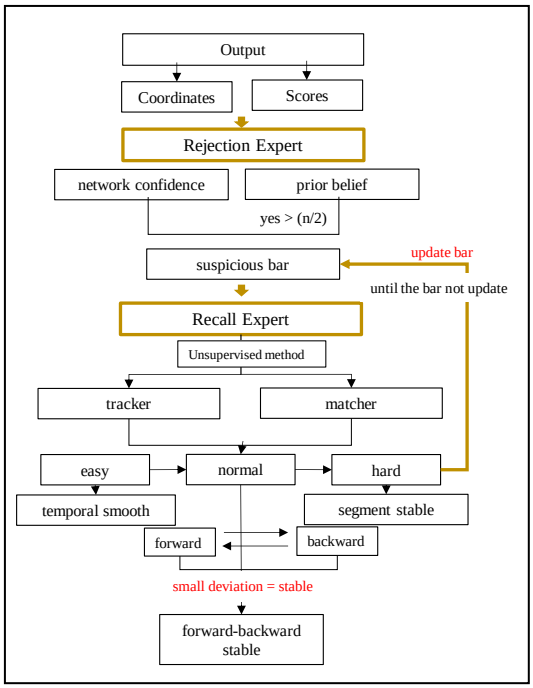

Figure2. precision inspection expert system.

BEB6978: Identification and validation of MicroRNA-mRNA Networks in Dorsal Root Ganglia after Peripheral Nerve Injury

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Abstract. Changes in DRG after nerve injury involve neuronal damage, apoptosis, pain transmission, and activation of regenerative programs. It is unclear which genes and microRNAs may play a major role in this process. Therefore, this study performed a meta-analysis of previously published gene expression data to reveal the potential microRNA-mRNA network in dorsal root ganglia (DRG) after peripheral nerve injury. We searched 5 mRNA and 3 microRNA expression data sets, obtained 447 differentially expressed genes (DEGs) and 5 differentially expressed miRNAs, determined the biological pathways enriched by these DEGs, and further predicted new microRNA-mRNA interactions, such as miR-21/Hmg20a, miR-221/Ube2ql1, miR-30c-1/Rhoq, miR-500/Sema3c, and miR-551b/Cdc42se2. We verified these hub mRNA and miRNA in rats by qRT-PCR and found the results were consistent with the bioinformatics analysis. And we predicted transcription factors associated with these genes (gTFs) and TFs associated with these microRNAs (mTFs) and constructed the mTF-miRNA-gene-gTF regulatory network to further explore the molecular mechanism in DRG. Finally, we compared the DRG transcriptome after PNI to that of chronic constriction injury (CCI), and found that PNI caused greater damage to DRG compared to CCI. At the same time, the related mechanisms of pain caused by the two pathophysiological process may be very different.

Key words: Transcriptome; mRNA; microRNA; Transcription Factors; Peripheral Nerve Injury

BEB6902: Joy or Loneliness? Cognitive Absorption Effect on the Short-form Video Apps problematic Use

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Abstract. Social Short-Form Video Apps (SFV) are embedded in the culture of younger generations. Prior knowledge regarding problematic SFV use focused on dark psychological sides, such as loneliness, stress, or anxiety. Yet the relationship between the enjoyment of using SFV associate with problematic use is rarely noticed. This study investigates TikTok problematic use based on the cognitive absorption theory. More, we compare the degree of cognitive absorption, loneliness, and nomophobia effect on problematic SFV use. Cognitive absorption serves as a second-order construct, formulated by heightened enjoyment, time distortion, curiosity, and focus immersion. A total of 327 respondents were yielded but filtered out 169 TikTok valid respondents. The research model was assessed by the component-based structural equational modelling. The results show that Tiktok users are not lonely. The cognitive absorption of SFV has the most effect on problematic use, followed by nomophobia and loneliness. This study also contributes to the correct second-order model analysis and clarifies the missing use of anxiety and nomophobia.

Keywords: Cognitive Absorption; Problematic Use; Second-Order Construct; TikTok

Acknowledgments: Authors thank the Far Eastern Memorial Hospital for all its support.

BEB6990: Treatment with Soluble Bone Morphogenetic Protein Type 1A Receptor Fusion Protein Alleviates Irradiation-induced Bone Loss in Mice through Increased Bone Formation and Reduced Bone Resorption

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Abstract. An increased fracture risk is often observed in cancer patients undergoing radiotherapy (RT), particularly at sites within the field of radiation. Therefore, the development of appropriate therapeutic options to prevent RT-induced bone loss is urgently needed. A soluble form of the BMP receptor type 1A fusion protein (mBMPR1A-mFc) serves as an antagonist to endogenous BMPR1A. Previous studies have shown that mBMPR1A-mFc treatment increases bone mass in both ovary-intact and ovariectomized via promoting osteoblastic bone formation and inhibiting osteoclastic bone resorption. The present study was designed to investigate whether mBMPR1A-mFc administration prevents radiation-induced bone deterioration in mice. We constructed an animal model of radiation-induced osteoporosis by exposure to a 2-Gy dose of X-rays. Micro-CT, histomorphometry, bone-turnover, and mechanical analyses showed that mBMPR1A-mFc administration prevented trabecular microarchitecture deterioration after RT because of a marked increase in bone formation and a decrease in bone resorption. Mechanistic studies indicated that mBMPR1A-mFc administration promoted osteoblastogenesis by activating Wnt/Lrp5/β-catenin

signaling while decreasing osteoclastogenesis by inhibiting the RANKL/RANK/OPG pathway. Our novel findings provide solid evidence for the application of mBMPR1A-mFc as a therapeutic treatment for radiation-induced osteoporosis.

Keywords: Murine BMP Receptor Type 1A Fusion Protein (mBMPR1A-mFc); Irradiation-Induced Osteoporosis, Wnt/Lrp5/β-catenin, RANK/RANKL/OPG

BEB6992: Motions of Worm-like Drug Particles and their Rheological Properties in Blood Flow

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Abstract. Nanoscale drug particles can achieve efficient, accurate drug delivery and controlled release. However, they need to overcome multiple pathological barriers before reaching the target tissue and target cells. Research found that the particles with non-spherical shape were easier to penetrate the cell barrier and more precisely to reach the target site than spherical ones. In this study, we numerically investigated the rheological properties of worm-like drug particles in the microvessel under a pressure-driven flow. Through simulations, we evaluated the influence of some key factors, such as particle deformability, flow velocity, and blood red cell stiffness on the motion and interaction of worm-like drug particles with red blood cells (RBCs) in micro-scale blood flow. The RBCs and drug particles were described by an elastic spring model through which deformations of moving bodies in flow can be captured. The fluid-body interaction was accomplished by the immersed boundary method. We observed the margination and tumbling of worm-like drug particles and they strongly depended on the blood flow velocity and the deformability of the particles and RBCs. The results showed that less deformable particles exhibited higher tendency of margination and high flow velocity facilitated the tumbling of worm-like particles. We hope the results in the present study can provide a deeper understanding into the factors that govern the biocirculation and biodistribution in microvessels and be useful to the design of a drug delivery system.

Keywords: Drug Delivery; Worm-Like Drug Particles; Red Blood Cells (RBCs)，Rheological Properties

Acknowledgements: The authors thank the support of the National Natural Science Foundation of China (Grant No. 11671203).

BEB6868: The Effect of Acute Caffeine Consumption on the Index of Cardiac Parasympathetic System and Blood Pressure in the Recovery Period after Swimming 400 Meters Girls Swimmers

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[3]*Assistant professor, Islamic Azad University, Department of Exercise Physiology, Tehran, Iran*

Abstract. ***Background and purpose:*** The purpose of this research was to investigate the acute effect of caffeine on cardiac parasympathetic nervous systems recovery following 400-m swimming in swimmer women. ***Methodology:*** 12 swimmer women (20.6 ± 1.5 years; weight 60.1 ± 3.1 kg; height 1.62 ± 0.03 m; body fat 21.5 ± 2.2 %; VO2max 48.8 ± 2.3 ml/kg/min) were submitted to a randomized, crossover and counterbalance study. They were intake 9mg/kg caffeine or placebo. After ingestion, individuals were monitored during 45 minutes, then complete 400 m swimming, followed by 60 minutes of recovery. RMSSD was recorded at the baseline, 45 minutes after caffeine consumption, (0-5 minutes), (10-15 minutes), (30-35 minutes) and (55-60 minutes) after exercise, SBP, DBP was recorded at the baseline, 45 minutes after caffeine consumption, immediately after exercise, 1st, 2nd, 3th, 5th, 10th, 20th, 40th, 60th minutes of recovery period. ***Results:*** RMSSD had no significant changes compared to placebo protocol. Reduced SBP was delayed 1^{st}, 2^{nd}, 3^{rd}, 5^{th} minutes of recovery period in placebo trial compared to caffeine ($P < 0.05$). DBP decreased significantly 30^{th} minute of recovery in placebo trial compared to caffeine ($P < 0.05$). ***Conclusion:*** The study found no evidence for effect of caffeine on cardiac parasympathetic nervous system recovery in swimmer women. Instead, caffeine ingestion inhibited SBP and DBP following endurance exercise.

Keywords: Autonomic Nervous System; Recovery; Blood Pressure; Caffeine

Acknowledgements: I would like to thank the 2 dear professors, Dr. Abdol Rasoul Daneshjoo and Dr. Masoumeh Hosseini, for their efforts and support in this project.

BEB6905: Digital Game Design on Hypoglycemia Dietary Recommendations: a Preliminary Study

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Abstract. With the rapid development of Internet information, modern people rarely spend time reading overly complicated medical education content. Therefore, this study condensed a large amount of information into a few key points and presented them in the form of web games. By simplifying hypoglycemia diet recommendations, this study makes them easy to follow while achieving a preventive effect by encouraging the public to watch our designed website. The study first identified game design priorities based on hypoglycemia dietary recommendations and then used games to improve public understanding of hypoglycemia dietary recommendations. In recent times, people frequently skip lunch to save time, which can lead to physical problems. In addition, although the elderly only eat light food, it does not necessarily mean that they will not develop physical problems. A balanced diet is extremely important. Previous studies have suggested that owing to the lack of nutritional knowledge, people often do not have sufficient body immunity to fight foreign viruses. As a result, hospitals have established dietary departments to assist those in need. The games developed in this study aimed to help the public understand that hypoglycemia can be controlled with a proper diet. Gamification was used to help people memorize rather than forget everything after watching educational films. Gamification refers to incorporating reward modes commonly utilized by games into daily life. The aim of this study was to promote healthy eating habits through digital game design and hypoglycemia dietary recommendations.

Keywords: Healthy Diet; Hypoglycemia; Game-based Learning; Interaction Web Design

Acknowledgements: Author thanks the Dietary Department of Far-Eastern Memorial Hospital for their supports.

MIST1089: Musculoskeletal Imaging

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Abstract. Musculoskeletal imaging helps to visualize the bones, joints, associated soft tissues, cartilage, ligament, tendons, muscles, etc. Indications of musculoskeletal imaging are as followsosteoporosis, osteoarthritis, fractures, joint synovitis, bursitis, tendonitis, etc. Imaging techniques used in musculoskeletal imaging are as follows- X-ray, computed tomography (CT), magnetic resonance imaging (MRI), ultrasound, bone scan, etc. CT scans and X-rays use ionizing radiation. Ionizing radiation, if given beyond a certain threshold, can lead to hair loss, dermatitis, increased incidence of cancer, etc. We should wear protective equipment like lead aprons, lead glasses, etc. We should use lead curtains and mobile shields. Computed tomography(CT) scan helps to view bone details, and magnetic resonance imaging (MRI) can provide images of soft tissues. MRI scans are costly, and they can be uncomfortable. Ultrasound is used to analyze superficial structures and does not use ionizing radiation. X-ray detects degeneration of the bone, fractures, etc. A bone scan detects benign bone tumours, arthritis, metastatic cancer involving bone, etc. In fluoroscopy, continuous X-rays are passed through the body to view the movement of the body parts. We should know the advantages and disadvantages of each imaging technique because a proper understanding of all the imaging techniques will help us to make an early diagnosis and start the treatment early. Advancements in the field of musculoskeletal imaging also help in diagnosing the condition early.

Keywords: X-ray; Computed Tomography (CT); Magnetic Resonance Imaging (MRI); Ultrasound; Bone Scan

BEB6952: An Improved Tracking-learning-Detection Method for Object Tracking

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Abstract. In this study, we designed an improved object tracking- learning-detection(TLD) method based on image clustering, which was verified on the dataset of 3000 images. Compared with the previous target tracking methods, the loss rate of target tracking is significantly reduced.
Target tracking is a classical and common method of object recognition. It is widely used in pedestrian recognition, autonomous driving and other fields. At present, the common object tracking strategy is to select the target in the initial frame and analyze the subsequent image according to the features extracted from the initial frame. But the change of shape, the change of scale, and the

occlusion and disappearance of the target may lead to the loss of the tracking target. Therefore, we design an object tracking algorithm based on flow pattern dimensionality reduction and verify it on 3000 frames of images. The loss rate of object tracking is reduced by 38.4%.

First, we used locally linear embedding(LLE) to reduce the dimension of 3000 consecutive frames of images, and marvelously found that the target objects in the same position are in a relatively concentrated cluster in the image after dimensionality reduction. We then used the TLD method to track the target in the close position. The results with stable tracking results are selected as the detection training dataset, and the target detection system is trained. The target detection and target tracking systems are mutually promoted to get better tracking results

The main contribution of this work is to propose an improved low-cost target tracking method, which can significantly reduce the tracking loss rate. Further work will focus on improving the accuracy of image cluster classification after dimensionality reduction.

Keywords: Tracking- Learning-Detection Method; Locally Linear Embedding; Object Tracking

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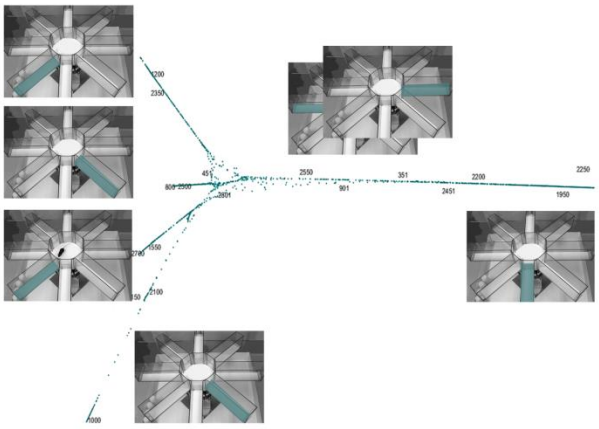

Figure1. Image distribution after dimensionality reduction by LLE.

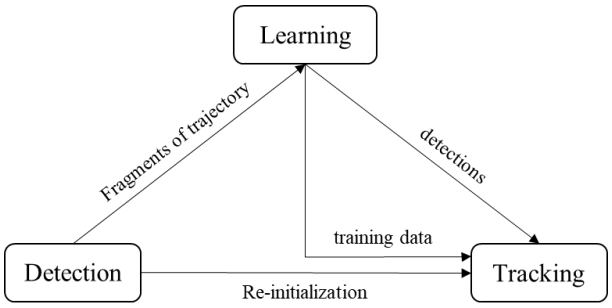

Figure2. the diagram of tracking- learning-detection method.

MIST1098: Using Point Shear Wave Elastography (Pswe) in Assessment Stiffness of Pancreas Tissue in Diabetic Patient Compared to Healthy Subjects

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Abstract. Background: Recently, the prevalence of diabetes mellitus (DM) has escalated to a greater extent. Ultrasound emerging technologies such as point shear wave elastography (pSWE) is used to quantify elasticity. However, applications of pSWE on pancreas stiffness quantification is still limited. This study aimed to investigate the feasibility of pSWE to detect alteration at three different pancreatic segments in DM patients and control. **Methods:** This study was approved by the institutional review board and comprised of 31 DM patients (9 male, 22 female) and 31 healthy (15 men, 16 women) as controls. Examination was performed by two certified experienced operators and measurements were obtained. **Results:** The mean shear wave velocities (SWVs) of the entire pancreas parenchyma of the patients and control was significantly different with 1.1 ±0.3 vs 0.7 ± 0.29 m/s, p =<0.001. A significant difference was found between SWVs of pancreatic segments in both patients and controls. The mean (SD) velocities of pancreatic segments in patients and controls are as follows: head (1.0 ±0.4 vs 0.7 ±0.3 m/s, p =0.04), body (1.1 ±0.5 vs 0.7 ±0.3, p = 0.01), and tail (1 ±0.3 vs 0.7 ±0.2, p =<0.001). **Conclusion:** This study revealed that quantifying pancreas tissue stiffness using pSWE is feasible. DM patients showed higher pancreas tissue stiffens compared to healthy volunteers. Further studies are required to determine the potential value of pSWE as a screening tool in the prediabetic stage.

BEB6998: Updates in the Classification and Diagnosis of Some Bone Metabolic Diseases

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Abstract. Mild osteogenesis imperfecta OI and postmenopausal osteoporosis are both bone disorders. Mild OI may be associated with postmenopausal osteoporosis. According to NCBI, COL1A2rs72658152 (COL1A2G661S) is a pathogenic proven cause of the association between mild OI and postmenopausal osteoporosis. Aims: The challenges facing DEXA and the treatment plans of the World Health Organization WHO for osteoporosis require a search for new diagnostic solutions such as genetic methods. Methods: COL1A2rs72658152 was detected by Restriction Fragment Length Polymorphism RFLP and DNA sequencing on 150 EDTA blood samples from pre and post menopause women in Tishreen University Hospital. BMD was measured using DEXA. A clinical examination was conducted for the participants. A questionnaire was filled out with information related to the study. Related-Samples McNemar Change Test, Chi-Square Test, and binary logistic

regression was used as a statistical method to estimate the correlation between mild OI and postmenopausal (osteopenia or osteoporosis) under 95% confidence level ($\alpha \leq .050$) as well as the correlation between (mild OI, postmenopausal osteoporosis or osteopenia) and some morphological characteristics under 95% confidence ($\alpha \leq .050$). Results & Discussion: The significant chance to the occurrence of mild OI with postmenopausal osteopenia or osteoporosis is 10.8% with confidence level of 95% or more ($p \leq .05$). Strong asymptotic significance of (2-sided)correlation is found between mild OI , on one hand ,and postmenopausal osteopenia or osteoporosis on the other(Chi-Square = 29.066, $p = .000 < .05$). Mild OI has a significant impact on postmenopausal osteoporosis or osteopenia ($p = .000 < .05$). They are in positive correlation relationship according to the nature of tendency slop (B=1.758). Conclusion: Mild OI is associated with postmenopausal osteopenia and osteoporosis with statistical significance with reasons other than COL1A2G661S,and no specific morphological characteristics are found. Postmenopausal osteoporosis is not a primary osteoporosis because there are causes for it to occur. This is contrary to WHO classification.

Keywords: COL1A2rs72658152; Post-Menopausal Osteoporosis; Osteopenia; Mild Osteogenesis Imperfecta; Challenges of DEXA, COL1A2G661S

BEB6851: A New Wearable Brace Monitoring Multiple Physiological Parameters Based on the Nb-Iot Technique

To avoid repeatability issue, this abstract will be available after the full paper is published.

BEB6994: The Effect of TECAR Therapy using Winback on Diaphragm Movement and Chest Mobility in Adults with Limited Chest Mobility

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Abstract. The diaphragm is an important respiratory muscle that accounts for 70% of the inspiratory function during stable breathing. Weakness of the diaphragm leads to decreased thoracic mobility due to overuse of the inspiratory assist muscles. It is closely related to respiratory dysfunction. The purpose of this study is to define the effect of TECAR therapy using Winback on diaphragm movement and chest mobility in adults with limited chest mobility. For this study, 36 young adults with limited chest mobility were selected as subjects.
TECAR therapy was applied to the subject's diaphragm for 15 minutes. Ultrasound was used to measure the movement of the diaphragm in each group, and a tape measure was used to measure chest mobility. A paired t-test was used to analyze the change in diaphragm movement and chest mobility in each group, and an independent t-test was used to analyze the difference in the amount of

change between groups. the a value was set to 0.05. As a result, after intervention, diaphragm movement significantly increased from 0.958±1.04 to 3.037±2.96 (p<.05). Upper chest movement significantly increased from 3.4±4.70 to 6.1±5.17, middle chest movement increased significantly from 3.1±2.16 to 5.3±4.08, and lower chest movement significantly increased from 2.7±2.08 to 3.3±2.92. (p<.05). The results provide innovative clinical evidence that TECAR therapy had a significant effect on diaphragm movement and chest mobility improvement in young adults with limited chest mobility

Keywords: Diaphragm; Chest Mobility; Winback; TECAR Therapy; Respiratory

BEB6912: The Mechanism of Thermal-pH Sensitive Lipid Nanoparticles for Controllable Intracellular Drug Release: Molecular Dynamic Simulation

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Abstract. Multi-sensitive lipid nanoparticles can release drug molecules reliably and efficiently under the regulation of various stimulus, and have significant advantages in biological safety and therapeutic effects. The thermal-pH sensitive lipid nanoparticles that release doxorubicin in the tumor area under the external heat stimulation are studied by using the molecular dynamics simulation. Through the morphological and structural parameters changes of the lipid nanoparticles, it is found that as the temperature increases, the nano-carrier structure becomes looser, and more doxorubicin molecules are released into the solution. Furthermore, the thermodynamic parameter landscapes are drawn based on the structural parameters, which shows that the drug release process of lipid nanoparticles is spontaneous. Entropy change is more than enthalpy change in Gibbes free energy change, indicating that the Brown force caused by high temperatures can drive the drug release rather than the intermolecular force. This study proves that high temperature has a positive effect on the drug release of lipid nanoparticles, and contributes to the structural disintegration and drug molecular diffusion.

Keywords: Intracellular Drug Release; Lipid Nanoparticles; Multi-Sensitive Nanoparticles; Molecular Dynamic Simulation; Thermodynamic Parameters Analysis

Acknowledgements: This work was supported by the National Natural Science Foundation of China for financial support (Grant No.51890891 and No.51890894) and the Scientific and Technological Innovation Foundation of Foshan (Grant No. BK20AE002).

BEB7018: Mercury Exposure Risk Evaluation of Tibetan Medicine Zuotai and Its Compounding Preparations Containing HgS by the RfD and PDE of Soluble Inorganic Mercury

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Abstract: Mercuric sulfide (HgS) is used throughout history by many traditional medicine systems. *Zuotai* is an ancient classic herbal-mineral mixture in Tibetan medicine and contains 54% β-HgS. It is believed to have the effects of reducing toxicity and enhancing efficacy for other medicines. Mercury toxicity is closely related to its chemical form and bioaccessibility. So far, the risk assessment of traditional medicines containing HgS is generally based on the total mercury. However, HgS is a typical insoluble covalent sulfide. Therefore, it is unreasonable to take the total mercury of HgS as soluble inorganic mercury. The present research is aimed to establish an *in vitro* biomimetic approach to evaluate the real Hg exposure risk of *Zuotai* and its compound preparations. Our previous study found the mercury leaching of *Zuotai* in artificial gastric juice was far more than in artificial intestinal juice, so the contribution of artificial intestinal juice to the soluble mercury bioaccessibility of *Zuotai* can be ignored. Based on this, we determined the leaching mercury of *Zuotai* and its compound preparations in artificial gastric juice, then converted them into the exposure dose and the daily total exposure amount of soluble mercury for adults. We found that the soluble mercury exposure doses of 17 batches of *Zuotai* and 11 batches of its compound preparations at clinical doses range from 0.0044 - 0.5317 μg/kg bw, and the average is 0.0662 ± 0.1061 μg/kg bw, less than the RfD value (0.3 μg/kg bw, EPA, US) of soluble inorganic mercuric salt. Only one batch of *Zuotai* (0.5317 μg/kg bw) exceeds this value. The daily total exposure amounts of soluble mercury from these *Zuotai* and its compound preparations at clinical doses range from 0.2663 - 31.9037 μg/day, and the mean value is 4.4769 ± 6.5153 μg/day, less than the permitted daily exposure (PDE) value (30 μg/day, International Council for Harmonisation of Technical Requirements for Pharmaceuticals for Human Use) of soluble inorganic mercuric salt. Only one batch of *Zuotai* (31.9037 μg/day) exceeds this limit. This study suggests the Hg exposure risk from *Zuotai* and its compound preparations generally are within a controllable range when they are taken at clinical doses, and this indicates that the quality of *Zuotai* should be kept stable batch-to-batch. Moreover, this provides a new strategy to assess the real mercury exposure risk for traditional medicines containing HgS.

Keywords: Traditonal Medicine; Mercuric Sulfide (HgS); Zuotai; Exposure Risk; Mercury; Reference Doses (RfD); Permitted Daily Exposure (PDE)

Acknowledgments: This work was supported by the Major Science and Technology Project of Qinghai Province (2020-SF-A3-2), the Applied Basic Research Project of Qinghai Province (2019-ZJ-7030), and the general project of National Natural Science Foundation of China (82171863).

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