ENCONTRO DE OUTONO 2021
SOCIEDADE BRASILEIRA DE FÍSICA
21 a 25 de junho de 2021

24/06/2021 - Oral Sessions (10:30-12:00)

MEDICAL PHYSICS IV - BIOPHOTONICS AND MAGNETISM IN MEDICINE

Chair: Susana de Souza Lalic
Co-Chair: Rogério Matias

10:30 - 11:00 **VIBRATIONAL SPECTROSCOPY OF BIOLOGICAL TISSUES**
Luciano Bachmann, Thiago Martini Pereira, Denise Maria Zezell, Joaquim Cezar Felipe

11:00 - 11:15 **A DEEP LEARNING APPROACH FOR BREAST TISSUE MALIGNANCY DIAGNOSIS USING MICRO-FTIR HYPERSPECTRAL IMAGING**
Matheus del-Valle, Moises Oliveira dos Santos, Sofia Nascimento dos Santos, Emerson Soares Bernardes, Denise Maria Zezell

11:15 - 11:30 **Female dog mammary cancer diagnosis by nonlinear optical images**
Luana A. Reis, Egleidson F. A. Gomes, Giovanna Paranhos, Ana P. V. Garcia, Geovanni D. Cassali, Francis G. J. Longford, Jeremy G. Frey, Ana M. de Paula

11:30 - 11:45 **An open-source platform for robotized transcranial magnetic stimulation**
Renan H. Matsuda, Thais Cunha Marchetti, Oswaldo Baffa, Victor Hugo Souza, Risto J. Ilmoniemi, Daisuke Araki, Glauco Augusto de Paula Caurin

11:45 - 12:00 **Electronic control of the stimulus orientation induced in the human brain with multi-channel magnetic stimulation**
Victor Hugo Souza, Jaakko O. Nieminen, Sergei Tugin, Lari M. Koponen, Risto J. Ilmoniemi, Oswaldo Baffa

A DEEP LEARNING APPROACH FOR BREAST TISSUE MALIGNANCY DIAGNOSIS USING MICRO-FTIR HYPERSPECTRAL IMAGING

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The breast cancer is the most incident cancer in women with an estimative of 2.1 million new cases in 2018. With the grown of deep learning techniques, several approaches in vibrational spectroscopy have been studied. In this way, this work aimed to classify breast samples as breast cancer or adenosis using a deep learning model. It was used the human breast cancer microarray BR804b (Biomax, Inc., USA), where one core of each group, cancer and adenosis, was imaged by a Cary Series 600 micro-FTIR imaging system (Agilent Technologies, USA). The system has a spatial resolution of 5.5 µm and about 100 thousand spectra were acquired for each group. The regions of interest were selected by two k-means clustering using amide I/II (1700 to 1500 cm^{-1}) and highest paraffin intensity (1480 to 1450 cm^{-1}) bands. Spectra were preprocessed by five steps: outlier removal using Hotelling's T^2 versus Q residuals; biofingerprint truncation; Savitzky–Golay filtering for smoothing and second derivative; Extended multiplicative signal correction (EMSC) with digital de-waxing; another outlier removal. The deep learning model was a convolutional neural network (CNN) fused with a fully connected neural network (FCNN). The CNN was built with 2 Conv1D-ReLU-MaxPooling1D-Dropout layers. The kernel size was set to 5 and dropout of 0.5. Dense layers were built by two layers of neurons-BatchNorm-ReLU-Dropout, with 100 and 50 neurons, dropout of 0.2. The output was a single neuron with sigmoid activation. Binary cross-entropy loss function was adopted with Adam optimizer. Accuracy metric was calculated during the training, where a threshold of 0.5 was applied on the output predictions. Model was trained by a 4-fold cross-validation by 20 epochs and using a batch size of 250. The train accuracy was 0.978/0.004 (mean/std), while the testing accuracy was 0.969/0.008, demonstrating a generalized model without overfitting. Accuracies near one indicate the proposed model as a potential technique for the breast cancer vs adenosis classification, where hyperparameters and the architecture should be optimized along higher sample number acquisition.