EAI Endorsed Transactions
on Bioengineering and Bioinformatics Editorial **EAI.EU**

Editorial

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doi: 10.4108/eai.24-3-2021.169074

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It is our pleasure to present this Special Issue of the EAI Journal of Bioengineering and Bioinformatics that deals with the COVID-19 pandemic. It contains a collection of 5 papers that were specially invited by Editor in Chief Dr. N. Bourbakis. The COVID-19 pandemic has spread over the world from the beginning of 2020 and it is still spreading with more than one hundred million confirmed cases. Thousands of patients worldwide need intensive care management and billions of individuals are living under national or regional lockdowns. In this Special Issue, we invite original research articles and state-of-the-art reviews focused on current knowledge and future perspectives on SARS-CoV-2 from bioengineering and bioinformatics point of view using beyond state-of-the-art biochemical engineering, environmental health engineering, genetic engineering, systems biology, machine learning methods, modelling methods, supervised classification, clustering and probabilistic graphical models for knowledge discovery, deterministic and stochastic heuristics for optimization and applications in genomics, proteomics including physiopathology, virology, biology, epidemiology, transmission, COVID-19 phenotypic expression, biomarkers of disease severity and of treatment response. It also includes studies and reviews evaluating the positive and negative effects of various national crisis management approaches and their psychological impacts.

Moura et al [1] investigated classification models to differentiate chest X-ray images between COVID-19-based pneumonia and typical pneumonia. The authors evaluated the performance of support vector machine (SVM), random forest (RF), AdaBoost (AB), and logistic regression (LR) classification methods. Moreover, they used the PyRadiomics to extract statistical texture-based features in the right, left, and in six lung zones. The final conclusion provides evidence that AdaBoost is the best discriminant method between features related to COVID-19-based pneumonia when compared to typical pneumonia, using a model of lung segmentation in six distinct zones.

Groumpos [2] proposed a new state space Advanced Fuzzy Cognitive Map (AFCM) methodology for exploring the causality between the variables of the medical problem. Groumpos applied his algorithm to two hypothetical cases of COVID-19. The results identified patients that tested positive and those that tested negative for COVID-19. Human health issues and the involvement of human intervention makes the problem of causality more acute as proposed.

Lucas et al [3] used a transfer learning technique to develop a neural network capable of detecting four different conditions from chest X-ray images related to COVID-19. Even when a small dataset used, the results are promising. The COVID-19 condition was detected and it was concluded that the multiclass classifier can easily be transformed into a binary classifier capable of detecting COVID-19 with very high accuracy. Lucas et al [3] used the heatmaps generated at the level of the last layer, of size 7 x 7. Furthermore, the authors worked on the problem of *explainability*, i.e., how the model has arrived at the prediction. They used the state-of-the-art Gradient Class Activation Map (Grad-CAM) technique to identify the location of biomarkers, i.e., measurable indicators of the medical condition. It was suggested that heatmaps generated using layers further below the output of the network would have had higher resolution and may reveal finer details in the area that contributes to the network output.

Katehakis et al [4] described a digital platform with applications for public health authorities, healthcare professionals and citizens to support surveillance of suspect, probable and confirmed cases outside the hospital. This tool can be used for self-reporting of symptoms by contacts and currently is not linked to proximity applications. The proposed solution supports return to the “new normal” with less stress and more security for individuals, more direct and safer management of patients by physicians, and better possibilities for monitoring the epidemic by public health authorities. Considering the several benefits these technologies can have requires taking the responsibility to act in an adaptable way to ensure health systems and people continue to benefit. Existing healthcare services and infrastructures can greatly benefit from innovative digital solutions when they adopt a policy for integration and interoperability in support of the wider digital market. Blagojevic et al [5] investigated a personalized model that combines machine learning and finite element simulation approach in order to predict a development of COVID-19 infection in patients. The methodology combines several strategies for classifying patients into four distinct classes of clinical condition (mild, moderate, severe and critical) of COVID-19 disease and predicting outcomes (change in severity of clinical condition) in advance. In addition, convolutional neural network U-net was implemented for segmentation of human lungs in X ray images, only to create 3D model of human airway and investigate the spreading of SARS-COV-2 virion in the lungs using finite element (FE) simulation. The findings reveal that the XGboost classifier has reached an overall accuracy of 94%. FE simulation has revealed that the distribution of airflow in the lungs changes in time with the infection, as well as that there is an overwhelming innate immune response that may occur if multiple areas of the lungs are simultaneously infected, resulting in a widely-distributed "cytokine storm".

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