**Papers:**

1. **Α Respiratory Sound Database for the Development of Automated Classification (**[***link***](https://eden.dei.uc.pt/~ruipedro/publications/Conferences/ICBHI2017a.pdf)**)**

**Abstract:** The automatic analysis of respiratory sounds has been a field of great research interest during the last decades. Automated classification of respiratory sounds has the potential to detect abnormalities in the early stages of a respiratory dysfunction and thus enhance the effectiveness of decision making. However, the existence of a publically available large database, in which new algorithms can be implemented, evaluated, and compared, is still lacking and is vital for further developments in the field. In the context of the International Conference on Biomedical and Health Informatics (ICBHI), the first scientific challenge was organized with the main goal of developing algorithms able to characterize respiratory sound recordings derived from clinical and non-clinical environments. The database was created by two research teams in Portugal and in Greece, and it includes 920 recordings acquired from 126 subjects. A total of 6898 respiration cycles were recorded. The cycles were annotated by respiratory experts as including crackles, wheezes, a combination of them, or no adventitious respiratory sounds. The recordings were collected using heterogeneous equipment and their duration ranged from 10s to 90s. The chest locations from which the recordings were acquired was also provided. Noise levels in some respiration cycles were high, which simulated real life conditions and made the classification process more challenging.

**Conclusion:** The creation of this database and the related scientific challenge constitute an initial but decisive step towards leveraging computational lung auscultation, and also towards highlighting the complexity of the RS classification problem. The availability of the database after the challenge (details will be posted on the challenge’s website), along with the challenge’s approaches and results, will set the basis to ensure the continuation of efforts, hopefully inspiring and facilitating future relevant competitions.

2. **LungBRN: A Smart Digital Stethoscope for Detecting Respiratory Disease Using bi-ResNet Deep Learning Algorithm (**[***link***](https://ieeexplore.ieee.org/abstract/document/8919021)**)**

**Abstract:** Improving access to health care services for the medically under-served population is vital to ensure that critical illness can be addressed immediately. In the scenarios where there is a severely lacking of skilled medical staff, a basic lung sound classification through a digital stethoscope can be used to provide an immediate diagnostic for respiratory-related diseases such as chronic obstructive pulmonary. In this work, we have developed an improved bi-ResNet deep learning architecture, LungBRN, which uses STFT and wavelet feature extraction techniques to improve the accuracy compared to the state-of-the-art works. To ensure a fair evaluation, we have adopted the official benchmark standards and the "train-and-test" dataset splitting method stated in the ICBHI 2017 challenge. As a result, we are able to achieve a performance of 50.16%, which is the best result in terms of accuracy compared to all participating teams from ICBHI 2017.

3. **Asthma and Chronic Obstructive Pulmonary Disease (COPD) – Differences and Similarities (**[***link***](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3633485/)**)**

**Abstract:** Bronchial asthma and COPD (chronic obstructive pulmonary disease) are obstructive pulmonary diseases that affected millions of people all over the world. Asthma is a serious global health problem with an estimated 300 million affected individuals. COPD is one of the major causes of chronic morbidity and mortality and one of the major public health problems worldwide. COPD is the fourth leading cause of death in the world and further increases in its prevalence and mortality can be predicted. Although asthma and COPD have many similarities, they also have many differences. They are two different diseases with differences in etiology, symptoms, type of airway inflammation, inflammatory cells, mediators, consequences of inflammation, response to therapy, course. Some similarities in airway inflammation in severe asthma and COPD and good response to combined therapy in both of these diseases suggest that they have some similar pathophysiologic characteristics. The aim of this article is to show similarities and differences between these two diseases. Today asthma and COPD are not fully curable, not identified enough and not treated enough and the therapy is still developing. But in future better understanding of pathology, adequate identifying and treatment, may be and new drugs, will provide a much better quality of life, reduced morbidity and mortality of these patients.

4. **Lung Disease Classification using Deep Convolutional Neural Network (**[***link***](https://ieeexplore.ieee.org/abstract/document/8983071)**)**

**Abstract:** The advanced technologies are essential to achieving the improvement of medicine. More specifically, an extensive investigation in a partnership among researchers, health care providers, and patients is integral to bringing precise and customized treatment strategies in taking care of various diseases. This paper aims to assess the degree of accuracy acceptable in the medical field by utilizing deep learning to publicly available data. First, we extracted spectrogram features and labels of the annotated lung sound samples and used them as an input to our 2D Convolutional Neural Network (CNN) model. Secondly, we normalized the lung sounds to remove the peak values and noise from them. For deep learning classification, publicly available data was not sufficient to conduct the learning process. Finally, we have created a deep learning model called Lung Disease Classification (LDC), combined with advanced data normalization and data augmentation techniques, for high-performance classification in lung disease diagnosis. The final accuracy obtained after the normalization and augmentation was approximately 97%. The proposed model paves the way for adequate assessment of the degree of accuracy acceptable in the medical field and guarantees better performance than other previously reported approaches.

**Projects:**

**1. CNN: Detection of wheezes and crackles (**[***link***](https://www.kaggle.com/eatmygoose/cnn-detection-of-wheezes-and-crackles)**)**

**Overview:** Implementation of a convolutional neural network used to identify wheezes and crackles in an audio file which is fed Mel-Spectrograms as inputs. During processing, audio clips are copied to 5 second long buffers, and are split into multiple segments if necessary, with zero padding added to fill the rest of the buffer. During training, Mel-Spectrograms are transposed and wrapped around the time-axis to help allow the network to learn to identify features occurring at arbitrary times within the recording. Data augmentation was employed in the form of audio stretching (speeding up and down) as well as Vocal Tract Length Perturbation, especially for the scarcer 'wheeze' and 'wheeze and crackles' classes. A one hot data labelling scheme was chosen as earlier attempts at using a multi-label scheme using a Sigmoid output layer resulted in poor training results (which in hindsight may have been caused by an excessively high learning rate). Currently, both the 'wheeze' and 'wheeze and crackles' classes pose the greatest challenge in the area of classification, and frequently produce false negatives, as indicated by the poor recall scores. Overall validation accuracy currently stands at roughly 70%.

**2. Healthy Lung Classification Spectrogram Fast.ai (**[***link***](https://www.kaggle.com/dienhoa/healthy-lung-classification-spectrogram-fast-ai)**)**

**Overview:** In general, stethoscope is an acoustic medical instrument that be used by the doctor to diagnose the problem in the heart or lungs. However, with the rise of deep learning in the field of Image Processing and Audio Processing, I believe deep learning model can achieved the acceptable level of disease diagnosis. If we can get to that state, stethoscope can help the patient or anyone who want to monitor their health, and inform the doctor if they find something anomaly. It might also be very helpful in this period of pandemic where we need to limit the contact as much as possible