Abstract:

Over the past few years, there has been a notable rise in the occurrence of lung diseases, positioning them as the third most prominent contributor to worldwide mortality. The World Health Organisation (WHO) has identified five major lung diseases in their data: tuberculosis, lung cancer, chronic obstructive pulmonary disease (COPD), asthma, and acute lower respiratory tract infection (LRTI). Together, these ailments are responsible for claiming the lives of more than 3 million people each year across the globe. These lung diseases not only place a significant burden on healthcare systems but also have a profound impact on the lives of the general population. Like many other serious illnesses, prevention is paramount to reducing their impact, and early-stage diagnosis and treatment are crucial methods for mitigating the adverse consequences of these deadly diseases. In light of these statistics, it becomes imperative that we redirect our attention towards the early and remote diagnosis of these diseases. To address the above issues, we start with making auscultation using a stethoscope an intelligent system for early and remote diagnosis of respiratory diseases. The process of computerised diagnosis through auscultation involves three crucial stages. To begin, it is necessary to remove any noises, both internal and external, that might obscure the respiratory sound signal (RSS). Next, the RSS must be divided into distinct cycles of respiratory sounds. Finally, these sounds are categorised into various classes to facilitate diagnostic use.

Auscultation stands as the primary diagnostic tool employed by physicians when examining patients afflicted with respiratory disorders. The ability to amplify abnormalities in auscultation sounds while minimising noise proves invaluable for the efficient and timely diagnosis of respiratory ailments. Achieving this necessitates the application of adaptive signal processing techniques, particularly for denoising non-stationary bio-signals. Adaptive decomposition methods such as empirical mode decomposition (EMD), variational mode decomposition (VMD), and wavelet synchro-squeezed transform (WSST) are robust tools designed for the denoising and enhancement of non-stationary signals. Within this thesis, we introduce an approach centred on WSST for denoising and compare its effectiveness with EMD and VMD in the context of enhancing respiratory sounds. A subjective assessment involving eight pulmonologists has been conducted to evaluate the denoising performance of EMD, VMD, and WSST across various sound types, including crackles, wheezes, and normal breath sounds.