

In the contemporary healthcare landscape, Artificial Intelligence emerges as a revolutionary paradigm with unprecedented potential to transform clinical practice. Vocal biomarkers, extracted from the rich information embedded in the human voice, have garnered substantial interest for their ability to provide valuable insights into various aspects of health. This dissertation delved into the multifaceted applications of vocal analysis within the healthcare domain, with a primary focus on Parkinson's Disease.

The research explored the entire pipeline of vocal analysis, encompassing data collection, development of automated analytical models, and comparative assessment of professional recording equipment versus more economical alternatives. Various speech tasks, including sustained phonation, isolated words, and text reading, were examined to identify relevant acoustic features for speech analysis. The study also investigated the influence of external co-factors and aimed to develop robust methodologies supporting diagnosis, monitoring, and follow-up of speech-affecting disorders.

A significant portion of the work was dedicated to the analysis of acoustic parameters, involving a comprehensive literature review, comparison of algorithms for parameter extraction, and exploration of new acoustic measures and analysis techniques. The research considered the dependency of these parameters on speaker characteristics, language, and the severity of the condition, as well as the recording setup. Statistical techniques and automatic classification algorithms were employed to evaluate algorithm effectiveness and propose novel pipelines for the analysis of speech samples of patients with Parkinson's Disease.

In addition, the dissertation investigated the effects of concurring pathologies, such as Gastroesophageal Reflux Disease and obesity, on vocal production. It explored the potential correlation between speech and poor sleep quality, shedding light on how temporary conditions may alter vocal patterns. The impact of transitory alterations from alcohol consumption on speech signals was also examined, laying the foundation for assessing psychological changes, particularly in-car contexts.

The study demonstrated the potential effectiveness of voice analysis across diverse fields, addressing neurodegenerative diseases, transient conditions, and the simultaneous presence of multiple pathologies. Experiments also highlighted the variability in speech samples due to individual characteristics and propose mitigating solutions, including the incorporation of covariates among acoustic parameters and the use of domain adversarial networks.

In conclusion, this dissertation emphasized the importance of constructing specialized models tailored to specific applications, mitigating the influence of confounding factors. This approach enhances the reliability, applicability, and interpretability of generated models, laying the foundation for the effective implementation of voice analysis techniques in real-world scenarios.