# ABSTRACT

Medical fields requires fast, simple and noninvasive methods of diagnostic techniques. Several methods are available and possible because of the growth of technology that provides the necessary means of collecting and processing signals. The present thesis details the work done in the field of voice signals. New methods of analysis have been developed to understand the complexity of voice signals, such as nonlinear dynamics aiming at the exploration of voice signals dynamic nature. The purpose of this thesis is to characterize complexities of pathological voice from healthy signals and to differentiate stuttering signals from healthy signals. Efficiency of various acoustic as well as non linear time series methods are analysed. Three groups of samples are used, one from healthy individuals, subjects with vocal pathologies and stuttering subjects. Individual vowels /അ/, /ഇ/, and /ഉ/ and a continuous speech data for the utterance of the sentence "ഇരുവരും വലിയ ചങ്ങാതിമാരാണ്" the meaning in English is "Both are good friends" from Malayalam language are recorded using a microphone . The recorded audio are converted to digital signals and are subjected to analysis.

Acoustic perturbation methods like fundamental frequency (F0), jitter, shimmer, Zero Crossing Rate(ZCR) were carried out and non linear measures like maximum

lyapunov exponent($(\lambda_{max})$, correlation dimension ($D_2$), Kolmogorov exponent($K_2$), and a new measure of entropy viz., Permutation entropy (PE) are evaluated for all three groups of the subjects. Permutation Entropy is a nonlinear complexity measure which can efficiently distinguish regular and complex nature of any signal and extract information about the change in dynamics of the process by indicating sudden change in its value.

The results shows that nonlinear dynamical methods seem to be a suitable technique for voice signal analysis, due to the chaotic component of the human voice. Permutation entropy is well suited due to its sensitivity to uncertainties, since the pathologies are characterized by an increase in the signal complexity and unpredictability. Pathological groups have higher entropy values compared to the normal group. The stuttering signals have lower entropy values compared to the normal signals.

PE is effective in charaterising the level of improvement after two weeks of speech therapy in the case of stuttering subjects. PE is also effective in characterizing the dynamical difference between healthy and pathological subjects. This suggests that PE can improve and complement the recent voice analysis methods available for clinicians.

The work establishes the application of the simple, inexpensive and fast algorithm of PE for diagnosis in vocal disorders and stuttering subjects.