ABSTRACT

Digital Signal Processing plays a major role in the field of telecommunication, digital audio, and video and in the development of new products in all areas of technology. Digital Filters form the core of most of the DSP systems, due to their memory, high precision, and the ability to work with a wide range of operating frequencies. Among the digital filters, FIR filters are preferable over IIR and find place in Digital Signal Processor due to their linear phase response and stability.

In this thesis, Genetic Algorithm (GA) has been used for the FIR filter design problems and application of the same towards the development of the filter bank and sub band coding of audio and images have been made. The performance of the filters and filter banks designed using GA has been compared with that of Parks and McClellan method which uses Remez exchange algorithm.

GA based windowing Algorithm has been proposed in this work for optimizing the filter length and cutoff frequency to satisfy the given set of magnitude frequency specifications. The designed filter has been tested in an Audio Codec environment.

Next, a Hybrid Genetic Algorithm (HGA) has been developed by combining GA with the Hill Climbing Algorithm, and HGA is applied for optimizing the frequency samples in the transition band. The performance of HGA is compared with the Minimax method of designing Frequency Sampling Filters.

Filter Banks are used in applications such as audio and image coding. Their major advantage in processing signals and images is that they constitute a multirate information system. Optimum filter banks of varying length have been designed using Single Objective GA with the objectives of energy minimization and code gain maximization. An eight bit audio signal, sampled at a rate of 22.05 kHz is applied

as the input to the designed filter banks and the PSNR values are calculated for the reconstructed signal.

In order to simultaneously optimize both the energy and code gain, Multi Objective GA has been applied to yield a set of solutions known as Pareto Optimal Solutions. The filter banks designed by MOGA have been applied for audio signal reconstruction.

GA based one dimensional (1D) filter bank design concept has been suitably extended to Two Dimensional (2D) filter bank development, by employing suitable transformation and sampling matrices. The performance of the GA based 2D filter banks developed has been studied by applying standard benchmarked images as the input and the results are compared with that of 2D filter bank development using Remez algorithm.