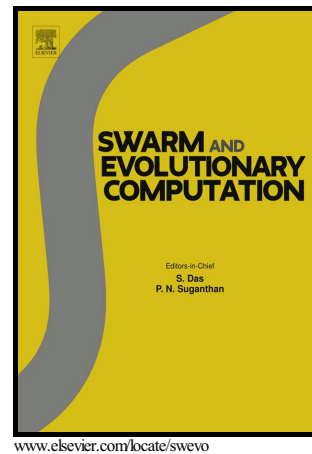


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# An Efficient Gbest-guided Cuckoo Search Algorithm for Higher Order Two Channel Filter Bank Design

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**Abstract:** This paper proposes a new algorithm based on Gbest-guided Cuckoo Search (GCS) algorithm for the design of higher order Quadrature Mirror Filter (QMF) bank. Although the optimization of lower order filters can be performed easily by applying existing meta-heuristic optimization techniques like Particle Swarm Optimization (PSO), Artificial Bee Colony (ABC) etc., these methods are unsuccessful in searching higher order filter coefficients due to multimodality and nonlinear problem space; leads to some undesirable behaviors in filter responses like ripples in transition band, lower stop-band attenuation etc.. Comparison with other available results in the literature indicate that the proposed method exhibits an 69.02% increase in stop-band attenuation and 99.71% reduction in Perfect Reconstruction Error (PRE) of higher order filter bank. Besides, the percentage improvements in Fitness Function Evaluations (FFE) of GCS based 55th order QMF bank design with respect to PSO, ABC and CSA are 81%, 82% and 59% respectively, and execution time is improved by 73%, 72% and 42% respectively. The simulation results also reveal that the proposed approach exhibits lowest mean and variance in different assessment parameters of filter bank and it does not require tuning of algorithmic parameters whereas in standard CSA replacement factor need to be adjusted. Further, the proposed algorithm is tested on six standard benchmark problems and complex benchmark functions from the CEC 2013 where it demonstrated significant performance improvements than other existing methods.

**Keywords** Filter Bank; CSD; NPR; PSO; ABC; Cuckoo Search

## 1 Introduction

During the last three decades, QMF bank has been extensively used in the design of wavelet bases, biomedical signal processing, discrete multi-tone modulation systems, wideband beam-forming and noise cancellation etc. [1-6]. For some important applications of the filter bank, like cross-talk suppression, echo cancellation, three-dimensional audio reduction systems, and ECG signal processing, efficient design of the higher order filter bank (FB) is essential as they require high stop-band attenuations. Originally, the idea of QMF is introduced to remove aliasing distortion in speech signal

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