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Design of Digital IIR Filter Using Opposition Learning and Artificial Bee Colony Algorithm

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Abstract : In almost all the digital filtering applications the digital infinite impulse response (IIR) filters are preferred over finite impulse response (FIR) filters because they provide much better performance, less computational cost and have smaller memory requirements for similar magnitude specifications. However, the digital IIR filters are generally multimodal with respect to the filter coefficients and therefore, reliable methods that can provide global optimal solutions are required. The artificial bee colony (ABC) algorithm is one such recently introduced meta-heuristic optimization algorithm. But in some cases it shows insufficiency while searching the solution space resulting in a weak exchange of information and hence is not able to return better solutions. To overcome this deficiency, the opposition based learning strategy is incorporated in ABC and hence a modified version called oppositional artificial bee colony (OABC) algorithm is proposed in this paper. Duplication of members is avoided during the run which also augments the exploration ability. The developed algorithm is then applied for the design of optimal and stable digital IIR filter structure where design of low-pass (LP) and high-pass (HP) filters is carried out. Fuzzy theory is applied to achieve maximize satisfaction of minimum magnitude error and stability constraints. To check the effectiveness of OABC, the results are compared with some well established filter design techniques and it is observed that in most cases OABC returns better or atleast comparable results.

Keywords : digital infinite impulse response filter, artificial bee colony optimization, opposition based learning, digital filter design, multi-parameter optimization
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