Spiral-based manta ray foraging optimization to optimize PID control of a flexible manipulator

Ahmad Azwan Abd Razak, Ahmad Nor Kasruddin Nasir, Nor Maniha Abd Ghani, Nurul Amira Mhd Rizal, Mohd Falfazli Mat Jusof, Ikhwan Hafiz Muhamad
Faculty of Electrical Electronics Engineering Technology, Universiti Malaysia Pahang, Pekan Pahang, 26600, Malaysia

ABSTRACT
This paper presents a Spiral-based Manta Ray Foraging Algorithm (SMRFO). It is an improvement of Manta Ray Foraging Algorithm (MRFO). The original MRFO has a competitive performance in terms of its accuracy in locating an optimal solution. Its performance can be improved further provided the balanced exploration and exploitation strategies throughout a search operation are improved. A modification in the Somersault phase of the MRFO is proposed. A spiral strategy is incorporated into the Somersault phase of the MRFO. This is to guide all agents toward the best agent in spiral-based trajectory in every iteration. The spiral strategy also offers a dynamic step size scheme for all search agents during the operation. The proposed algorithm is tested on a set of benchmark functions that consist of various fitness landscapes. In terms of solving an engineering application, the proposed algorithm is applied to optimize a PID controller for a flexible manipulator system. Result of the accuracy performance test on benchmark functions shows that the proposed algorithm outperforms the original MRFO significantly. In solving the engineering problem, both SMRFO and MRFO optimize the PID control adequately good. The SMRFO-PID control tracks the bang-bang test input better than the MRFO-PID. It confirms the superiority of the SMRFO over the MRFO.

ACKNOWLEDGMENT