Non-dominated sorting manta ray foraging algorithm with an application to optimize PD control

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ABSTRACT

This paper presents a multi-objective (MO) version of Manta Ray Foraging Algorithm (MRFO) by using components in Non-Dominated Sorting Genetic Algorithm (NSGAII). MFRO is a recent developed algorithm which was inspired from behavior of a cartilaginous fish called Manta Ray. MRFO search solution by using three strategies of manta ray which are chain foraging, cyclone foraging and somersault foraging. However, this algorithm solves only single-objective problem and can be improved to solve multi-objective problem. Thus, non-dominated sorting (NS) strategies including crowding distance (CD) were adopted into MRFO. NS is a sorting technique based on Pareto's game. It is a fast strategy to develop a good characteristic of Pareto's front (PF). Meanwhile, CD is a strategy to preserve good distribution of solutions along the PF. This proposed algorithm is called NSMRFO. It is tested using several benchmark functions and its performance is compared to its parent by using statically analysis of hypervolume indicator. Then, it is applied to a Proportional-Derivative (PD)-controller for an Inverted Pendulum System (IPS) in order to know its performance on real-world application. Result of the NSMRFO on benchmark functions shows that it outperforms NSGAII and satisfactorily optimizes PD-control for the IPS.

KEYWORDS

Genetic algorithm; Manta ray foraging algorithm; Multi-objective algorithm; NSGAII; PD-Controller; Spiral