

Opposition based Spiral Dynamic Algorithm with an Application to a PID Control of a Flexible Manipulator

Ahmad Azwan Abdul Razak, Ahmad Nor Kasruddin Nasir¹, Mohd Falfazli Mat Jusof, Shuhairie Mohammad, Nurul Amira Mhd Rizal

Faculty of Electrical & Electronics Engineering Technology, Universiti Malaysia Pahang, 26600 Pekan
Pahang, Malaysia

¹ kasruddin@ump.edu.my

Abstract:

This paper presents an improved version of a Spiral Dynamic Algorithm (SDA). The original SDA is a relatively simple optimization algorithm. It uses a spiral strategy to move search agents within the feasible search space. However, SDA suffers from a premature convergence due to an unbalanced diversification and intensification throughout its search operation. Hence, the algorithm unable to acquire an optimal accuracy solution. An Opposition learning is adopted into SDA to improve the searching strategy of the SDA agents. Therefore in the proposed strategy, a random and a deterministic approaches are synergized and complement each other. The algorithm is tested on several benchmark functions in comparison to the original SDA. A statistical nonparametric Wilcoxon sign rank test is conducted to analyze the accuracy achievement of both algorithms. For solving a real world application, the algorithms are applied to optimize a PID controller for a flexible manipulator system. Result of the test on the benchmark functions shows that the Opposition based SDA outperformed the SDA significantly. For solving the PID control design, both algorithms acquire PID parameters and hence can control the flexible manipulator very well. However, the proposed algorithm shows a better control response.

Keywords: Component; Spiral dynamic algorithm, Opposition learning, Flexible maipulator, PID control

Acknowledgment

This work has been financially supported by the Fundamental Research Grant Scheme with a FRGS reference number FRGS/1/2016/ICT02/UMP/02/1 and a university reference number RDU160103. It has been awarded by the Ministry of Higher Education Malaysia via Research and Innovation Department, Universiti Malaysia Pahang, Malaysia.