Adaptive Spiral Dynamics Metaheuristic Algorithm For Global Optimisation With Application To Modelling Of A Flexible System

A.N.K. Nasir[, a,] , R.M.T. Raja Ismail[a,] , M.O. Tokhi[b,]

[a] Faculty of Electrical & Electronics Engineering, Universiti Malaysia Pahang, Pekan Pahang 26600, Malaysia

[b] Department of Automatic Control and Systems Engineering, University of Sheffield, S1 3JD, UK

ABSTRACT

This paper presents a nature-inspired metaheuristic algorithm namely linear adaptive spiral dynamics algorithm (LASDA) and its application to modelling of a flexible system. The performance of spiral dynamics algorithm (SDA) is in general not satisfactory due to the incorporation of a single radius and single angular displacement values during the whole search process. LASDA is proposed as an improved version of SDA where the spiral radius and angular displacement are dynamically varied by employing novel mathematical equation based on linear function, which establishes a relationship between fitness value, spiral radius and angular displacement. The proposed algorithm is tested with various types of multimodal and unimodal benchmark functions and its performance in terms of fitness accuracy is discussed. A linear parametric modelling approach is utilised with an autoregressive model with exogenous inputs (ARX) structure for a flexible system. The proposed algorithm is then used to optimise parameters of the ARX structure. The performances of the LASDA in terms of convergence speed to the optimum value, fitness accuracy, time-domain and frequency-domain responses of acquired model is presented in comparison to SDA, BFA and IBFA. The results show that the proposed algorithm achieves better performance in finding an optimal solution for the benchmark functions as well as for the modelling of the flexible system.