A Novel Hybrid Spiral-Dynamics Bacterial-Foraging Algorithm for Global Optimization with Application to Control Design

A. N. K. Nasir, M. O. Tokhi and N. M. Abd Ghani
Department of Automatic Control & Systems Engineering,
University of Sheffield, Sheffield, UK.
cop11ann@sheffield.ac.uk

M. A. Ahmad
Faculty of Electrical & Electronics Engineering,
Universiti Malaysia Pahang (UMP), 26600 Pekan, Pahang, Malaysia.

Abstract—This paper presents a hybrid optimization algorithm referred to as Hybrid spiral dynamics bacterial foraging (HSDBF). The algorithm synergizes spiral adaptive simplified bacterial foraging algorithm (BFA) and spiral dynamics inspired optimization algorithm (SDA). The standard BFA has better exploitation strategy while SDA has superior exploration approach and stable convergence when approaching the optimum value. The hybrid algorithm preserves the strengths of BFA and SDA, thus producing better results. Moreover, it has simple structure and involves less computational burden. Several unimodal and multimodal benchmark functions are employed to test the algorithm in determining the global optimum point. Furthermore, the proposed method is applied to a proportional-derivative (PD) controller optimization for a flexible manipulator system (FMS). The results show that HSDBF outperforms BFA in all test functions and successfully optimizes the PD controller.

Keywords-*Spiral dynamics; bacterial foraging; optimization algorithm; PD control; flexible manipulator.*