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DESIGN OF OPTIMAL BACKSTEPPING CONTROLLER FOR A ROBOT MANIPULATOR USING SLIME MOULD ALGORITHM

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Abstract. In this paper, a new application of Slime Mould Algorithm (SMA) for the optimization of backstepping controller parameters for the tracking control and the perturbations rejection of the robot manipulator. The algorithm is compared to other optimization algorithms which are antlion algorithm (ALO), whale optimization algorithm (WOA) and grey wolf algorithm (GWO). The simulation results prove the superiority and the effectiveness of the SMA algorithm to deal with this problem and overcome the other algorithms.

Keywords. Tracking control, robot manipulator, optimization algorithms, Slime Mould Algorithm, backstepping control.

AMS (MOS) subject classification : This is optional. But please supply them whenever possible.

1 Introduction

Backstepping control constitutes an important design method for nonlinear systems, specially the robot manipulators, which offers a choice of design tools for nonlinearities accommodation. This technique, developed in 1990 by [1] is a new type recursive and systematic design methodology for the feedback control of uncertain nonlinear system, particularly for the system with matched uncertainties. It is known by its flexibility obtaining Lyapunov functions and removes the difficulties using recursive methodology. The final control law designed by this method can guarantee the stability of the global control system. The final outputs can be derived systematically through suitable Lyapunov functions by using a virtual control variable to make the original high order system simple with a number of recursive steps that never exceed the system order [2]. Over the last few decades, the backstepping control system has been widely used in variety applications of robotic control systems [3-7]. The fuzzy logic and neural networks have been proven to be a good candidate of intelligent techniques for enhancing the ability of the recursive backstepping design methodology [8-15]. Control strategy based on the coupling of the backstepping and sliding mode has been investigated to