Decentralized Intelligent PID based controller tuned by Evolutionary Algorithm for Double Link Flexible Robotic Manipulator with Experimental Validation

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***Abstract*—In this paper, a development of decentralized intelligent proportional–integral–derivative (PID) controller for multi input multi output (MIMO) controller of double link flexible robotics manipulator is presented. Simultaneous optimization method is implemented in optimizing the parameters The controllers are incorporated with optimization algorithm that is PSO to find out the parameters of the PID controllers. Numerical simulation was carried out in MATLAB/Simulink to evaluate the system in term of tracking capability and vibration suppression for both links. The optimal values of PID controller parameters that were achieved via off-line tuning using PSO were tested experimentally on the DLFRM experimental test rig. Experimental results show that the proposed control algorithm managed to control the system to reach desired angle for both hub at lower overshoot. Meanwhile, the vibration reduction shows improvement for both link 1 and 2. This signifies that, the PSO algorithm is very effective in optimizing the PID parameters for double link flexible robotics manipulator.**

Keywords—Flexible Manipulator, Particle Swarm Optimization, Hub Angle ,Vibration suppression, Intelligent PID

I. INTRODUCTION

Despite various advantages shown by flexible manipulator such as offers cost reduction, lower power consumption, improved dexterity, better maneuverability, safer operation and light weight, the undesirable vibration is the common shortcoming occurred in the structure. In order to satisfy the conflicting requirements, number of research on improving the control methods have been carried out.

Among available wide range controllers, PID controller is still the most widely used in the industrial environment for MIMO systems because they are capable of providing a satisfactory performance in spite of their simple structure and intuitiveness. The main issue of PID controllers is to tune the gains. Other than that, PID controller is still significant because of its robustness performance in a wide range of operating condition and easy to implement.

There are few research that consider double link flexible robotic manipulator (DLFRM) using PID controller. The decentralized PI-PID controller for DLFRM have been proposed in [1-2] by employing manual tuning for both PD and PID whereby the parameters of the first link was carried out followed by the second link. The overall system performance has been improved by introducing ILC and adaptive control respectively which were proven in the simulation. Another tuning method that has been implemented in flexible manipulator is simultaneous equation solving method. The Linear matrix inequalities (LMI) based PID control of a nonlinear DLFRM incorporating payload have been presented in [3]. Another researcher proposed a class of stabilizing decentralized proportional integral derivative (PID) controller