Adv Robot Autom 2016, 5:2 (Suppl)
http://dx.doi.org/10.4172/2168-9695.C1.006

Automation of industrial processes using fractional order controllers tuned by swarm intelligence techniques

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Chemical plant has hundreds or thousands of control loops. The process includes linear or nonlinear loops, stable or unstable loops, interacting or non-interacting loops, time varying or time invariant loops, etc. Normally, the processes in nature have fractionality but approximated as integer order for modeling and controller design. When the process is modeled considering the fractionality, it will revolutionize the automation field. Identifying the model parameters and controller design are tedious if mathematical formulation is involved. In the present work, solution is provided by modeling and controller tuning by different types of systems using swarm intelligence techniques like Harmony search algorithm, bee colony optimization, bat algorithm, bacterial foraging, etc. Different types of controller schemes like fractional order PID controller, model predictive controller and internal model control, nonlinear fractional order PID controller is adopted which will serve as a viable solution to provide efficient and optimal control. The techniques can be adopted in different plants like power plant, petrochemical industries, pharmaceutical industries, paper and pulp industries, etc.

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Parameter optimization of pulsed Nd:YAG laser for obtaining desired cut characteristic using Taguchi technique and ANN

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The current requirement of the industrial sector with respect to machinability of work piece, work piece shape complexity, miniaturization, automation of data communication, surface integrity and precision requirement and introduction of newer material and products is unseen before. Thus there exists need to explore the possibilities of tackling the issue by adopting high-end technologies like LASER machining. Laser cutting is serial, stochastic and dynamic in nature. It demands to control the behavior of heat (energy imbibed through laser beam) and fluid flow (assist gas) with respect to work piece properties (optical, thermal and geometry). The numbers of process variables are very high. Each variable affects the process output, also the interaction of these variables leads to different results. Thus the laser cutting process assumes very complex nature. Laser cut is characterized by top kerf width, bottom kerf width, heat affected zone, dross and material removal rate. In the current work attempts are made to minimize the top kerf width, bottom kerf width and maximize the material removal rate. The control over the kerf width ultimately controls the heat-affected zone (HAZ) and hence no separate attempts are made to control HAZ. The design of experiments and Taguchi technique application are applied to obtain the required process parameter. An artificial neural network (ANN) model is developed for optimization of process parameter of pulsed Nd:YAG laser. The proposed ANN model is trained by using experimental data of process parameters.

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