

## Mini Review

### SOFT COMPUTING BASED INDUSTRIAL PROCESS: A REVIEW

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#### ABSTRACT

This paper presents the survey on Soft computing algorithms like genetic algorithm, particle swarm optimization, bacterial foraging optimization techniques, Ant colony optimization and firefly algorithm. This optimization technique handles the uncertainty present in the real-world problem appreciably hence presently much research is being done on various areas covered by soft computing algorithms. The primary aim is to provide background information, motivation for applications and an exposition to the methodologies involved in the development of soft computing technologies in engineering. This paper covers the survey on the work that has been done in the field of soft computing algorithms in various industrial processes.

**Keywords:** *Soft computing, Genetic Algorithm, Particle swarm optimization, Ant colony optimization*

#### INTRODUCTION

Soft Computing (SC) is the fusion of methodologies that was designed to model and enable solutions in modern era, they are used to solve real life problem. These methods applied to real world problems regularly offer more strong, good and less expensive solutions than those obtained by more predictable mathematical techniques (Sethuramalingam and Nagaraj, 2016). These methods address different types of problems both in typology (data mining, prediction, modeling, optimization, etc.) and its application. Although the solutions obtained by these methods do not always equal to the mathematically solutions, a near optimal solution is sometimes sufficient in most useful purposes. Soft Computing is an umbrella term for a collection of computational techniques. The term was introduced by Lotfi (1994), who developed the concept of fuzzy logic. Soft computing is the problem-solving methods that have similarity with biological reasoning and problem solving. The basic methods included in cognitive computing are neural networks (NN), genetic algorithms (GA), fuzzy logic (FL). And the recent advancements are particle swarm optimization (PSO), bacterial foraging optimization (BFO), Ant colony optimization (ACO), cuckoo search (CSO) and firefly algorithms (FA).

Industrial process is nonlinear in nature. During the past decades, the process control techniques have made great advance. Numerous control techniques like, neural control, fuzzy logic control (FLC), adaptive control, adaptive neuro fuzzy inference system (ANFIS) Model reference adaptive control (MRAC) has however, been developed.

Due to the presence of non-linearity, it is necessary to tune the parameters of these controllers.

Conventional Proportional integral derivative controller is widely used in much industrial application due to its simplicity in structure and easy to design (Anandhi et al., 2015). However. it is very difficult to achieve the desired controller performance. Tuning is important parameter for the better performance of PID controllers. PID controllers can be tuned in a variety of ways including hand tuning Ziegler Nichols tuning; Cohen-coon and Z-N step response, but these have their own limitations. Soft computing techniques like PSO, BFO, GA, ACO and FA have proved their excellence in giving better results by improving their performance indices.

#### SOFT COMPUTING TECHNIQUES

Soft-Computing techniques such as Fuzzy Logic, Neural Network, Genetic Algorithms, Ant colony optimization, Particle swarm optimization, Cuckoo search algorithm, Firefly algorithm, Bacterial foraging optimization techniques, etc. based on their fundamental characteristics are designed for organizing, capturing, analysing and representing knowledge by computers. Considering the plethora of finding and developments that have taken place during the past few years, it would be a herculean task to present before the reader the entire gamut of information in the field of intelligent systems. Our endeavour therefore has been to put emphasis on learning the design, implementation and application of soft computing tech-

nologies through a selective set of systems, thereby conveying the tricks of the trade to the reader ((Sethuramalingam and Nagaraj, 2014).

Alfi and Modares (2011), they described an optimal control parameter using Adaptive Particle swarm optimization technique. Parameter estimation has been done and there are various examples are taken like unstable nonlinear system, First order system with time delay. This has been compared with genetic algorithm, Linear decreasing inertia weight-PSO, Ziegler Nichols tuning and Adaptive particle swarm optimization in this research the complete design for identifying system parameters and PID controller gains was based on the proposed APSO algorithm.

Agalya et al., (2013) proposed position control of DC Motor using PID controller. For tuning a PID controller the author used various optimization algorithms and conventional tuning method. Compared to conventional tuning method GA, PSO and EP tuned system has very good steady state response and performance indices.

Melin and Castelo (2004), described a new methodology for intelligent control of nonlinear robotic dynamical system with the use of a neuro-fuzzy inference system with multiple differential equations. In this case the parameter used for the fuzzy system is the fractal dimension of a time series of measured variables. In addition, ANN was used to control the robotic dynamic systems trained with Levenberg-Marquardt learning algorithm. Situm and Cikivic (2014) presents Genetic algorithm to tune the PID parameters for the control of position in a single-rod hydraulic cylinder. From the result it is observed that the GA gives the better performance indices. Samuel and Latha (2014) developed a distributed model predictive control using particle swarm optimization for a control of for alkylation process. Model Predictive Control algorithms predict the change in dependent variables due to change in independent variables. Centralised MPC and decentralised MPC methods are used to design distributed MPC and the results area analysed. Kalaivani et al., (2012), presents the work focus on the pneumatic control valves, which are widely used in industrial process. The modelling of valve stiction has been done after that The Stenman model identification problem has been formulated as an optimization

problem and Ant Colony Optimization is used to estimate the unknown parameters from input-output data. Thus, Ant colony algorithm as a distributed optimization algorithm, it has demonstrated its superior ability to search the optimal solution for a variety of combinatorial optimization.

Agalya and Nagaraj (2013) analysed a comparative study on various soft computing algorithms to control a concentration in continuous stirred tank reactor. In this ethylene oxide is reacted with the water in the tank and produces ethylene glycol. To get an accurate concentration, controlling of inlet valve is very much important, so choosing better controller leads to better result. PID controller is used to control the valve and the tuning mechanism like ZN, PSO, BFO, GA, FA and proved that the Firefly optimization gives comparatively better performance indices.

Pankaj et al., (2015), this research paper presents the review on application of various soft computing techniques. Number of researchers have been analysed about the various survey papers that concluded the soft computing algorithm plays a vital role in recent research areas.

Asif et al., (2014) have presents the review on soft computing algorithm in material Engineering. In this paper the various analyses like prediction, optimization, modelling, Analysis, Identification and design were compared with number of applications and the analysis chart also made for the comparison of Year of publication with Number of papers published. The new inventions of firefly and Cuckoo Search Algorithm algorithms are used for controlling of recent process. Ali et al., (2013), says that the steam turbine is controlled by using PID controllers and the tuning methodology like PSO and GA. The comparative analyses are done, and the numerical results are validated. Nagaraj and Vijayakumar (2012) developed a comparative analysis of soft computing algorithms like ZN, EP, GA, PSO, BFO have been done for the control of consistency in real time control of a Blend chest consistency system using ABB AC4-50 DCS in paper industry, and the comparative results dynamic performance and performance indices are discussed. Dwi et al., (2013), proposed a modelling of air heater have been done. A Simu-

link model, consisting of step input command and the data acquisition system using NI-USB 6009, is designed. that step response resulted by PID controller tuned by GA is better than the response of PID controller tuning by Ziegler-Nichols. A significant improvement on step response characteristics of output temperature is achieved using proposed method.

### CONCLUSIONS

This paper presents a brief review of recent researches and their techniques for optimizing the output of PID control system and system identification in nonlinear process. The diversity of researches done by various researchers have summarized and studied in this paper.

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