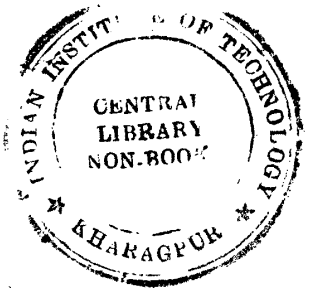


# Abstract

This thesis is an effort towards developing a generic paradigm of soft-computing by integrating the features of robustness, learning and generalizing abilities of the Artificial Neural Networks, computational efficiency and tractability of the Fuzzy Logic systems and global controlled-random searching features of the Genetic Algorithms into what can be termed as *Hybrid Intelligent Computational Systems* for autonomous and continuous modeling, control and optimization of large scale industrial manufacturing processes. For the purposes of evolving and demonstrating the feasibility of the proposed paradigm, the problem of modeling, controlling and optimizing a typical multivariate, time-varying, manufacturing process, namely, Blast Furnace, has been addressed in the present work. Data collected from a functional, large scale, industrial furnace has been used for the purposes of investigations.

In the present investigations, the suitability of feedforward neural networks for modeling the dynamics of the multivariate, time-varying, processes has been investigated. A procedure of performing *Sensitivity Analysis* of the neural networks based models has been developed for characterizing the time-varying behavior of such processes. Further, a *pseudo-recurrent* approach and optimal criteria for developing efficient predictive models such processes. A framework of Hybrid Computational Intelligence System for deriving Fuzzy Logic Controllers from the Neural Networks based process models using using Genetic Algorithms has been developed. The efficacy of the proposed HCIS has been demonstrated for evolving Fuzzy Logic Controllers for controlling the important blast and charge parameters, to produce the hot metal of the desired composition. The scope of the HCIS has been extended to evolve possible alternative control strategies for stabilizing the operations of time-varying, multivariate, large scale industrial processes. The efficacy of this HCIS in stabilizing the operations of the industrial blast furnace over a long period of time has been demonstrated.

The HCIS framework developed in the present work and the strategies evolved for the purposes of evolving efficient predictive models, fuzzy controllers and on-line optimization are general enough and would be applicable to any multivariate, time-varying complex process.