COLLECTIVE BEHAVIOR OF DISTRIBUTED SYSTEMS IN MANUFACTURING ENVIRONMENTS

G. Nasiff-Hadad*, K. Yen**, A. Caballero**, F. Ren***

We study the Hogg-Huberman model used for resource allocation problem and extend the results of 2 agents and 2 resources to L agents and L resources. It has been shown that when processes can choose among many possible strategies, while collaborating in the solution of tasks, the dynamics can lead to oscillations and chaos. In this paper a first-order exponential filter has been proposed to improve the response. Another solution based on the average of the payoff functions for every resource shared by agents can also achieve a stable response and hold a good convergence time.

Key words: *chaos, distributed system, exponential filtering, payoff functions*

1. Introduction

Trends in manufacturing challenge engineers, due to the increase of the complexity of products themselves and the systems that produce them. Manufacturing process is increasingly spread out over a supply network rather than being confined in a single firm. In addition, the variety of products, which a firm must offer, is increasing while time needed to bring them to the market is decreasing. We can see this phenomenon in automobile, appliances, machine tools, aircrafts, and many other industries. Today the global economy and the computer network allow us to build up a more profitable production line, from a group of different suppliers or manufactures, depending on the availability and prices. Consequently, the production line that turns raw materials into final products is a *supply network*, or more commonly called a *supply chain*, consisting of many different firms.

The resource allocation problem, embedded in the Ecological Computation field, has been studied in the recent years. Its solutions have been extended to manufacturing environment to improve the efficiency of the production process when different products will be manufactured with different machines [1–3] The asynchronous operations and imperfect knowledge on manufacturing conditions have been the main reasons for some undesirable behaviors. The dynamic response of an agent, trying to reach a new equilibrium state when resources allocation changes, sometimes becomes oscillatory or chaotic when some conditions are met. So an efficient way based on an intelligent decision has to be adopted to manage this situation. In this paper, we have studied the behavior of the Hogg-Huberman model for allocation resource problem, and extended the results to L agents and L resources. We have used a first-order exponential filter to improve the stability of the responses and proposed another solution based on the average of the payoff functions for every resource shared by agents. The results show a stable response and a good convergence time.

* G. Nasiff-Hadad, BAE SYSTEMS, Wayne, NJ, USA
** K. Yen, A. Caballero, Florida International University, 10555 W. Flagler St. Miami FL 33174, USA
*** F. Ren, Tokushima University, Tokushima 770-8506, Japan