# EXECUTIVE SUMMARY – UGC- MINOR RESEARCH PROJECT

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**Title of Research Project :Development of an Efficient Bio-inspired, Agent based Algorithmic Technique for Dynamic task allocation in Industrial Settings**

**Period of Project :01/02/2011 to 31/01/2013**

## Executive Summary

The aim of this project is to develop an efficient bio-inspired, software-agent based algorithmic technique to perform dynamic and coordinated task allocation in an often-changing, dynamic industrial setting to achieve optimum performance under any circumstance.

The methodology framed to devise an improved task allocation technique can be made comprehensible by the following phases:

- A detailed research review of the contemporary bio-inspired task allocation strategies was carried out.
- Parameters that influence task allocation in various applications were identified.
- An industry-like job environment with adaptation mechanism for dynamically changing job arrivals was designed and simulated.
- Quadratic assignment problem, Job shop scheduling problem and Dynamic truck allocation problem were selected for testing.
- Ant Task Allocation algorithm, Consultant guided Search algorithm and Bacterial Swarming algorithm were applied for problem solving

- The chosen algorithms were improved by hybrid task allocation method, implemented and the results have proven that task allocation & scheduling are improved.
- Efficient bio-inspired task allocation techniques to handle uncertainties in a dynamic industrial environment were suggested as an outcome of this research project.

In this research project, an improved bio-inspired approach, termed as Modified Ant Task Allocation to deal with Dynamic Task Scheduling problem was proposed, where tasks generated with uncertain demands are to be allocated to multiple, homogeneous processing units. The environment to experiment the dynamic truck scheduling problem was simulated using Java language.Independent tasks are considered, whereas the sequencing of tasks plays a major role in minimizing the objective functions considered. This work primarily focuses upon minimizing the changeover and waiting time of the booths. It also analyzes the behavior of the Bio-inspired technique in terms of the threshold variations for the differing task types, proportion of tasks serviced at the booths and the final queue length of the booths at the end of the simulation. The parameters for implementing this technique were adopted from R-wasps.Tasks are dynamically generated with varying demands from the task generating facility in 4 different modes of random, probabilistic distribution. No a-priori knowledge about the demand of the next arriving task was available. The simulation was executed for 100 minutes at the rate of 2 tasks generated per minute.

Experimental results based on the original version of the algorithm as well as the modified and improved versions have clearly shown that the proposed technique has outperformed existing Ant Task Allocation in terms of changeover and also highly comparable in terms of queue length and waiting time. Random task distribution and uniform task distribution have shown an average of 10% to 22% reduction in changeover, whereas the probabilistic distributions have shown highly considerable changeover reduction of 43% to 52%. In case of booth waiting time, Random task distribution and uniform task distribution have shown an average reduction of 60 seconds in waiting time of the booths, whereas the probabilistic distributions have shown a very good reduction of 125 seconds average. Waiting time of the booth is the time for which the booth remains idle. Our approach has lessened the booth idle time to a great extent, which improves the utilization rate of all the booths, so that no booth will be underutilized or over utilized.

The key objective of this research work is to minimize the changeover, waiting time and queue length by applying an efficient, adaptive scheduling mechanism in a highly uncertain and dynamic environment. Three significant improvements were made to an existing algorithm and a new bio-inspired scheduling technique was proposed in this research project.The proposed bio-inspired algorithms were tested with benchmark problem instances as well as dynamic test cases in a simulated environment and they were found to be highly effective than the existing algorithm taken for study. The test cases were generated by using probabilistic distributions to add up the level of dynamism and unpredictability in the generation of tasks. Bio-inspired task allocation techniques developed in this research have proven their competency to handle uncertainties in dynamic industrial environment in a highly effective manner thereby improving the scheduling performance.

**List of Publications**


- T Amudha, “An Efficient Bio-Inspired Technique for Distributed Truck Scheduling in a Dynamic Environment”, Advancements in the Era of Multi Disciplinary Systems (AEMDS), ISBN: 978-93-5107-057-3, Elsevier Publications, pp. 341-352, Aug 2013.
- Amudha T, Shivakumar B L, “Improving the Solution Quality of Quadratic Assignment Problems using Harmony Improvised Consultant Guided Search Technique”, International Journal of Scientific & Engineering Research, ISSN 2229-5518, Volume 3, Issue 8, August 2012.
- Shivakumar B L , Amudha T, “A Hybrid Bacterial Swarming Methodology for Job Shop Scheduling Environment” , Global Journal of Computer Science and Technology (A) Hardware & Computation, Volume 12, Issue 10, Version 1.0, pp. 7-16, ISSN: 0975-4172, May 2012.


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