CHAPTER 7

CONCLUSIONS AND SCOPE FOR FUTURE WORK

Heuristic, multidimensional and failure handling based grid scheduling algorithms have been presented in this thesis. This work is aimed to develop efficient heuristic grid scheduling algorithms. IAC, EMACO, ACHPSO, PAPSO and 5D are the algorithms that have been developed to achieve performance enhancement in Grid task scheduling.

7.1 CONCLUSIONS ON THE DEVELOPMENT OF IMPROVED ANT COLONY ALGORITHM HYBRID WITH PSO ALGORITHM

i. IAC and ACHPSO algorithms are the two new heuristic based grid scheduling algorithms developed for decreasing the value of makespan and flowtime.

ii. Modified heuristic information and probability matrix calculation procedures are developed to enhance the algorithms for producing better results.

iii. Simulated benchmark instances of Braun et al (2001) are used to test the existing and proposed algorithms. In this simulation model, 100 instances of $ETC$ matrices are used, each with 12 possible types. It assumes that the scheduler wants to schedule 512 tasks with 16 resources. These $100 \times 12$ matrices are used for testing the algorithms.
iv. IAC algorithm yields better makespan results for 10 out of 12 considered instances due to inclusion of ETC in the calculation of pheromone updating rule. Makespan values of MET, ACFD and OLB algorithms are higher in comparing with other algorithms. OLB algorithm yields poor results for most of the instances and ACFD algorithm produces poor results for 6 out of 12 instances.

v. Average makespan of the proposed ACHPSO algorithm has shown a reduction of 77%, 78%, 76%, 51%, 32% and 31.7% with MET, ACFD, OLB, MaxMin, MCT and ACKB algorithms respectively for all the 12 considered instances.

vi. On comparing the average makespan of proposed ACHPSO algorithm with the previously proposed IAC algorithm, a reduction of 20.88% is observed.

vii. The proposed ACHPSO algorithm gives better results by producing least makespan and flowtime values when compared to all the existing algorithms as well as the proposed IAC algorithm. Hence the proposed IAC and ACHPSO algorithms are most suited for consistent, partially consistent and inconsistent instances.

7.2 CONCLUSIONS ON THE DEVELOPMENT OF ENHANCED MULTIPLE ANT COLONY ALGORITHM

i. In the proposed EMACO algorithm, experiences are shared by the cooperation of multiple ant colonies. At the same time, positive and negative feedbacks are applied to avoid stagnation situation encountered during searching.
ii. The modified pheromone updating rule used in the EMACO algorithm helps in allocating the resources optimally.

iii. EMACO algorithm manages the degree of load imbalance and achieves optimal scheduling with decreased makespan when compared to the existing algorithms.

iv. The average makespan of the proposed EMACO is reduced by 13.5% with MACO and 39.2% with ACO for different number of ant colonies.

v. Makespan of the proposed EMACO has been decreased by 41.8% and 8.8% with ACO and MACO respectively for various number of tasks. The average degree of load imbalance of the proposed EMACO has been decreased by 25% with MACO and 58.8% with ACO.

7.3 CONCLUSIONS ON THE USE OF PARALLEL ASYNCHRONOUS PSO ALGORITHM FOR GRID SCHEDULING

i. The proposed PAPSO algorithm updates particle positions and velocities continuously and also check the convergence based on currently available information in parallel, which improve the execution time and parallel efficiency.

ii. Makespan of the proposed PAPSO has been decreased by 44.9% with ACO, 21.6% with MACO and 9.4% with the proposed EMACO. Degree of load imbalance of the proposed PAPSO has been decreased by 70.9% with ACO, 47% with MACO and 29.4% with the proposed EMACO algorithms.
iii. Parallel efficiency of the proposed PAPSO is 14.3% more than the proposed EMACO and 9.4% more than the PSPSO algorithms.

iv. Hence the proposed PAPSO algorithm is best suited for tracking problems with more number of resources.

7.4 CONCLUSIONS ON THE DEVELOPMENT OF MULTIDIMENSIONAL SCHEDULING ALGORITHM WITH FAILURE HANDLING METHODS

i. A new 4D scheduling algorithm that satisfies both resource requirements and economic parameters has been developed. Incorporating failure handling methods in the 4D scheduling algorithm [5D scheduling algorithm] has also been developed to reduce job failure rate.

ii. The simulated results show that the proposed scheduling algorithms give better result when compared with the existing algorithms. The proposed 4D scheduling algorithm has reduced the average waiting time and queue completion time by 28.6% and 28.6% respectively when compared with the traditional Backfill algorithm.

iii. Pro-active failure handling method estimates the availability of grid resources and avoids rescheduling of jobs during execution time. Results show that the scheduling algorithm with failure handling improves the job processing rate by 2.4 times and reduces the job failure rate by 39.8% when compared to the algorithm without failure handling.
7.5 **SCOPE FOR FUTURE WORK**

Considerable scope exists for further investigation in the following areas in order to explore various aspects of grid task scheduling and failure handling.

i. Future research may focus on adding local search methods along with task severance and task parceling to improve the makespan further. Similarly, advanced reservation systems may be included in task severance and task parceling.

ii. QoS based heuristic algorithms in real grid environment may be implemented to investigate the ways and means of enhancing the grid task scheduling.

iii. Passive failure handling methods may be identified to work along with pro-active method to handle failures during runtime.