Persistent Systems Limited, Pune

Job Scheduling in Networked Manufacturing Using Game Theory

Feasibility Study Report

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Approvals Signature Block

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1.INTRODUCTION

The job scheduling problem has been known as an NP- complete problem for several decades .This project addresses job scheduling problem as an N-person non-cooperative game with complete information where each job acting as a player decides the processing strategies to arrive at its goal. The job scheduling problem will be translated to find the NE point of the job scheduling game using Genetic Algorithm

1.1 PURPOSE

The purpose of feasibility study is to verify whether proposed system -

- can be implemented or not
- can produce a feasible solution

1.2 METHODOLOGY

Following methodologies are used to prepare this document -

1.Literature Survey

2.Group Discussions

1.3 REFERENCES

- Merging Nash Equilibrium Solution with Genetic Algorithm : The Game Genetic Algorithm

  By Massimo Orazio Spata, Salvatore Rinaudo

  Citation - Journal of Convergence Information Technology Volume 5, Number 9. November 2010

- A game-theory approach for job scheduling in networked manufacturing

  By Guanghui Zhou & Pingyu Jiang & George Q. Huang

  PublisherSpringer U K. http://www.springer.com/engineering/production+eng/journal/170

Citation - International Journal of Advanced Manufacturing Technology, 2009, v. 41 n. 9-10, p. 972-985

2. General Information

Genetic Algorithm is to be developed for mathematical framework developed using Game Theory for different jobs in Networked Manufacturing

2.1 Current Systems and Processes

Brute Force , Heuristic search , Mapping of n job m machines problem to n job two machines are used for finding near optimum solution.

All the above solutions limit research objects to one job-shop considering the whole scheduling

objective of all jobs .

These approaches doesn't consider competitive nature of jobs in networked manufacturing.

2.2 System Objectives

The major goal of the system is to implement Genetic Algorithm for job scheduling in Networked Manufacturing

The system will simulate job scheduling in Networked Manufacturing using Game Theory

Genetic Algorithm will be used to find Nash's Equilibrium point for all jobs in a Networked Manufacturing Environment

Game Theory will be applied to this problem for finding Nash's equilibrium point

On supplying inputs, the system is to be automated to provide the optimal solution in three different formats.

- Textual
- Graphical (Using Gantt Charts)
- Analytical

2.3 Issues

- The type of interface that displays output
- Execution Time will depend on how system interacts with data

2.4 Assumptions and Constraints

Assumptions:

- Using Genetic Algorithms, we can get a reasonable solution
- When an operation of a job is being processed on a machine, it cannot be interrupted until finished
- No two jobs are scheduled to be processed on the same machine at the same time
- All jobs can be simultaneously available at the time of zero
- The transportation time exists. After an operation of a job is processed on a machine, it is immediately transported to the next machine according to its own routing
- The machines are distributive, ranging from an intra- shop to inter-shop and even inter-enterprise, which means the job scheduling bound is no longer limited to a single shop but extends to geographically distributive shops and even different enterprises

Constraints:

- Availability of real time data of a networked manufacturing system

3. Alternatives

- Alternatives for Job Scheduling Approaches :-
  - Converting n job m machines problem to n job two machines
  - Heuristic Algorithms
- Alternatives for Genetic Algorithms for finding Nash's Equilibrium:-

- Local Search Methods for Finding a Nash Equilibrium [1]

- Software Alternatives for Interface Design :-
  - Python
  - Ruby

3.1 Comparisons of Alternatives

Brute force approach finds all combinations of n jobs and m machines .But it becomes increasingly difficult to find all combinations as complexity of n job m machines problem is n!^m .

Converting n job m machines problem to n job two machines can give optimal result when input size is small . But the complexity of n job m machines problem is n!^m .So as the number of jobs or machines increases it will not give optimal solution. Also it depends on how machine inputs are split into two parts.

Solution given by heuristic method depends on heuristic function designed and doesn't give optimal solution in all cases.

Local search methods for finding Nash's Equilibrium are only applicable to 2 player game.

4.Recommendations And Conclusions

Recommendation

Use Game Theory Approach :-

As compared to Brute Force and other approaches Game theory approach correctly models job scheduling in networked manufacturing as n player non-cooperative game giving optimal solution.

Use Genetic Algorithm for Nash's Equilibrium point :-

Finding Nash's equilibrium is NP-Hard problem. But using genetic algorithm we can approximate the equilibrium point for n player game.

Conclusion

We are trying to solve n job m machines inter-enterprise/inter-shop problem using Game theory and Genetic Algorithm.

REFERENCES

1) [1] Local Search Methods for Finding a Nash Equilibrium in Two-Player Games

http://ieeexplore.ieee.org/xpl/freeabs_all.jsp?arnumber=5615609

2) http://en.wikipedia.org/wiki/Nash_equilibrium#Computing_Nash_equilibria

3) How hard is it to approximate the best Nash equilibrium?

By Elad Hazan IBM Almaden and Robert Krauthgamer Weizmann Institute of Science