A PARALLEL BEST-FIRST SEARCH

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The best-first search method is commonly employed in searching a dynamic search space with heuristic information which allows the method to locate the goal state or solution by generating only a small part of the search space. This search is efficient because it always considers the most promising node or state for expansion or exploitation. By transferring the best-first methodology into a parallel environment, the task of solving current problems is handled more efficiently.

Several concepts of parallel best-first search methodologies are addressed in this presentation. From these concepts, certain methods of parallelization become evident. These methods include node parallelism, rule parallelism, node-rule parallelism and processor parallelism.

Asynchronous parallel algorithms, algorithms that are designed for shared memory multiprocessors, have been developed through this research to handle many ideas of parallel best-first search. These algorithms include parallel procedures for node expansion and rule application. The former is inherently obvious from the original best-first search algorithm [1, 3] and is generally understood by most researchers of this area [2]. However, current efforts have led to the development of dynamic parallel algorithms. The dynamic procedures decide which is the best method of parallelism during the execution of the algorithm. Among these dynamic strategies are conditional node/rule parallelism, combinational node-rule parallelism, processor parallelism, and a comprehensive algorithm. The latter of the above, presently, appears to be the best approach and is the main focus of this presentation.

Naturally, each of the above have advantages and disadvantages associated with them. These promote several issues of concern which involve the number of nodes/states, the number of rules and the number of processors. Furthermore, the issues at hand can be architecturally dependent. On the other hand, there are areas of concern that delve below the surface issues of the application of the parallel best-first search methodology into the inner workings of the algorithm. The inner workings can be obscure and hard to approach in cases such as the goodness of the involved heuristics and the applicability of a rule. Surely, the general and commonly known problems of the above can be visibly seen.

Currently, several strategies associated with the parallel best-first search methodology are being implemented on a 30 processor Sequent Balance computer system which is a shared memory multiprocessor system. The implemented versions of the parallel algorithms will be tested and compared with one another to determine which approaches to parallelism are the most efficient for the parallel best-first search procedure.

References

[1] P. E. Hart, N. J. Nilsson and B. Raphael, A formal basis for the heuristic determination of minimum cost paths. IEEE Trans. Syst. Science and Cybernetics, 4 (1968) 100-107.

[2] T. Lai and S. Sahni, Anomalies in parallel branch and bound algorithms, Comm. of ACM 27 (1984) 594-602.

[3] N. J. Nilsson, Principles of Artificial Intelligence (Tioga Publishing, Palo Alto, CA, 1980).