Design, Prototype Implementation and Experimental Evaluation of a Scalable Multiprocessor Architecture for Qualitative Simulation

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Abstract

This dissertation presents the design, the prototype implementation and the experimental evaluation of a scalable multiprocessor for qualitative simulation. The main objective of this work is to improve the running time of the qualitative simulator QSim. In qualitative simulation, physical systems are modeled on a higher level of abstraction than in other simulation paradigms, like in continuous simulation. A major strength of qualitative simulation is that it can represent and reason with incomplete knowledge - qualitative simulation requires neither a complete structural description nor a fully specified initial state. All physically possible behaviors consistent with this incomplete description are predicted by qualitative simulation. In engineering, qualitative simulation is mainly applied in monitoring and diagnosis. QSim is the most prominent algorithm for qualitative simulation. QSim is implemented in Lisp and executed on general-purpose computers.

References

[1] Berleant, Daniel, and Benjamin Kuipers. "Qualitative-numeric simulation with Q3." Recent advances in qualitative physics 98 (1992): 285-313.

[2] Moldovan, Dan, Wing Lee, Changhwa Lin, and Minhwa Chung. "SNAP: Parallel processing applied to AI." Computer 25, no. 5 (1992): 39-49.

[3] DeMara, Ronald F., and Dan Moldovan. "The SNAP-1 parallel AI prototype." Parallel and Distributed Systems, IEEE Transactions on 4, no. 8 (1993): 841-854.

[4] Kuipers, Benjamin J., et al. "Higher-order derivative constraints in qualitative simulation." Artificial Intelligence 51.1 (1991): 343-379.

[5] Platzner, Marco, Bernhard Rinner, and Rebecca Weiss. "A distributed computer architecture for qualitative simulation based on a multi-DSP and FPGAs." In Parallel and Distributed Processing, 1995. Proceedings. Euromicro Workshop on, pp. 311-318. IEEE, 1995.