Abstract

Safety or mission critical applications have to recover from an error within an acceptable time window or it may potentially lead to disastrous effects or higher costs. The usual industrial practice is to employ fault tolerance using hardware redundancy where costs are highly exorbitant depending on the mission. In this paper, we present a framework for adaptive fault tolerance on the commonly used hardware redundancy. This proposed model gives enhanced resource management and improved system performance under normal runtime and provides minimal safe functionality under error conditions. A new scheduling method, a combination of dynamic planning and dynamic best effort approach has been designed for joint scheduling of periodic and aperiodic tasks which also include online reconfiguration for error management. This fault recovery technique allows all critical tasks to meet their deadlines and the system continues functioning with minimal safe functionality upon errors. This model has been analyzed and evaluated on a practical case study of a Cruise Control System vis-à-vis a traditional redundancy scheme with simulation and validated with appropriate performance metrics. The results demonstrate the high performance throughput and process speedup (Execution time of process) that can be gained by applying this model to an m-processor
redundancy model and the advantages can be accrued specially in the field of avionics in terms of fuel/weight ratio.

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Index Terms

Computer Science

System Design

Keywords

Fault tolerance, resource management, Cruise control system, Process speedup.