Techniques and Analysis for Mixed-criticality Scheduling with Mode-dependent Server Execution Budgets

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Problem Description
- Develop a mixed-criticality system that schedules applications of different criticality to share resources and reduce cost
- Ensure the temporal behavior of each application
- Simplify the certification process by providing sufficient temporal isolation
- Any misbehaving computational task should not affect the execution of any other task of the same or higher criticality
- Efficiently use the processing capacity to reduce costs

Main Idea
- An adaptive mode-based scheduling arrangement is used to schedule mixed-criticality applications
- Isolation among applications is achieved through servers
- Servers are scheduled in a cyclic executive manner to reduce certification cost
- Vary the server budgets dynamically upon a mode-switch to improve processing resource utilization
- Assign per-mode execution budgets to servers via heuristics

Server-level Schedulability

System-level Schedulability

Budget Assignment Heuristics

Static (X^L=X^H) vs Dynamic (X^L≠X^H) server budgets

Evaluation

Concluding Remarks
- New schedulability analysis for mixed-criticality systems
- Periodic servers scheduled in a cyclic executive manner
- AMC scheduling policy within each server
- Varying server budgets in different modes
- Strict temporal isolation
- Mode dependent budgets can improve the schedulability ratio by up to 52.8% vs. static budgets
- Even simple heuristics can yield up to 27% of improvement
- The order of servers can influence the schedulability ratio and the proposed ordering heuristics perform well