Real Time Scheduling

- PERFORMANCE EVALUATION
  - Metrics
  - Benchmarks
  - Examples
Real Time Scheduling Metrics

- Worst case utilization bounds
- Normalized ratio of algorithm A to optimal algorithm
- Speedup factor - the amount the processor speeds need to increase in order to make all tasksets feasible
- Simulation and empirical measurements using randomly generated tasksets
  - % schedulable tasksets (guarantee ratio)
  - # missed deadlines
  - # pre-emptions
  - # migrations
Real Time Benchmarks

- Low level: Rhealstone, Superconducting Supercollider (SSC)
- High level - Hartstone
- Honeywell benchmarks for complex real time apps
- Mitre benchmarks for real time DSP applications
- DARPA Benchmarks - military
Hartstone

• PH Series – periodic tasks, harmonic frequencies
• PN Series – periodic tasks, non-harmonic frequencies
• AH Series – aperiodic tasks
• SH Series – periodic tasks with synchronization
• SA Series – periodic tasks with aperiodic processing and synchronization

• Deadlines for tasks and for messages
Example of Simulation Experiments
[Zapata and Alvarez, 2005]

• 500 synthetic tasksets
  - Period $T_i$ from uniform distribution $[1,500]$  
  - Execution time $C_i$: uniform distribution $[1, \alpha \times T_i]$ where $\alpha$ are utilization values $[0.2, 0.5, 0.8, 1.0]$ 

• 16 processors 

• Performance metric: 
  guarantee ratio = percentage of feasibly scheduled tasksets
Example of Simulation Experiments
[Zapata and Alvarez, 2005]
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RM v. EDF: Judgment Day
(Butazzo 2005)

• Claim: EDF has been unfairly judged inferior to RM
• Implementation complexity
• Runtime overhead due to pre-emption
• Schedulability Analysis - new results $\rightarrow O(n)$ with EDF, pseudo-polynomial with RM
• Robustness during overloads
• Jitter and latency (among jobs from the same task)
• Resource Sharing and mgmt of critical sections
Figure 1. Preemptions introduced by RM (a) and EDF (b) on a set of two periodic tasks. Adjacent jobs of \(r_2\) are spicted with different colours to better distinguish them.

Figure 2. Preemptions introduced by RM and EDF as a function of the number of tasks.