Energy Efficient Scheduling Algorithm for Real-Time Computing Systems

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Introduction

- **Applications: Real-Time Systems**
  - *Multi-robot systems*
  - *Satellite*
  - *Avionic systems*
  - *PEDs*

- **Computing Systems:**
  - *Uniprocessor*
  - *Multiprocessor*  
    - Homogenous
    - Heterogeneous
  - *Multi-Core*
  - *Distributed System*

- **Objective: Energy Consumption**
Real-Time Multiprocessor Scheduling Problem

A given task set

A valid schedule on 2 processors
Water Tank Model as Scheduling Dynamics

A fluid Model

Remaining Execution Time

T1

Fluid Schedule

Practical Schedule

Time
Problem Formulation

- Mixed Integer Nonlinear Programming

\[ \text{Minimize} \quad \text{Total Energy Consumption} \]
\[ \text{subject to} \]
1. Scheduling Dynamic.
2. All tasks meet deadlines.
3. Every task is assigned to only one processor at a given time.

- Reformulation to NLP: Fraction of Execution Time instead of Task Assignment.
Simulation Results

- Simulation Results
- Normalised Energy Consumption vs. Normalised Taskset Utilization
- MINLP, NLP, RT-SVFS, LLREF
Future work

- Feedback Scheduling:

#### Fluid Scheduling with uncertainty in task execution time

![Graph showing model and real fluid scheduling paths](image)

- Valid Schedule
- Task finished early

Overall Architecture Block Diagram