XI JORNADA DE JÓVENES INVESTIGADORES DEL I3A

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Thermal Intelligent Control DVFS for Cyber-physical Systems

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Motivation

- Improved performance and capabilities of embedded systems lead to a greater consumption of power and bigger heat dissipation
- This creates a problem where heat has to be dissipated but there is either not enough space or the power available is not enough
- Different proposals:
  - Task prioritization
  - Limiting frequency
  - Big heatsinks

Approach

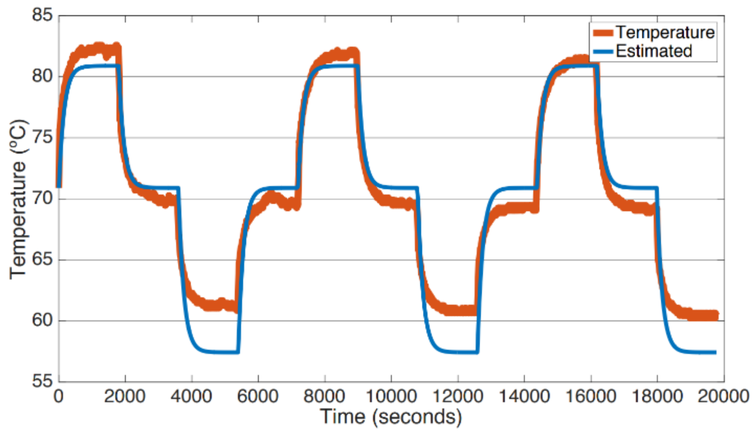
- Formal control techniques from control engineering to improve performance stability
- A control for frequency to keep a constant and stable temperature
- Supervisor to perform workload identification, and adapt the controller to each type of workload:
  - Integer
  - Floating point
  - Memory

System Identification

- We need a mathematical model to relate dynamical response of temperature to frequency
- Approximation with a first order transfer function with constant time delay

$$G(s) = \frac{\Delta T(s)}{\Delta F(s)} = \frac{k_p}{1 + T_p s}$$

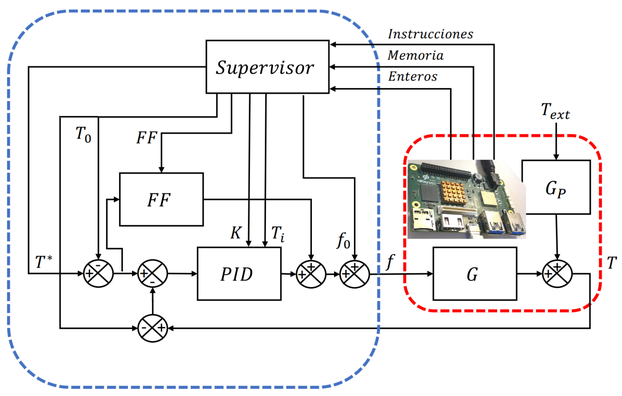
- For workload we use performance counters that count events like memory accesses and floating point instruction. We used a multinomial logistic regression to perform the classification



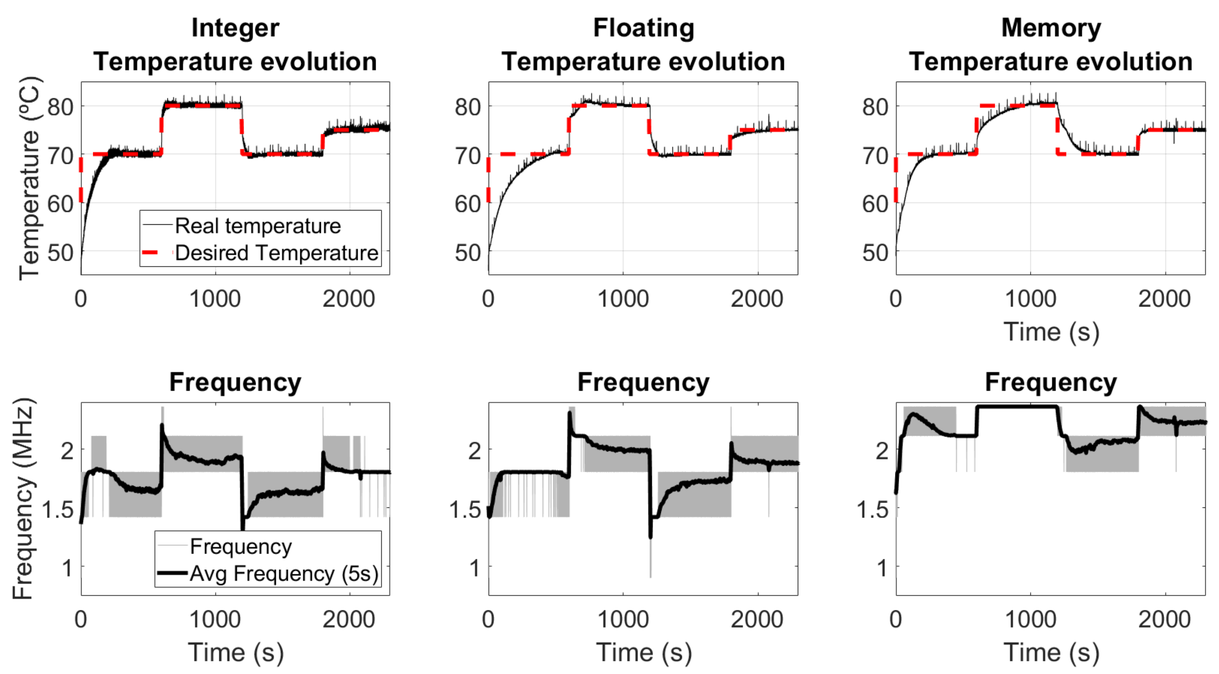
Methodology

- We use a HiKey 960 with 8 cores big.LITTLE 4 performance and 4 power efficient
- 3 different types of benchmarks for each type of workload to train the classifier and adapt the controller to each of them
- Control and supervisor implemented as a Linux kernel for fast and stable execution
- Evaluated with Geekbench

Control scheme



Adjustments



Conclusions

- We have a functional control scheme that is capable of recognise workloads and adapt the control to successfully manage the temperature
- It shows an improvement in performance stability with less frequency changes and lower temperature

Results