TIPTOP
Thermal and power/performance management for multicores

A DISTRUPTIVE SOLUTION AND A PATENT READY TO BE COMMERCIALY EXPLOITED

High-speed integrated thermal/power/performance management for high power density microprocessors

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Status: Available

LOOKING FOR COMMERCIAL EXPLOITATION AND RESEARCH LINKS

Developed during

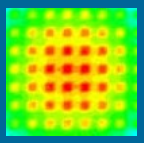
HARPA project: Harnessing Performance Variability
FP7-ICT-2013-10-612069 – http://www.harpa-project.eu/

HARPA

SEVENTH FRAMEWORK PROGRAMME

POLITECNICO MILANO 1863

TIPTOP
Tightly Integration of Power and Temperature for Optimal Performance



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DESCRIPTION

We created a thermal control method for high power density microprocessors, that straightforwardly integrates with power/performance management. Our solution is capable of guaranteeing safe operation without unduly limiting speed. Thanks to a thorough exploitation of event-based control and to a convenient hardware/software partition, the solution causes a negligible computational overhead, and is easy to tune - also automatically - after the processor is deployed, to withstand heterogeneous operating conditions. Also, the solution is agnostic with respect to the operating system.

A prototype was realised, in which the hardware part is software-emulated, and proved successful beyond the current state of the art.

APPLICATION FIELDS

The invention can be applied in all cases where a processor – or a digital processing unit at large - has thermal dissipation issues, provided that it supports DVFS and has a temperature sensor. In the case of multi-core processors, the invention is applicable to each core individually provided each has a DVFS and a temperature sensor.

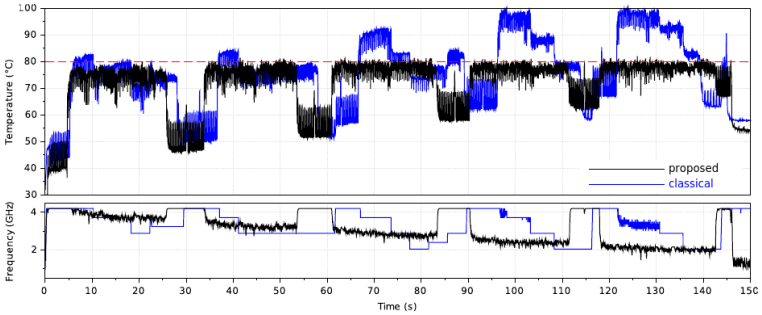
Examples of products that can take advantage of this invention are:

- processors (possibly multi-many core CPUs) for desktop computers, laptops, servers, smartphones, tablets;
- graphical processors (GPU) for desktop computers, laptops, servers, smartphones, tablets.

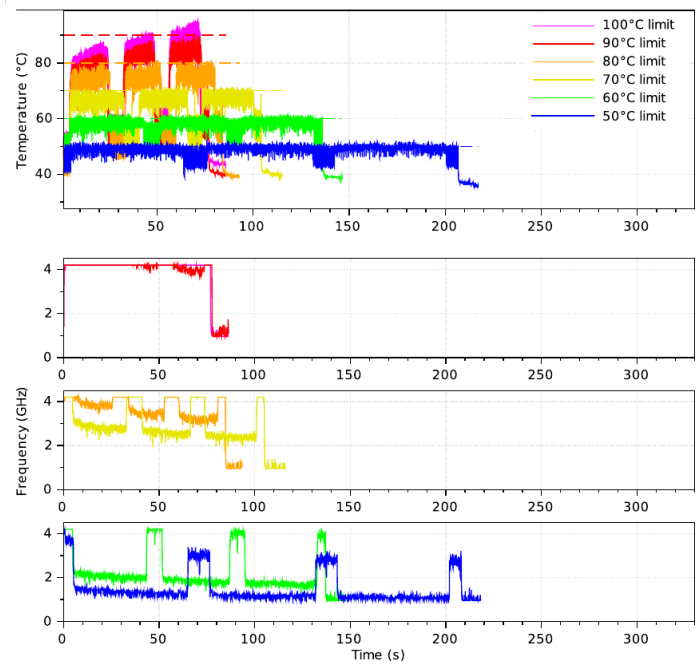
MAIN ADVANTAGES

- Guarantee thermal safety with, in the critical cases, only graceful degradation of the software exec speed
- Seamless transition from maximum speed to thermally limited operation
- Permit smooth and gradual transition from a performance oriented to a power saving oriented operation
- Increase the processor performance while reducing the production cost, compared to solutions employing a dedicated microcontroller
- Reduce thermal cycling, thus increasing reliability and life time of the devices
- Automatically tuneable after deployment

DEVELOPMENT LEVEL: PHYSICAL PROTOTYPE



Advantages yielded over standard thermal control: temperature along a benchmark (top) and frequency (bottom). The standard control strategy cannot handle the fast thermal transients caused by the data-dependent power consumption, and the temperature reaches 100°C, causing the activation of hardware thermal protection at around 120 seconds. The proposed event-based thermal controller is instead capable of reacting fast enough, keeping the temperature at the prescribed limit of 80°C while requiring much less intervention on the DVFS.



Performance of the proposed technique with different limit temperatures as a means to trade thermal stress versus completion time on a LINPACK benchmark: temperature (topmost plot) and frequency (other plots, colours match limit temperatures).