Executing Parallel Real-time Software on Multi- and Many Cores in a Timely Manner

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The transition to multicore- and many core-based SoCs is becoming ubiquitous in the so-called critical (real-time) domains, and the space domain does not make an exception to that. While multicore and many core systems carry a huge potential for increased performance and functionality integration – reducing the amount of hardware to procure and increasing reliability – they also bring their own set of challenges including the following:

- Defining proper criticality-aware programming models and tools for performance analysis able to satisfy domain-specific V&V requirements;
- Managing time predictability of hard-to-predict resources like caches and hardware shared resources (e.g. interconnects, memory controllers).

In this talk, we will present the work carried out in the CAOS group (www.bsc.es/caos) and current research trends in these fields, with emphasis on the space domain. In particular, we will discuss:

- our experience on applying parallel programming models to exploit the performance opportunities of highly parallel and heterogeneous architectures (including those featuring GPUs) while guaranteeing the safety and real-time constraints of space applications.
- our experience introducing randomization (both at hardware and software level) and probabilistic analysis to handle cache jitter and the design of a time-analysable processor for the space-domain.
- our experience and trends in multicore contention modelling, leveraging standard hardware monitors as provided by statistical units of current COTS processors, its interaction with multicore scheduling, and its integration with commercial tools like RapiTime.

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