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Demo

Multicore emulation-in-the-loop in the Khronosim project

Luis Miguel Pinho

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Luis Miguel Pinho

*CISTER Research Centre

Polytechnic Institute of Porto (ISEP-IPP)

Rua Dr. António Bernardino de Almeida, 431

4200-072 Porto

Portugal

Tel.: +351.22.8340509, Fax: +351.22.8321159

E-mail:

http://www.cister.isep.ipp.pt

Abstract

Multicore emulation-in-the-loop in the **Khronosim** project

Luís Miguel Pinho

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Outline

> Context

> The **KhronoSim** project

> Distributed testing framework

> Supporting emulation-in-the-loop

> Conclusions

Context

> Complex systems and systems of systems are an integrated set of components and sub-systems

>> Tightly interacting together to achieve a specific goal

> Guaranteeing that individual sub-systems behave according to their specifications is a (relatively) "simple" task

>> The magnitude of the validation is much higher when it comes to provide guarantees on the correct integrated behavior

> All the possible interactions between the sub-systems must be properly tested in order to capture all the system properties.

Context

> Testing systems in actual environment is overly expensive and/or too slow

>> In particular when considering Cyber Physical Systems

>> Even simple algorithms and software may become extremely complex to test due to the interaction with the environment

> The use of model and platform simulators is growing in importance to address testing of complex systems

>> Nevertheless there is a challenge on how to integrate the different testing components

Context

- Simulators allow for an increase in the productivity of software development, enabling:
  - Simultaneous development of software and hardware
  - Testing software before actual hardware exists
  - Providing a friendlier environment for software testing, without requiring actual hardware-in-the-loop
- Supporting hardware emulation is key for software testing
  - But requires emulator in the loop of the testing framework
  - Introduces further challenge on how to provide real-time behavior of the integrated system

KhronoSim

> ## KhronoSim

>> A distributed, modular and extensible system for simulation and test of complex systems

>> Enables integration of simulation models, platform emulators and physical systems in a closed-loop test environment

>> Ongoing industrial project, led by Critical Software, including CISTER and UCoimbra

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KhronoSim

> **KhronoSim** allows to
>> Simulate complex systems in real-time by including either the whole or part of the system under test
>>> Including the simulation of the environment and other interacting systems
>> Emulate the hardware platform upon which the system will execute
>>> A special concern is in particular multicore embedded platforms

Actuators

Environment Models

Sensors

Platform emulator

Application Software and/or models
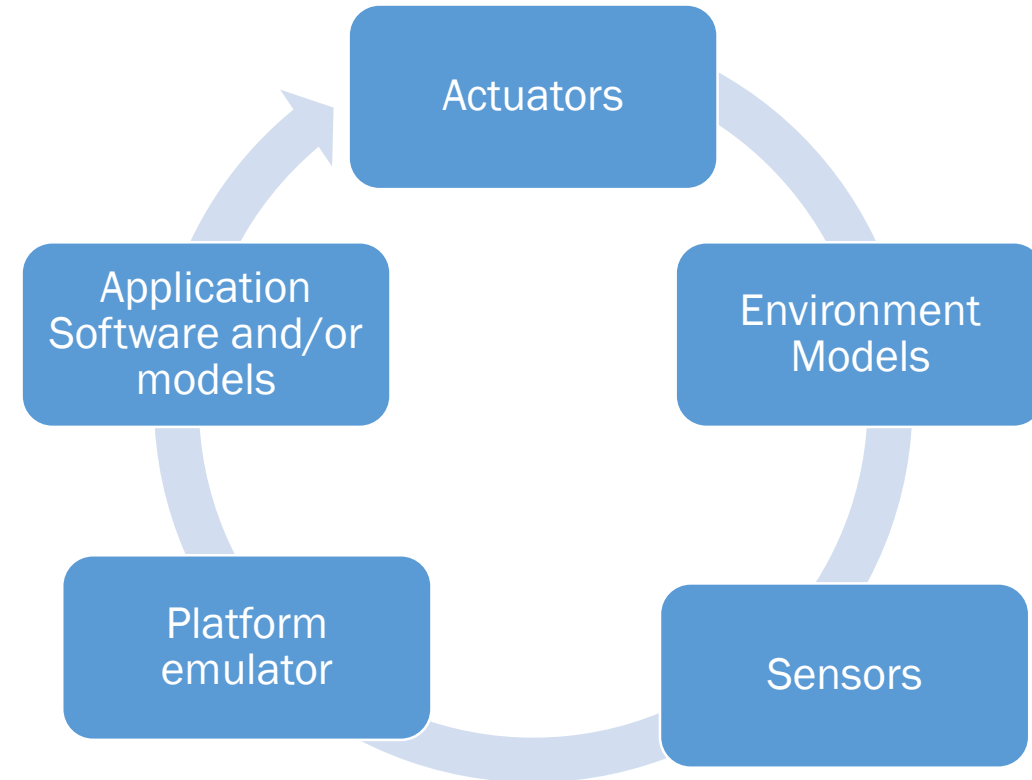
Multicore emulation-in-the-loop

> Multicore emulation is of paramount importance
>> Testing several configurations of the system and thus providing a better understanding of the design choices
>> Accelerate the certification and the development of components, e.g., real-time operating systems (RTOS), mixed-criticality systems (MCS), etc
>> Provide a further insight into the latest developed methods and techniques to solve multicore challenges

Emulation-in-the-loop

> Addressed with the integration of QEMU within the KhronoSim platform
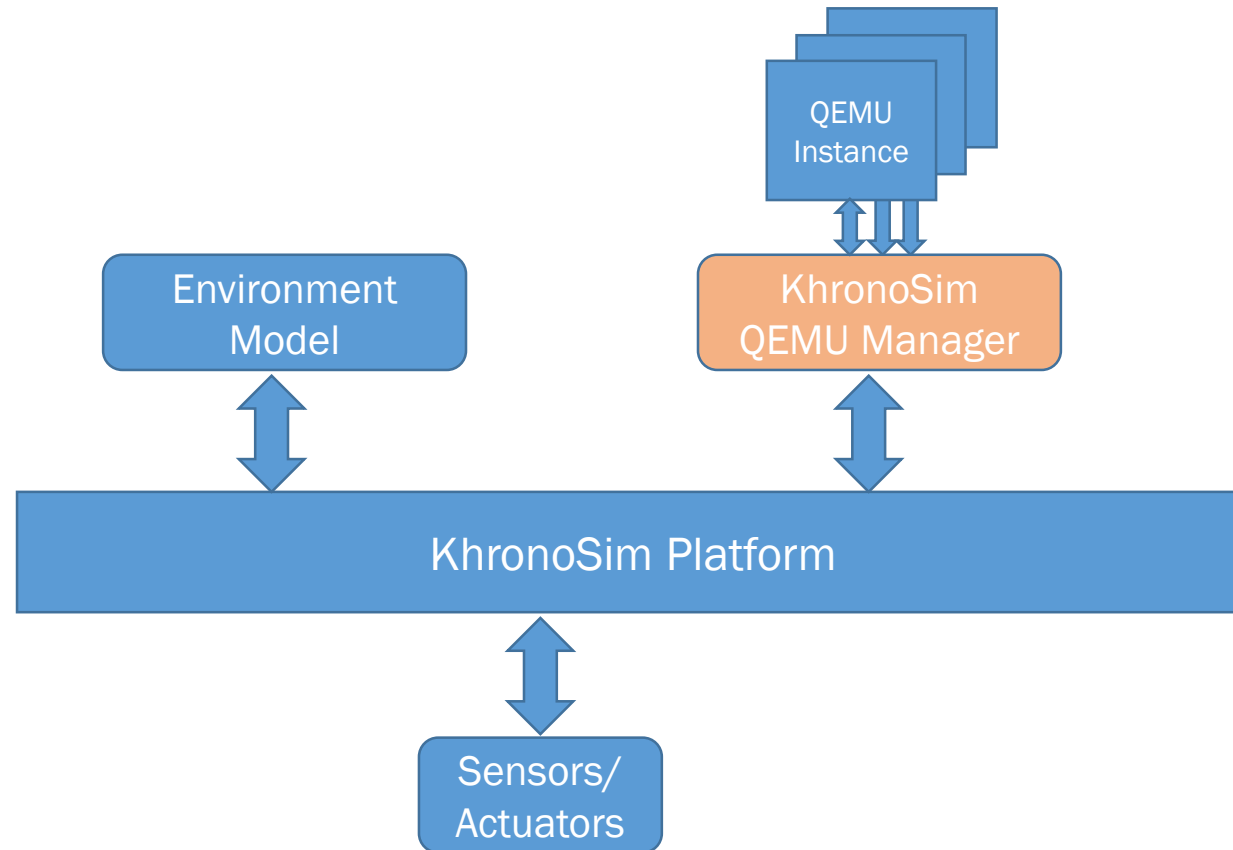
Emulation-in-the-loop

› QemuManager

  › The QEMU Machine Protocol allows interaction with QEMU instances using predefined commands

  › KhronoSim provides a QemuManager that natively implements this system and uses TCP sockets to communicate

    › A TCP server exists in each QEMU instance and then sending QMP commands to interact, using JSON format.

  › This approach allows for a simpler and suitable way to interact with the QEMU

    › It is also scalable as it is possible to add new commands to the QEMU system

Emulation-in-the-loop

> QemuManager allows services to
>> Load specific configurations of a platform and/or application
>> Start/stop emulation
>> Suspend/resume the execution of the emulated application
>> Execute and trap commands
>> Control the speed of emulation

Emulation-in-the-loop

> Emulation speed control

>> Important feature is the ability to control and align the time base of the emulator with the overall timebase of the other modules

>>> E.g. Matlab model execution

>> The QEMU throttle control is exposed to the QemuManager

>>> A throttle command is then made available to the distributed simulation control

Conclusions

> KhronoSim tackles the challenge of testing and validating complex Cyber-Physical Systems

> > Using hardware emulation in the testing loop, integrated with models and environment

> The KhronoSim QEMU Manager was developed to enable the integration of hardware emulation in a closed loop in the KhronoSim platform

> > Goal is to test and analyze different configurations of a multicore platform

Thank You.

Questions?

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