

Project in Embedded Real Time Systems

Description:

In this exercise, you should propose and demonstrate the use of a methodology based on SysML/UML and related profiles for the design of an Embedded Real Time project. The methodology must be applied for the design of a system that you define and specifies. The project should include a SysML/UML model with architectures for alternative SoPC solutions. A model should be developed to evaluate and verify the system in terms of hardware and software processing modules for a selected architecture. Finally part of the system should be implemented and verified on the ZYBO board.

Goals:

When you have completed this exercise you will:

- have developed and used a co-design method on a practical problem
- have experience for how to apply SysML/UML for HW/SW co-design problems
- have describe an SoPC architecture with SysML or UML
- have experience with selecting and applying design patterns
- have experience with modeling and verification using the HLS tool
- have implemented a design on the ZYBO board

1. Define a methodology¹ using SysML/UML diagrams for the development of your system. Specify SysML/UML diagrams that need to be made in the different phases of the project. Make a short description of each design phases and the SysML/UML diagrams and profiles you decide to use in the methodology. Remember to use references to the papers you have use as inspiration for your work. Decide on an UML² tool.

2. Write a requirement specification with functional and non-functional requirements especially with focus on performance like throughput and latency. The functional requirements can be described in terms of use cases.

3. Use your design methodology found in **1.** to describe a SysML/UML model of your system in terms of structure and behavior. Make a suggestion for alternative HW/SW architectures. Decide on which parts of the functionality should be mapped to hardware components and software processes.

4. Design the software and apply design patterns that are suitable for your project, and motivate the choice of the used patterns. Use the Two-Part Architecture Model if relevant for the problem. Use the abstract OS package for the ZYBO board.

¹ See as an example “A HW/SW Co-design Methodology based on UML” and literature on Blackboard

² In case you don't have a tool preference ask for a license to Enterprise Architect: <http://www.sparxsystems.com.au/>

5. Select the SysML/UML model for your preferred architecture suggestions in **3**. Choose a part of the functionality including both hardware and software components to create a model and a test-bench in HLS using SystemC or C-code. Simulate and validate your design model.

Argue for your choice of modeling language and abstraction level of modeling. Use the reports from the HLS tool to evaluate performance of the design. Assess whether the design is able to fulfill your requirements and constraints.

6. Implement and test a part of your system using the ZYBO platform including at least one IP core written and verified with the HLS tool.