**Internship Proposal**

A Distributed Simulation Environment for Cyber-Physical Systems

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**Context**

Ptolemy [1, 2] is an open source modeling and simulation tool for heterogeneous models of computation, developed at University of California at Berkeley (UCB). The High-Level Architecture (HLA) [5] enables a distributed simulation which several simulation systems work together. The basic notion is a **Federation** that gathers together **Federates** which can be simulators or tools like a 3D visualizer or hardware (eg joystick). The federates can run on a same computer or on different computers. **CERTI** [6, 9] is an open source HLA-compliant RTI developed at ONERA.

In a joint work ISAE-ONERA-UCB, a first version of a collaborative simulation framework combining Ptolemy II simulations with a distributed simulation provided by HLA-CERTI was developed called PTII-HLA [7]. The PTII-HLA framework allows experimenting with heterogeneity of models of computation provided by Ptolemy and interoperability provided by HLA. It has been ported in the research demonstrator PRISE (Platform for Research and Teaching in Embedded Systems Engineering) [3], a platform for distributed simulation and execution using HLA-CERTI.

Ptolemy was extended with dedicated components that enable the connection to HLA. The **HlaManager** manages the advancement of time, a fundamental issue in HLA and Ptolemy, for event-based federates and time-stepped federates. Two new Ptolemy actors, **HlaPublisher** and **HlaSubscriber** are in charge of the data communication.

From a centralized model as the one in fig. a, a Federation is obtained in a straightforward way: each block (as AutoPilot) can become a Federate (as the one in fig. c). This is done by: i) replacing each input port by a **HlaSubscriber** (e.g. stick), ii) replacing each output port by a **HlaPublisher** (e.g. elevCom) and iii) adding a **HlaManager** (AutoPilot). A Federation with Aircraft and AutoPilot block as PTII-HLA Federates and a real Joystick (fig. b) replacing the PilotStick block was successfully implemented.

**Objectives**

The mains goal of this internship is improve the PTII-HLA collaborative simulation framework, mainly by evaluating the different mechanisms for advancing time in the federation. A particular attention will be done in the case there are simultaneous events. A performance evaluation of the implementation can be done in order to optimize, if necessary, the current framework.

This project is done in the framework of a joint work between ISAE/DMIA and CHESS/EECS/UCB. All the new implementation successfully tested will be added to Ptolemy project [8] with the name of the authors.

**Skills** Students preparing for a Master’s degree or equivalent (BAC+5) with a good knowledge of Java and Eclipse, interested in distributed systems and simulation of cyber-physical systems. A knowledge of C++ would be a plus. It is a R&D theoretical and experimental work.
References


