

# Contract programming for cyber-physical systems

ENSTA Paris



**NICOLAS BAUDIN**  
INTERNSHIPS IN FRANCE INITIATIVE

Name of the hosting institution in France	ENSTA Paris
Name of the host laboratory / research team	Computer Science and System Engineering Department
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Web site	<a href="http://u2is.ensta-paristech.fr">http://u2is.ensta-paristech.fr</a>
Name of the supervisor	Chapoutot Alexandre
Function	Associate Professor
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## Internship offer

Topic of the internship (title)	Contract programming for cyber-physical systems			
Proposed dates of the internship*	Start	2020-12-01	End	2021-05-31

\* The supervisors have indicated the dates proposed are flexible and are able to be postponed subject to COVID-19 border closures.

### Scientific and academic objectives of the internship (detailed description of the internship content, work expected from the intern and expected outcomes):

The goal of this internship is to design and develop a new method to verify properties on cyber-physical systems. Those systems are systems in which a mechanism is controlled or monitored by computer-based algorithms. Models are mandatory to design such systems and modelling languages are often used to design cyber-physical systems. The verification of cyber-physical systems require adapted methods to prove that all the system behaviours fulfil its requirements. Set-based simulation is a method to perform this task. In particular this technique can be used to perform exhaustive testing by propagating sets of values. Hence we can prove that no behaviour of the system reach a bad state. The goal of this internship is to continue the development of code generator for the modelling programming language Zélus targeting a C++ library allowing set-based simulation of hybrid dynamical systems and apply some verification methods on it. The main tasks to performed are:

- Understanding the compilation process of the Zélus compiler
- Understanding the main principles of set-based simulation
- Defining and implementing new compilation rules for set-based simulation code in particular for discrete-time part of cyber-physical systems.
- The design of verification method based on SAT solver could be also studied during the internship in function of the preference of the student.

Name of industrial partner	Naval Group
Role of the industrial partner in the internship Project	Industrial validation of the solution developed during the internship
Main contact at the French industrial partner	Vincent Lescaret
Email of contact at French industrial partner	vincent.lescarret@naval-group.com

## Expected profile of applicant

Level of study	Master
Discipline	Computer science
Required qualities, knowledge and skills	Functional programming, formal verification techniques as model checking methods. Strong programming skills and logical reasoning.