

# Bachelor X CSE 303 Project: Aggregate measures for control and coordination of IoT systems

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The main goal of this project is to propose specification mechanisms for the coordination and control based on aggregate measures, such as the percentage of entities in a given state, e.g. if less than 75% of system blocks have enough charge to emit light for 5 minutes, then 20% of these blocks shall switch off their speakers (thus allowing these blocks to continue emitting light for a longer period).

## Context

We are working on a formalism [1] for the modelling and control of dynamic self-adaptive systems. Namely, we consider systems composed of a multitude of small agents similar in nature that collaborate to achieve a common goal, for example, in the context of the Internet of Things (IoT). One example of such systems is provided by the so-called [modular robots](#).

We aim for a formalism that supports hierarchical modelling of such systems and naturally integrates adaptive control for the optimisation of the physical system aspects, such as power consumption.

The hierarchical structure of such systems is heterogeneous with very few entities at some levels and hundreds or more at other levels.

## Project goals

For levels with a large number of entities, we need specification mechanisms for the coordination and control based on aggregate measures, such as the percentage of entities in a given state, e.g. *if less than 75% of robot blocks have enough charge to emit light for 5 minutes, then 20% of these blocks shall switch off their speakers* (thus allowing these blocks to continue emitting light for a longer period).

The student will be expected to read 3–4 related papers (e.g. [2,3]) and propose ideas for such specification mechanisms.

## Required skills

Good analytical skills will definitely be required. The candidate must have good understanding of logics.

## Location

The internship will be carried out in the [Spirals](#) project team at [Inria Lille – Nord Europe](#) under supervision by Simon Bliudze, Sophie Cerf, and Olga Kouchnarenko ([FEMTO-ST institute](#)).

## Contact and application

For additional information and to apply please send an e-mail to [Simon Bliudze](#) (in English or French) with the subject “Aggregate measures project”.

## References

- [1] S. Bliudze, S. Cerf, and O. Kouchnarenko, “Controlling Hierarchical Motifs to Avoid Systems’ Blackout” in preparation.
- [2] J. Beal, D. Pianini and M. Viroli, “Aggregate Programming for the Internet of Things,” in *Computer*, vol. 48, no. 9, pp. 22-30, Sept. 2015, doi: 10.1109/MC.2015.261. [[PDF](#)]
- [3] R. Scattolini, “Architectures for distributed and hierarchical model predictive control — a review”, in *Journal of process control*, 19(5), 723-731, 2009. [[PDF](#)]