Digital Sobriety: controlling unused resources

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Context

This internship investigates an emerging application of control theory: Digital Systems [1]. The "plant" to be controlled is a software—or an application— running on a hardware infrastructure. The focus is made on datacenters, and specially High Performance Computing, for the significant roles it plays in ICT footprint. Controlling software offers many novel and interesting opportunities compared to classical control usecases. Multiple sensors and actuators can simply be created and implemented via a few lines of code. Experimenting is easy, even for non-experts, and largely reproducible.

The general goal of the internship is to reduce unused resources in a computing center—also called grid. Control theory techniques are used, relying on sensors of grid availability, and on a task actuator (sending waiting tasks on the grid to "fill the holes"). Previous works have shown the feasibility of such control using a PI controller [2]. Such a reactive controller is however limited in that it cannot anticipate for knowledge on future grid usage.

Expected work

The internship will consist in studying a new control, with anticipation action, aiming at overcoming previous limitations.

In particular, the student may work on one or more of the following:

- study of the existing system, its sensors and actuators, and previous controllers,
- design of a control with anticipation action, e.g. a feedforward control,
- experimental evaluation using an already existing platform [3].

There are opportunities to pursue this internship with a PhD.

Required skills

A good knowledge of linear control theory is required. **No** prior knowledge of computer science is needed, experimentations will be assisted by grid experts.

Location

The project will be carried out in the Spirals team, at Inria Lille.

Contact and application

For additional information and to apply, please send an e-mail to Sophie Cerf and Lionel Seinturier (in English or French).

References

1. Filieri, A., Maggio, M., Angelopoulos, K., d'Ippolito, N., Gerostathopoulos, I., Hempel, A. B., . . . & Vogel, T. (2015, May). Software engineering meets control theory. *In 2015 IEEE/ACM 10th International Symposium on Software Engineering for Adaptive and Self-Managing Systems* (pp. 71-82). IEEE. [PDF]

2. Quentin Guilloteau, Olivier Richard, Bogdan Robu, Eric Rutten. Controlling the Injection of Best-Effort Tasks to Harvest Idle Computing Grid Resources. *ICSTCC 2021 - 25th International Conference on System Theory, Control and Computing*, Oct 2021, Iași, Romania. pp.1-6, [PDF]

3. Bruno Bzeznik and Ghislain Charrier, CiGri. lic: GPL-3.0-or-later. [Website]