

# Online HPC workload data analysis for light and reactive control

**Keywords:** High Performance Computing, Control theory, Traces and Data Analysis.

## 1 Description

Many scientific processes can be expressed as a workflow graph where nodes are computational tasks (scientific simulations, analysis, visualization) and edges are data exchanges between tasks. Traditional workflow infrastructures exchange data through files. However, the increasing gap between I/O bandwidth and computational capabilities in current and future supercomputers requires a change in the way scientists are analyzing data produced by simulations. File-based workflows must now be replaced by in situ workflows performing data extraction, data reduction, or online visualization before storing relevant data to the file system.

On current supercomputers, a in situ workflow execution can span across thousands of nodes. Such execution may exhibit single tasks distributed across multiple nodes, or multiple tasks sharing a same single node. In this last case, tasks must be isolated from each other, to avoid potential performance degradation.

However, the behavior of each task and the performance of the HPC application itself depends on several external factors : the input dataset, the number of computing resources available, possible network contention, ... In such a situation, the HPC runtime should adapt online its placement and isolation policies in reaction to the actual execution it controls. Often the cost of running this control process can be high and the runtime choses to perform it sporadically to lessen its global impact. The main issue here is to decide when it is the most pertinent to run the control process in order to adapt the resources policies.

## 2 Expectations

The purpose of this internship is to design a method to analyze an application online, that is during its execution. The idea is to continuously collect a trace, that contains software and hardware metrics, and to analyze it in order to detect changes in the execution. We are mainly interested in detecting phases changes (the application switch for computation to communication or conversely), load changes (the input dataset is irregular and the computation is not balanced) and environmental changes (there is a network contention, some nodes are down). The objective being to sort out what is relevant (has an impact on the performance) from what is not and to trigger the runtime control algorithms only when a relevant change occurs.

## 3 Contact

- Guillaume Huard <Guillaume.Huard@imag.fr>
- Swann Perarnau <swann@anl.gov>