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Uncertainty Propagation in Graphs of Models

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1 - CONTEXT

Need for uncertainty modelling and computation in simulation of industrial complex systems:

- Existing state-of-the-art approaches are well suited for simple graphs of models.
- Objective: developing new methods to deal with the complex multi-model cases, allowing efficient computations of design margins.

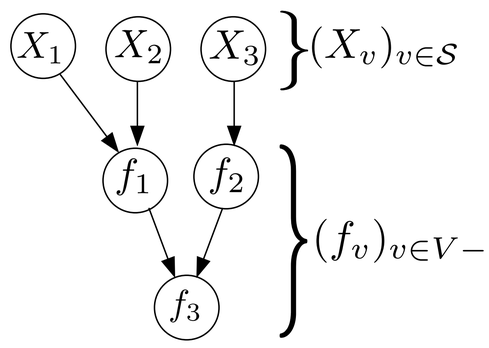
2 - CHALLENGE

To model and compute design margins, some typical challenges encountered are:

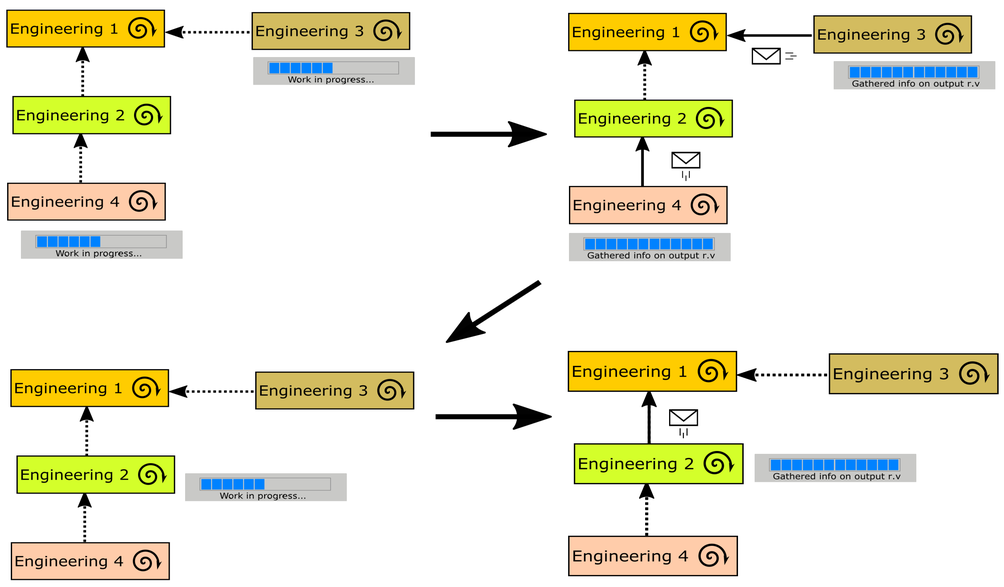
- The cost of information exchange between engineering processes
- The numerical complexity of engineering models
- The sequentiality of the workflow
- The dependency between random variables
- The strong coupling of some engineering processes

3 - PROPOSED MODEL

The numerical workflows are formally described with a graph, a set of functions and a set of random inputs.



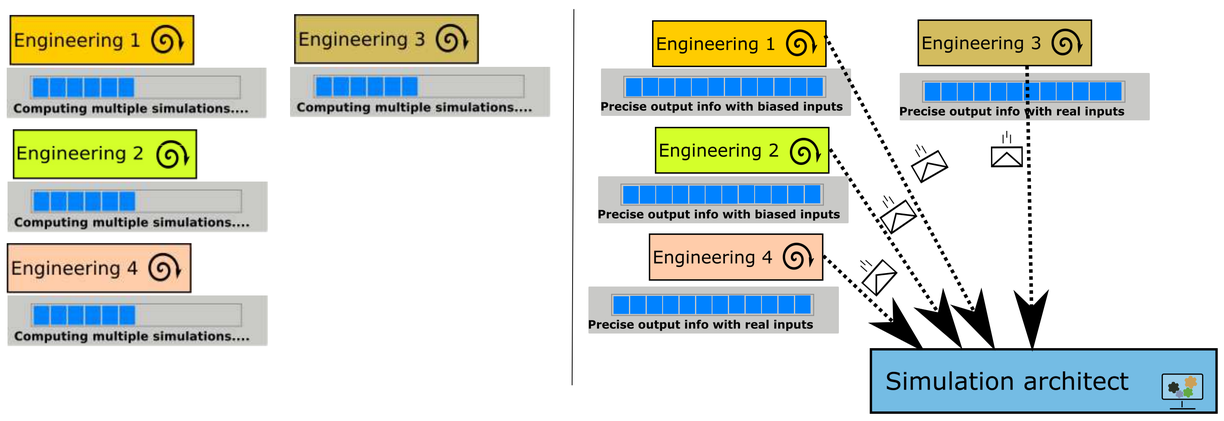
The interaction between disciplines are modelled by engineering processes.



4 - RESULTS

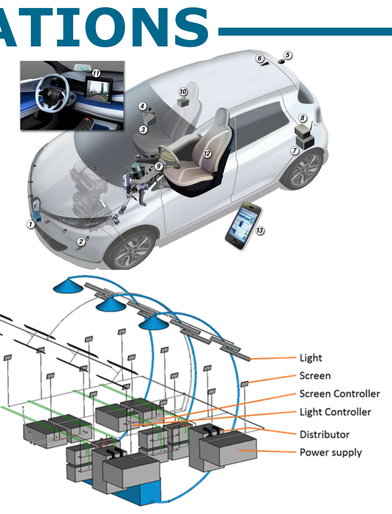
Based on a decomposition-based approach [1], our proposed method allows:

- Monte-Carlo computations without communication between the engineering processes.
- Aggregation of the "local" computations to get global information on the system.
- A proof of convergence rates of the Mean Square Error



5 - EXPECTED APPLICATIONS

- The autonomous and economical car use case.
- The electrical wiring interconnect system use case.



6 - FUTURE WORK

- Extending the mathematical framework of the proposed algorithm.
- Methodology to define design margins and development of the related numerical methods.

REFERENCE

[1] Sergio Amaral, Douglas Allaire, and Karen Willcox. A decomposition-based approach to uncertainty analysis of feed-forward multicomponent systems. 2014.

Scientific Domain: Scientific Computation
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