

Systemic Optimisation and Functional Digital Twin

<http://www-instn.cea.fr/en/education-and-training/research-training/post-doctoral-research/post-doc-offers/systemic-optimisation-and-functional-digital-twin,18-0098.html>

Context

LIDEO (Executable Languages and Optimisation Engineering Laboratory) develops the Papyrus tool (www.eclipse.org/papyrus), a highly customisable graphical modeller for the UML2 language, which also allows functional simulations. Papyrus has been hosted by the Eclipse open source foundation since 2009. An industry consortium was created in 2016 around the users of this tool. LIDEO plays an important role in standardisation groups of the OMG (Object Management Group) responsible for the UML, SysML and MARTE standards. The laboratory applies its recognised expertise in functional simulations, particularly in the manufacturing sector: in the context of the industry of the future (Industry 4.0), Papyrus notably makes it possible to create a functional Digital Twin of the factory / site. It is a functional model (process, resources) which may be coupled to numerical models (differential equations, CAD, ...) and which validates and / or optimises the overall system operation via a complete Digital Twin.

Work description

The current economic constraints in the industrial field are getting tighter, which leads to increased competitiveness and a need to produce better and quicker. The optimisation of production processes and their design therefore lies at the centre of the considerations on the Factory of the Future. Optimisation needs are large and cover various scopes ranging from design and logistics to processes, with the objective of reducing time and costs while maintaining or even increasing the quality and tailoring of products and services. Optimisation and simulation tools need a comprehensive vision of the systems they study, which may be provided by a Functional Digital Twin of the factory/construction site. The approach of Model-Driven Engineering (MDE) allows engineers to design such a Twin and to interconnect it with numerical models (equations, 3D models ...), which allows validating and/or optimising the overall system operation through a complete Digital Twin.

The goal of this Post-Doc is to investigate and develop a generic and configurable framework for process optimisation (scheduling, sizing ...) around MDE tool Papyrus and its simulator. An executable language, dedicated to the description of Digital Twins, has been implemented in Papyrus, and first industrial optimisation projects have been completed [1,2]. The main objective of this Post-Doc is to generalise the approach used [3,4] by proposing a generic framework based on simulation to solve optimisation problems of the factory or the construction site.

The Papyrus simulation environment also has a decision support platform that will need to be improved, notably on the basis of optimisation and simulation results.

The candidate will have to:

- Familiarise himself/herself with the Papyrus platform and existing simulation, optimisation and decision support methodologies;
- Develop and validate a generic and configurable framework for process optimisation (scheduling, sizing, ...) around the Papyrus simulator;
- Provide expertise on the various conventional optimisation methodologies to guide answers to case studies;
- Actively participate in the formalisation of case study issues;
- Be proactive in improving the architecture of the solution;

- Participate in the evolution of a decision support dashboard synthesizing the results of simulation and optimisation;
- Ensure a technology watch on the topics of process optimisation within the framework of the industry of the future;
- Organize and animate the optimisation theme in the laboratory;
- Contribute to the scientific and technical influence of the laboratory by writing scientific articles and/or patents.

Profile

You completed a Ph.D. in the area of Optimisation no longer than two years ago. You have knowledge and expertise in formalising industrial optimisation problems and in developing innovating and adequate optimisation solutions. You are familiar with one or more programming languages (C++, Java, Python ...) as well as with at least one optimisation formalism and its tools (MILP with CPLEX, GLPK, MOSEK for ex.). You are aware of open software initiatives and you actively ensure that you remain aware of the latest developments in state-of-the art optimisation technology.

The age limit is 30 years old for post-doc offers.

Application documents

Send the following documents to arnaud.cuccuru@cea.fr

- Detailed CV
- Motivation letter
- Recommendation letters

Contact

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Start date and duration

Start as soon as possible. Post-Doc positions last one year and can be renewed once only (for 1 year).

[1] Ariane Piel, Mohamed Benazouz, and Charles Brunet. The Digital Twin at the Service of Storage Zone Optimisation and Assembly Line Simulation. International Conference on Modelling, Optimisation and Simulation (MOSIM), Toulouse, France, 2018

[2] M. Viel, P. Salaun, J.Y. Pierron, J.P. Gallois, and M. Klein-Jaby. Design of I&C Architecture for new Nuclear Power Plants. NPIC-HMIT, USA, 2015.

[3] M. Benazouz and J.-M. Faure, Safety-level aware bin-packing approach for control functions assignment. Symposium on Information Control Problems (INCOM), Ottawa, Canada, 2015

[4] Mohamed Benazouz and Ariane Piel. Dimensionnement des Stocks Tampons d'une Ligne d'Assemblage. Congrès annuel de la société Française de Recherche Opérationnelle et d'Aide à la Décision (ROADEF), Lorient, France, 2018