Postdoctoral Position

Robustness of Scheduling under epistemic Uncertainty

Instituion: Université de Lorraine (France)
Host laboratory: CRAN
ANR project: POMPIER – Planning, Scheduling and Maintenance for Integrated and Robust Production
Contract type: Fixed-term contract (18 months)
Starting date: September 1st, 2026

Scientific context and challenges

Industry 4.0 relies on increasingly reactive and flexible control of production systems, made possible by the availability of real-time data and by the development of new decision-support tools for planning, scheduling, and maintenance. Despite these advances, the effective integration of such tools into traditional production management approaches remains a major scientific challenge.
The ANR POMPIER project aims to address these challenges by proposing a methodological framework to improve the consistency and robustness of production plans, in close connection with predictive and prescriptive maintenance issues. The objective is to better account for the robustness of planning and scheduling decisions with respect to:

- discrepancies between tactical plans and operational reality,
- strong interdependencies between production and maintenance,
- uncertainties affecting processes, whether random or epistemic in nature.

In particular, the project relies on the identification and modelling of prescriptive data derived from the relationship between system usage and degradation, in order to promote better synchronization across decision-making levels.

Scientific problem statement

Production planning and scheduling are traditionally addressed as optimization problems. The consideration of uncertainty has been studied for several decades through approaches such as stochastic optimization and robust optimization. However, these approaches largely rely on the assumption that uncertainty models and their parameters are known with sufficient accuracy.
In practice, two major categories of uncertainty must be distinguished:

- Aleatory (or stochastic) uncertainties, related to the intrinsic variability of processes;
- Epistemic uncertainties, resulting from lack of knowledge, incomplete data, or imperfect models.

While aleatory uncertainties have been widely studied in scheduling, epistemic uncertainties remain comparatively underexplored, particularly in models coupling scheduling and maintenance. This postdoctoral project is situated within this perspective and aims to contribute to the evaluation of scheduling robustness with respect to epistemic uncertainties, by relaxing the assumption of perfectly known uncertainty models.

Scientific objectives and work plan

The research will be structured around the following three main axes:

1. Definition, formalization, and modeling of epistemic uncertainties (Months 0–3)
Based on an in-depth literature review, this axis will focus on:

- characterizing and formalizing epistemic uncertainties in scheduling and maintenance;
- identifying and comparing the most relevant modeling frameworks for representing such uncertainties.

2. Definition of robustness indicators (Months 3–9)
This axis aims to define and formalize robustness indicators to assess the ability of scheduling solutions to withstand epistemic uncertainties. These indicators may be expressed in probabilistic terms (e.g., service levels) or based on performance degradation measures.

3. Simulation and robustness assessment (Months 9–18)
A simulation framework will be designed to evaluate the previously defined robustness indicators. The preferred approach will rely on Discrete Event System models. The work will build upon prior studies addressing robustness with respect to aleatory uncertainties, while seeking to improve the efficiency and suitability of existing simulation engines for handling epistemic uncertainties.

Candidate profile

The candidate should have strong expertise in one or more of the following areas:

- Modeling and simulation of Discrete Event Systems for performance evaluation;
- Operations research with uncertainty handling, particularly robust optimization;
- Applied mathematics (probability, statistics).

Expected transversal skills include:

- Autonomy and ability to conduct a research project independently;
- Strong scientific writing and publication skills;
- Proficiency in scientific English, both written and spoken.

Required qualification: PhD (CNU sections 61 and/or 27), with demonstrated research experience in at least one of the project's research areas.

Application

Administrative requirements
This position requires authorization related to national defense confidentiality. Obtaining this authorization is subject to an administrative background check and depends on applicable regulations. Only candidates meeting the legal requirements will be eligible for clearance and recruitment.

Net salary: €2,250 per month.

Application procedure
The application file must include:

- A CV demonstrating the candidate's suitability for the position;
- One published article by the candidate related to the project topic.

Applications should be sent to: Alexis Aubry (alexis.aubry@univ-lorraine.fr) and Pierre-Emmanuel Hladik (pierre-emmanuel.hladik@ls2n.fr).
Following the evaluation of applications by the selection committee, shortlisted candidates will be invited for an interview.

Recruitment timeline

- April 15th, 2026: application deadline
- April 30th, 2026: selection of candidates for interviews
- May 2026: interviews of shortlisted candidates
- September 1st, 2026: starting date

Scientific Environment

The position is a full-time, 18-month fixed-term contract. The postdoctoral researcher will be hosted at the CRAN laboratory (Nancy), University of Lorraine, as part of a close collaboration with the LS2N laboratory (Nantes). Short research stays in Nantes are expected.
The supervisory team includes:

- Alexis Aubry,) Associate Professor at the University of Lorraine (robust scheduling)
- Pierre-Emmanuel Hladik, Associate Professor at Centrale Nantes (numerical simulation and high-performance computing for real-time scheduling)
- Pascale Marangé, Associate Professor at the University of Lorraine (models and tools for discrete event systems with a focus on production control)
- Charlotte Seidner, Associate Professor at Nantes University (formal methods applied to high-level model verification)