Fully funded Postdoc position - sponsored VISA

Multi-agent decision-making for planning large digital infrastructure in a stochastic environment

Keywords: Decision theory, Game theory, Stochastic modeling, Optimization, AI, Edge computing

About IP-Paris

The Institut Polytechnique de Paris is a world-class Institute of science and technology, ranked 34th worldwide in Engineering and Computer Science. [IPP]

Short description

The introduction of new infrastructure, such as Mobile Edge Computing (MEC), introduces massive energy consumption, both in equipment manufacturing and operation, which should be minimised. This infrastructure can be owned by multiple agents, for instance Infrastructure Providers (IPs), which can cooperate in order to reach this goal.

The **aim** of this postdoctoral research is to lay the foundations of a theoretical framework to describe the short term and long term decision making strategies that each agent would pursue in line with their own interest. These strategies include the amount of investment in computation capacity and in energy resources, the willingness to share infrastructure with other agents, etc. The **core research question** is to understand under which conditions such strategies converge to a sustainable outcome.

The **challenge** in this setting is that agents decide their strategies under imperfect information. Indeed, future user demand as well as the availability and prices of energy and material, more or less green, that are used to operate the infrastructure are uncertain. Agents' decisions are based on a belief about future conditions. This belief can be modelled via probabilistic forecasts which are continuously updated as new information becomes available. This results in dynamic and stochastic agent behaviour, with continuously revised decision strategies. The setting is further complicated by the heterogeneity of risk aversion profiles of agents: decisions may be more or less conservative in the face of uncertainty.

To cope with these challenges, the framework will rely on tools from decision theory, game theory, stochastic or distributionally robust optimisation, and probabilistic modeling.

Context

European project (RAI6Green) involving several academic and industrial partners, from Sweden, Portugal, Turkey, Hungary and France.

Information

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Where: Télécom Paris / SudParis (Paris Region - Palaiseau)
When: starting date flexible. Duration: 1.5 years
Requirements: Excellent mathematical modeling and analytical skills (no preference on the language)
To apply: Please send (i) your CV, (ii) an explanation of max 5 lines explaining why you are the best fit for this position (with factual non-vague or generic elements), (iii) the list of your publications, (iv) a description of your best 2 publications (max half a page in total), (v) 2 or 3 references (vi) all the marks of your BSc and MSc level courses; Sending your ranking is not mandatory (but it is a big plus).

References

Sakr, A., Araldo, A., Chahed, T., Patanè, R., & Kofman, D. (2025, June). Co-investment under uncertainty: coalitional game formulation and application to edge computing. In IEEE International Conference on Communications (ICC). (https://hal.science/hal-05063036/).

Doan, X.V., Nguyen, T.-D.: Robust stable payoff distribution in stochastic cooperative games. arXiv preprint arXiv:1403.5906 (2014) (https://optimization-online.org/wp-content/uploads/2014/03/4289.pdf).

Kiedanski, D., Bušić, A., Kofman, D., & Orda, A. (2020). Efficient distributed solutions for sharing energy resources at local level: a cooperative game approach. 59th IEEE CDC, 2020 (https://hal.science/hal-02520203v2).