Open PhD Position

Decision-Making in Proficiency and Risk-Aware Multi-Agent Systems

Program: PhD in Electrical, Electronic, and Information Engineering (ETIT), University of Bologna (UNIBO, Italy), https://phd.unibo.it/etit/en

Supervisors: Prof. Anna Guerra

Project Context: The selected candidate will join the **ERC Starting Grant project "CUE-GO – Contextual Radio Cues for Enhancing Decision-Making in Networks of Autonomous Agents"**, which aims to develop a new methodological framework to improve decision-making in autonomous systems. The project combines high-frequency radio sensing and localization, semantic environmental mapping, and intelligent agent coordination.

Scientific Motivation: In everyday decision-making, humans continuously assess how risky a situation is and how competent others are before deciding whether and how to cooperate. Endowing autonomous agents with similar estimation and decision capabilities remains an open engineering challenge. For example, in economic settings or time-critical missions, outcomes depend not only on environmental uncertainty, but also on uncertainty about the reliability and proficiency of other decision-makers involved. Robust multi-agent cooperation in these settings requires not only reasoning about environmental uncertainty but also estimating risk-related properties and proficiency of other agents and incorporating these estimates into decision-making.

Autonomous agents operating in real-world environments must make decisions under uncertainty while interacting with other agents whose behavior, competence, and reliability are only partially observable. Such agents may be artificial or human, but from the perspective of an autonomous decision-maker they constitute uncertain and dynamically evolving components of the environment.

This PhD project aims to develop a decision-theoretic framework for autonomous agents that explicitly estimate: (1) risk and ambiguity profiles of other agents; (2) proficiency of itself and others, and (3) exploit these estimates to improve cooperative decision-making in dynamic environments.

Humans, when present, are treated as decision-making agents whose actions provide noisy signals about latent parameters.

International Visiting Period: A visiting period of approximately six months at Pennsylvania State University, Penn State, USA, in collaboration with Prof. Nina Lauharatanahirun, is planned during the second year of the PhD. This period will support:

- the implementation of interactive experimental environments in which simulated autonomous agents cooperate with human participants;
- the collection of behavioral data to validate estimation and decision models;
- the assessment of whether incorporating risk and proficiency estimation leads to improved or degraded decision-making performance in human–agent teams.

This period will support the implementation of interactive experimental environments in which simulated autonomous agents cooperate with human participants, allowing the evaluation of whether risk- and proficiency-aware estimation improves or degrades autonomous decision-making.

Possible Activities: The selected candidates will work on

- Develop novel estimation frameworks for inferring latent risk, ambiguity, and proficiency parameters of other agents in cooperative multi-agent systems;
- Develop decision-theoretic models that integrate these estimates into autonomous decision-making policies;
- Validate the proposed framework through human–digital agent experiments, assessing decision quality, and cooperative performance.

Working Environment: The PhD will be conducted at the University of Bologna (Bologna, Italy) in collaboration with the National Research Council of Italy (CNR-IEIIT, Bologna, Italy) and the Pennsylvania State University (Penn State, USA).

Candidate Profile: We are looking for **motivated candidates** with the following background:

- MSc (or equivalent) in Electrical Engineering, Computer Science, Telecommunications, or related areas.
- Solid background in signal processing, wireless systems, applied mathematics, and/or machine learning.
- Proficiency in programming (e.g., Python, Matlab, C++).
- A passion for engaging in cutting-edge research and innovation.

Salary: Standard Italian PhD scholarship.

Application Window: May 30 – June 30, 2026

Application Website: https://www.unibo.it/en/study/phd-professional-masters-specialisation-schools-and-other-programmes/phd/phd-programme

Contacts: Interested candidates are welcome to contact anna.guerra3@unibo.it; nina.lauhara@psu.edu; for further information.

This is a call for expressions of interest. The formal selection process will be carried out by a selection committee at the University of Bologna.