



# PhD in INGEGNERIA DELL'INFORMAZIONE / INFORMATION TECHNOLOGY - 40th cycle

Research Area n. 3 - Systems and Control

**THEMATIC Research Field: DATA-BASED OPTIMISATION FOR RESOURCE ALLOCATION  
IN COMPLEX AND MULTI-AGENT DECISION-MAKING SCENARIOS**

<b>Monthly net income of PhDscholarship (max 36 months)</b>
<b>€ 1400.0</b>
In case of a change of the welfare rates during the three-year period, the amount could be modified.

<b>Context of the research activity</b>	
<b>Motivation and objectives of the research in this field</b>	<p>Taking decisions in complex environments with multiple agents, subject to uncertainties and resource, time and interaction constraints is a challenging problem, requiring specialized solutions that are flexible enough to adapt to the specific needs of the different instances in the respective application domains. In such complex scenarios, appropriate optimization methods must be flexible in order to encompass the different requirements as constraints and accommodate correct and effective notions of optimality, seeking not only for cost minimization but also considering scenario-dependent factors of interest, such as usability, acceptance and fairness. Indeed, including these aspect is crucial to shape the solution space, while enabling its exploration in an interpretable manner. We intend to contextualize such optimization framework in different application domains, which range from the optimal management of multi-vehicle fleets to the coordination of interactive smart mobility systems, so as to test the proposed approaches with significant application examples.</p>
<b>Methods and techniques that will be developed and used to carry out the research</b>	<p>As is clear from the above discussion, the design of effective decision-making tools applicable to a diverse set of complex, multi-agent and constrained problems is a challenging task, requiring the Ph.D. candidate to develop</p>



	<p>diverse and integrated competencies. We envision the information encrypted in data to be unveiled and harnessed by leveraging data-analysis techniques and machine learning (ML) approaches. The goal of the project would be nonetheless to develop novel approaches that strive to strike a balance between performance and explainability of the outcomes attained by applying these techniques, enabling links with the domain experts and strong cross-fertilization of knowledge. These data-based techniques will be paired by the use of constrained optimization techniques and system theoretic tools, thus inheriting the notion of feedback-based dynamicity in the decision process. Thanks to the combination of all these elements, we will seek to develop a context-informed strategy for advanced data-based decision-making methods.</p>
<b>Educational objectives</b>	<p>The candidate will have a unique opportunity of working on a multidisciplinary research project, combining both control-oriented and decision-making aspects that are needed to address the challenging and timely topic presented above. This entails a growth path for the candidate that will make her/him acquire different competencies – mainly technical and technological, in the disciplines mentioned in the methodology description. The research outputs will target publishing on international conferences and journals, with specific attention to all the venues of interest for the different facets of the research.</p>
<b>Job opportunities</b>	<p>Expertise in data analysis, machine-learning and control making certainly makes the PhD candidates very appealing for a wide range of high-end positions. These range from the more control-oriented ones to those more related to the considered technologies. Thus, our candidates might apply for positions both in technical companies and in academia.</p>
<b>Composition of the research group</b>	<p>3 Full Professors 2 Associated Professors 33 Assistant Professors 25 PhD Students</p>
<b>Name of the research directors</b>	Prof. Mara Tanelli



Contacts
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Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents (more than 80Km out of Milano)	--

Scholarship Increase for a period abroad	
Amount monthly	700.0 €
By number of months	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
<p><u>EDUCATIONAL ACTIVITIES</u> (purchase of study books and material, including computers, funding for participation in courses, summer schools, workshops and conferences): financial aid per PhD student. 5.707,20 Euro</p> <p><u>TEACHING ASSISTANTSHIP:</u> availability of funding in recognition of supporting teaching activities by the PhD student. There are various forms of financial aid for activities of support to the teaching practice. The PhD student is encouraged to take part in these activities, within the limits allowed by the regulations.</p> <p><u>COMPUTER AVAILABILITY:</u> 1st year: Yes 2nd year: Yes 3rd year: Yes</p> <p><u>DESK AVAILABILITY:</u> 1st year: Yes 2nd year: Yes 3rd year: Yes</p> <p>Premiality</p>



Premialities will be recognized to the PhD candidate.

Up to 2500 euros (gross amount) after the completion of the the 1st year;

Up to 3500 euros (gross amount) after the completion of the the 2nd year;

Up to 4500 euros (gross amount) after the completion of the 3rd year.

The premialities will be assigned provided that the candidate demonstrates a significant contribution to the growth of scientific excellence, the industrial valorization of research, the networking and communication activities of the Department.