"Covering mappings and their applications in functional equations, difference equations and optimization"

Results in Brief

Spaces and mappings

EU-funded scientists have developed solid theoretical foundations to analyse general dynamic systems formulated in metric spaces to investigate their solvability and solution features.

DIGITAL ECONOMY

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Complex systems consist of a large number of components interacting in a way that all together as a whole may have unexpected responses. The nature and intensity of interactions among the different components can encode this intriguing behaviour. Mapping complexity by tracing and appraising these interactions is now possible for real systems thanks to the recent developments in mathematical analysis.

Scientists working on the EU-funded COVMAPS project have developed mathematical tools needed to investigate general classes of dynamic systems in metric spaces. The key research effort addressed the properties of covering mappings in generalized metric spaces as well as sufficient solvability conditions for multiple types of equations and inclusions defined by conditionally covering multi-valued mappings in metric spaces. These technical results were applied to the

investigation of solvability conditions, existence of equilibrium, and stability conditions of types of equations and inclusions with practical significance in many application areas. These results are the basis to address the technical challenges arising in the research of global solvability conditions for control systems, as well as, necessary optimality conditions for control systems defined by Volterraequations.

The results of the COVMAPS project are in the realm of Mathematical Analysis with relevance to control and optimization, and, therefore, they are of interest to the Mathematical and Engineering research communities. Their pertinence is strengthened by the challenges arising in the rapid development of the Information Society Technologies as they require increasingly sophisticated Mathematical frameworks to support the design of advanced systems. Key classes of problems involve the control and optimization of hybrid and impulsive systems to model networked interacting or distributed agents, which encompass both the so called “cyber-physical systems” and also the “systems of systems”. This emergent paradigm has been increasingly regarded as the most promising for large scale, distributed, networked systems.

COVMAPS scientists will exploit established collaborative links with the Underwater Systems and Technology Laboratory (LSTS) of the University of Porto in Portugal to evaluate the practical applicability of their research. LSTS specialises in the design, construction and operation of unmanned robotic vehicles whose on-board computers run optimisation-based control algorithms. These multi-robot networks offer the desired test bed for algorithms enhanced with the new results.

The pioneering results of the COVMAPS project are a step forward to a better understanding of large-scale systems, with an impact far broader than computing networks. The research work is expected to help transform research on how to model, predict and control various classes of systems, like epidemic spreading, protein folding and social dynamics.

Keywords

Mappings, complex systems, metric spaces, covering mappings, control algorithms

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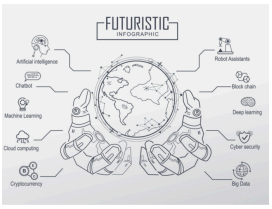

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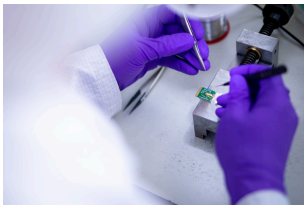

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Project Information

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