Distributed methods for dynamic optimization with application to cooperative control
Metodi distribuiti per ottimizzazione dinamica applicati al controllo cooperativo

Piano di attività per Assegno di Ricerca

RESEARCH PROJECT

1. Context

Optimization is an important building block for numerous estimation, learning, decision and control tasks arising in complex network systems. Thus, solving optimization problems in a peer-to-peer, distributed framework represents an important and timely challenge. The main methodological goal is to design distributed algorithms in which identical processors, with a partial knowledge of a global optimization problem, solve it by performing local computation and by exchanging data only with neighboring processors. Then, another key goal is to apply these distributed optimization methods to the solution of estimation, learning, decision and control problems in smart cyber-physical networks.

2. Research Activity (attività di ricerca)

The research activity will focus on the development of methodologies for the solution of dynamic optimization problems arising in large-scale systems as control networks. These systems include, e.g., spatially distributed control systems or cooperative robotic systems. At a theoretical level the candidate will develop methods and algorithms to solve nonlinear and constrained optimization problems arising in this context under a cooperative and distributed computational framework. In particular, the candidate will develop distributed techniques for the solution of nonlinear optimal control problems for distributed systems and their possible iterative implementation in control schemes. The developed methodologies will be applied to relevant control problems arising in networks of aerial and/or ground robots.

L’attività di ricerca mirerà a sviluppare metodologie per la soluzione di problemi di ottimizzazione dinamica di elevate dimensioni che si presentano in sistemi su larga scala quali reti di sistemi di controllo. Tali sistemi di controllo possono includere ad esempio sistemi spazialmente distribuiti o sistemi robotici cooperanti. Da un punto di vista teorico il candidato svilupperà metodi e algoritmi per risolvere problemi di ottimizzazione non lineari vincolati secondo un modello di calcolo di tipo cooperativo e distribuito. In particolare il candidato svilupperà tecniche distribuite per la risoluzione di problemi di controllo ottimo non lineare per sistemi distribuiti e la loro possibile implementazione iterativa in schemi di controllo. Le metodologie sviluppate saranno applicate a problemi di controllo in reti di robot mobili aerei e/o terrestri.

2. Activity Plan

The researcher will acquire or consolidate, preliminarily or in parallel with the research activity, advanced methodologies useful for the subject of investigation, and be able to use suitable mathematical and software tools. In particular, to reach the theoretical and application research goals, the researcher will:
• perform a detailed study of the state of the art on advanced methods for distributed optimization with special focus on nonlinear and constrained, dynamic optimization problems as optimal control problems;

• develop methodologies for the classes of optimization problems under investigation, test them in simulations, and analyze them;

• study and model application scenarios especially in the context of spatially distributed control systems and/or cooperative robotic teams, and apply the methodologies developed at a theoretical level;

• attend national and international courses and conferences.