PhD position in Control - Applied Mathematics
LSIS, Marseille, France

Research project
Crowd Control: from control theory to applications to road traffic

In recent years, the study of collective behavior of a crowd of autonomous agents has drawn a great interest from scientific communities, e.g. in civil engineering (for emergency egress and traffic problems), robotics (coordination of robots), computer science and sociology (social networks), and biology (crowds of animals).

Beside the problem of analyzing the collective behavior of such systems, it is now interesting to understand what changes of behavior can be induced by an external agent (e.g. a policy maker) to the crowd. For example, one can try to enforce the creation of relevant patterns (such as forcing agreement, or alignment), or to break the formation of such patterns. This is the problem of control of crowds.

Problems of control of crowds addressed in the project can be stated in different mathematical frameworks, depending on the model used to describe the crowd dynamics. We address it in three different mathematical frameworks: microscopic models (sizable finite-dimensional dynamical systems), macroscopic models (transport partial differential equations), and multi-scale models (measure evolutions).

The control problems will be effectively studied by building bridges between the three mathematical frameworks by studying in which cases control strategies can be translated from one setting to another.

The key application of control of traffic models will be addressed too. The goal is both to solve challenging specific problems of traffic control, and to use such application as a benchmark for the theory developed in the project.

The researches developed in this project will be carried out by a team based in Marseille. The strength of our team is its interdisciplinarity, that permits to merge different techniques (geometric control, control of partial differential equations, systems theory) to give a significant contribution in solving challenging problems of crowd control.

PhD job description

The PhD candidate should have a Master degree in Applied Mathematics, or Control, or related topics with a strong mathematical background. He/she should have a good knowledge of mathematical control (Lyapunov methods, geometric control) and/or partial differential equations. A genuine interest in mathematical modeling is required. Some numerical skills (modeling with MATLAB) would be a plus.

During the three years of the Ph.D. program, he/she will develop control methods for models of crowds. The research project is mostly of theoretical nature, but models coming from applications (such road traffic) will be studied too.

The candidate can contact Francesco Rossi francesco.rossi@univ-amu.fr for more details about the position.
For applying, please send an application to Francesco Rossi, with a CV and a motivation letter. Two letters of recommendation (one possibly from the Master's advisor) are also needed.