International Cooperative Projects

ASTRONET- II

Name
: AstroNet-II

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Project Homepage
: http://www.ieec.cat/astronet2/portal/home.htm

AstroNet-II is a Marie-Curie Research Training Network on Astrodynamics that brings together mathematicians, engineers and astronomers from universities, governmental agencies and industry. The network continues the training (through research) activities undertaken under the former Training Network "AstroNet" (2007-2010).

The research topics of the network include innovative new methods for designing spacecraft trajectories and controlling their dynamics. Particular emphasis is placed on optimizing trajectories and control to minimize fuel use and extend mission ranges. This is achieved by maximizing the use of 'natural dynamics', employing sophisticated ideas and techniques from dynamical systems theory. The results are being extended to studies of the dynamics and control of novel spacecraft architectures, such as solar sails, space tethers and formations of spacecraft.

AstroNet-II training programme centres on projects for Early Stage Researchers (ESRs) and Experienced Researchers (ERs) that cross the traditional boundaries between mathematics, engineering and industry, ensuring that they obtain an interdisciplinary and multisectorial overview of the field. This is supported by an extensive programme of Schools, Workshops, Tutorials and Internships, and by a close collaboration between academia and space companies.

Main Objectives

Space missions are being required to fulfill many different types of functions and, as a consequence of this, are becoming increasingly more complex. Furthermore, a number of different spacecraft architectures, such as constellations, formations, tethered spacecraft or solar sails, have been proposed for some specific objectives. To achieve their functions and objectives, future missions require new and unusual kinds of trajectories and faster and more precise attitude control whose determination, in many cases, raises new major dynamics and control questions.

A broad range of mathematical objects, theories and techniques are needed for these new concepts and applications. New methods for trajectory design will apply theories, concepts and methods from dynamical systems theory. Incorporating attitude dynamics, the shape dynamics of formations, and the dynamics of flexible attachments, will also require inputs from geometric and symmetric mechanics. For control it will be necessary to include ideas from impulsive and timecontinuous optimal control theory, discrete mechanics, closed-loop control methods, and graph/network theoretical methods. All these aspects will require accompanying state-of-the-art numerical implementations. AstroNet-II's project presents considerable challenges which will necessitate theoretical advances in most of these areas of mathematics. With the above framework for the problems to be considered, the goals to be achieved are:

- To introduce the researchers of the network (ESR's and ER's) to a range of astrodynamical concepts and problems as well as to the relevant new mathematical theories and techniques.
- To develop their expertise in the above mentioned topics and to train them to conduct research, collaborate, and communicate their results in both papers, reports and oral presentations.
- To deepen and broaden the knowledge and skills of the E(S)R's working in the areas of astrodynamics, dynamical

systems, control theory and numerical methods.

- As part of their research project, to offer to the E(S)R's opportunities for doing their research in private companies, international organisations and academia.
- To provide the E(S)R's with the complementary communications and project management skills that are needed, in addition to the scientific skills, for a successful career.

For more detailed information on the project: ASTRONET-II website