

# Preface

*One cannot predict how knowledge will be applied – only that it often is*

(Charles Conley, 1968)

The advances in the field of dynamical systems led to the development of innovative methods and techniques for investigating stable and chaotic dynamics. The application of these findings to the classical three- and N-body problems provided a novel approach to studying the dynamical evolution of the celestial bodies and finding novel spaceways and orbital configurations for artificial satellites and spacecrafts. The exploitation of quasi-periodic orbits around the collinear Lagrangian points of the Earth-Sun system for solar and astronomy missions is a well known example of this kind.

In the last years the renewed interest of the major space agencies in the exploration of Solar System bodies, foreseeing also manned missions to the Moon and Mars, widened the potential benefits of the dynamical systems approach to space-flight dynamics. Moreover, mission profiles are becoming more and more complex, often requiring a multi-disciplinary approach, where the contribution of operations, the impact of the space environment, and the possibility of in-situ resource exploitation play an increasingly important role.

Within this framework, the Space OPS Academy promoted by Telespazio (a Finmeccanica-Thales Company) to foster the development of scientific and professional skills on flight dynamics, ground system management, and Earth observation, organized in October 2007 the workshop “Novel Spaceways for Scientific and Exploration Missions – a dynamical systems approach to affordable and sustainable space applications.” The aim was to work out a coherent picture of the possibilities offered by the stable/unstable manifold approach to space mission design, by analyzing the advantages and the drawbacks of using these novel trajectories when faced to the requirements imposed by the scientific payload, the operational aspects, and the industrial approach.

The three-day meeting (from 15 to 17 October 2007) was honored by the participation of more than 70 experts coming from widely different institutions and countries. The opening session was hosted at the Telespazio Fucino Space Center (Avezzano, Italy), one of the largest space communication facilities in the world,

where an impressive collection of antennas (up to 32-m dishes) is displayed. The workshop moved then to the nearby “Scuola Superiore Guglielmo Reiss Romoli” (L’Aquila, Italy), where the other sessions and the final round-table discussion were held. This last event turned out to be particularly fruitful, and a list of recommendations for follow-up actions, as reported in a separate section after the preface, was compiled.

The need for a book somehow different from the usual “workshop proceedings” was also pointed out, an indication that resulted in what is now presented to you. The reason is that the workshop gathered together different communities, both scientific and technological, thus requiring an additional effort for clarity in the contributions. Each topic should be discussed in a proper context, articles written as far as possible self-consistent, and the use of introductory sections and extended explanations encouraged. The need for a reference publication highlighting the common dynamical ground underlying the “novel spaceways” was also felt, as witnessed by the different names under which they are referred to in the literature (e.g., Lagrangian trajectories, stable/unstable manifolds, weak stability boundary, etc.). We owe to Alessandra Celletti the term “Space Manifold Dynamics,” which found immediate consensus among all participants. Our hope is of having succeeded in spreading the good news that there is an alternative way of thinking to spacecraft trajectories if one dares to abandon the “patched conics paradigm” when entering the realm of the three- and N-body problems.

Many people and institutions deserve acknowledgments. The Telespazio CEO Giuseppe Veredice and the top management of the company, with a special reference to Giorgio Dettori, HR Director of the company, provided the will, the contacts, and the funding scenario needed for making it all come true. The professional skills and the enthusiasm of the director of the SpaceOPS Academy, Francesco Perillo, have been a steady source of motivation for us all. We are in debt to Silvano Casini, former administrator of the Italian Space Agency and presently CEO of DdB, for the original idea of a workshop devoted to the subject of space manifold dynamics. We would like to thank Roberto Battiston, Alessandra Celletti, Guido Di Cocco, Glauco Di Genova, Reno Mandolesi, Walter Pecorella, Piergiorgio Picozza, and Giovanni Valsecchi for trustfully joining the organizing committee and Livio Mastroddi for hosting us at the Fucino Space Center. To Gianna Fattore, Alessandra Gaetani, and Orietta Gagliano goes our sincere appreciation for taking care of logistics, administration, and positive thinking. Viviana Panaccia and Paolo Mazzetti have properly managed communication aspects. Maria Luisa Porciatti, Biagio Calicchio, and Alfredo Calzolaio ensured safe and timely car/bus/train/plane trips. A special thank to all participants and in particular to Letizia Stefanelli for her support in “contingency” situations.

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has greatly profited from the experience coming from the CELMEC meetings on celestial mechanics and from the Moon Base International Conference.

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NOTE ADDED IN PROOF - While the book was in print the Space Academy has grown into a non profit foundation jointly promoted by Telespazio, Thales Alenia Space Italia and The University of L'Aquila. The aim is to bridge space-related issues between the scientific and the industrial communities and to promote high level training in space culture in a wide context.

Space Manifold Dynamics

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