

# Stefano Campagnola, Ph.D.

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website: [www.missionanalysis.org/campagnola.php](http://www.missionanalysis.org/campagnola.php)  
Italian citizenship  
Languages: English and Italian (*fluent*),  
German, Spanish, French, Japanese (*basic knowledge*)

*Main interests: Trajectory and spacecraft design for space missions. Nonlinear dynamical systems. Optimal control problems. Optimization problems.*

## Education

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- 2010** Ph.D. by the Aerospace and Mechanical Engineering department of the **University of Southern California**. Dissertation title: **New Techniques in Astrodynamics for Moon Systems Exploration**. This thesis develops new techniques for the design of gravity-assist trajectories, improving and unifying old and recent approaches. Motivated by collaborations with staff and faculty from ESA, JPL, Caltech, GeorgiaTech, University of Glasgow. Adviser: Prof. Paul Newton.  
Classes taken/audited include: Low-Cost Missions (Dr. Werzt, Microcosm), Remote Sensing (Dr. Freeman JPL, Dr. McDonald JPL), Chaos in Dynamical Systems (Prof. Newton), Numerical Geometric Integration (Prof. Desbrun, Caltech), Geometric Mechanics (Prof. Marsden, Caltech), Geometry of Nonlinear System (Prof. Marsden, Caltech), Spacecraft Navigation (basic and advanced), Optimal Control, Optimization. **GPA: 4.0/4.0**
- 2008** **Lunar Mission Design Workshop**, AAS/AIAA SFMM, Galveston, TX, 20 Jan. Lectures by Carrico J., Folta D., Woodburn J.
- 2008** **Short Course on Extreme Environment Technologies**, 6th IPPW, GeorgiaTech, Atlanta GA, 21-22 June.
- 2004** Summer school: **Advanced Topics in Astrodynamics**, IEEC, Barcelona, 5-10 July, 2004. Lectures by Barrabés E., Gómez G., Rodríguez-Canabal J., Lo M. W., Masdemont J.J., Hughes G., McDonald M., Alfriend K. T., Folta D. C., Peláez J. and Mondelo J. P.
- 2002** **Workshop on Trajectory Design and Optimisation**, ESA/ESTEC, 26-27 October. Lectures by Conway B., Betts J., Brouke R., Ciriani T., Bardi M., Locatelli M.
- 2002** BS and MS degrees (95/100) in Aerospace Engineering by **Politecnico di Milano**. Classes taken include: Spacecraft Mission Design, Celestial Mechanics, Spacecraft Dynamics and Control, Aerodynamics, Structural Mechanics, Finite Element Methods.
- 2000** Workshop: **Non-Linear Programming and Direct Collocation for Optimal Control Problems**, Politecnico di Milano. Lectures by Betts J.

## Invited Lectures

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- 2011** **Enabling Technologies for Space Mission Design**, Aeronautics and Astronautics department, **Stanford**, Stanford CA, USA.
- 2010** **Optimal control and space trajectory design**, Lecture at the Introduction to Control Theory class (CDS 110b), Control and Dynamical Systems, **Caltech**, Pasadena, CA, USA.
- 2009** **The Endgame Problem for Outer Planet Moons**, Numerical Algorithm for Space Flight seminar, **Jet Propulsion Laboratory**, Pasadena, CA, USA. Lecture also given at **JAXA**, Sagamihara Campus (ISAS), Japan.
- 2005** **Mission Analysis Challenges at the European Space Agency**, Introduction to Astronautics class (MECH AE161a), Mechanical and Aerospace engineering, **UCLA**, Los Angeles, CA, USA. Lecture also given at the Aeronautics Seminar Series, GALCIT, **Caltech**, Pasadena, CA, USA.
- 2004** **Mission Analysis Challenges**, MS Space Mission Analysis and Design class, Department of Aerospace Engineering, **University of Glasgow**, Scotland.

2004 **BepiColombo: Mission Analysis Challenges**, Paderborn Institute for Scientific Computation (PaSCo) and Institut fuer Mathematik, **Universitaet Paderborn**, Germany.

## Professional Experience

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2011 **Caltech/JPL** (Outer Planet Mission Analysis Group) Postdoctoral fellow, working on chaotic trajectory options for the Jupiter Europa Orbiter.

2010 **Japanese Aerospace Exploration Agency** (Space System and Astronautics Department) Postdoctoral fellow, working on the trajectory design of the Jupiter Magnetospheric Orbiter, and supporting the Akatsuki mission team after the orbit insertion failure.

2006 **Caltech** (Computer Science department), Assistant Research Engineer, working on an optimization toolbox for computer vision applications.

2005 - 2006 **Caltech/JPL**, Assistant Research Engineer, designing the trajectory of the SmallTug Mission to the Moon.

2002 - 2005 **European Space Agency** (ESA/ESOC/Mission Analysis Office) Contractor for the Spanish company GMV and ESA Young Graduate Trainee, improving the capabilities of the DITAN optimization package and designing and optimizing trajectories for the BepiColombo mission to Mercury, for the SOLO (SOLar Orbiter) mission, for the Europa mission feasibility study.

2002 **Politecnico di Milano** (Department of Aerospace Engineering), Assistant Research Engineer, working on an optimization software.

2002 **European Space Agency** (ESA/ESTEC/Advanced Concepts Team , CDF) Trainee, designing and optimizing the trajectory for a mission to Europa.

1999 **Technical Services s.r.l.** Technical consulting at the Help Desk of an international company.

## Teaching Experience

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2007 - 2010 **USC** Teaching Assistant for: Linear algebra and complex variables (AME525, spring 08/09/10, fall 08), Partial differential equations (AME526, fall 09), Incompressible fluids (AME630a, fall 09), Linear Control System (AME451, fall 07).

2006 - 2012 **The Mountain School of Arts** ([www.themountainsofarts.org](http://www.themountainsofarts.org) at The Mountain Bar, Los Angeles) Faculty, holding the course ‘Topics on Science and Technology’.

2007 - 2009 **Caltech** Mentor for SURF students at the Control and Dynamical Systems department (summer 07/09/10).

2006 - 2007 **UCLA** Faculty Mentor for the JPL Team at the RIPS summer school at the Institute for Pure and Applied Mathematics (summer 06/07).

1996 - 2002 Physics and Mathematics tutor for high school and college students.

1998 Windows and MS Office tutor at national banks for the ‘Technical Services s.r.l.’, Milan (Italy).

## Publications

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### *Peer-reviewed journals*

Campagnola S., Russell R., Skerritt P., **Flybys in the planar, circular, restricted, three-body problem**, *Celestial Mechanics and Dynamical Astronomy*, *in press*. Also paper AAS 11-425.

Campagnola, S. and Kawakatsu, Y., **Jupiter Magnetospheric Orbiter: Trajectory Design in the Jovian System**, *Journal of Spacecraft and Rockets*, Vol. 49, No. 2, pp. 318-324, DOI: 10.2514/1.A32055.

Campagnola, S. and Kawakatsu, Y., **3D Resonant Hopping Strategies and the Jupiter Magnetospheric Orbiter**, *Journal of Guidance, Control, and Dynamics*, Vol. 35, No. 1, pp. 340-344, DOI: 10.2514/1.53334.

Park, R. S., Asmar, S. W., Buffington, B. B., Bills, B., Campagnola, S., Chodas, P. W., Folkner, W. M., Konopliv, A. S., Petropoulos, A. E., **Detecting tides and gravity at Europa from multiple close flybys**, Geophysical Research Letters, Vol. 38, No. 24, DOI: 10.1029/2011GL049842.

Lantoine G., Russell R., Campagnola S., **Optimization of Low-Energy Resonant Hopping Transfer Between Planetary Moons**, Acta Astronautica, Vol. 68, No. 6-7, pp. 1361-1378, DOI:10.1016/j.actaastro.2010.09.021. Also paper IAC-09-C1.1.1

Campagnola, S., Strange, N., Russell R., **A Fast Tour Design Method using Non-Tangent V-Infinity Leveraging Transfers**, Celestial Mechanics and Dynamical Astronomy, Vol. 108, No. 2, 2010 pp.165-186, DOI: 10.1007/s10569-010-9296-0. Also paper AAS 10-164 **John V. Breakwell award**.

Campagnola S., Russell R. **Endgame Problem Part 1: V-infinity Leveraging Technique and the Leveraging Graph**, Journal of Guidance, Control, and Dynamics, Vol. 33, No. 2, Mar/Apr 2010, pp.463-475, DOI: 10.1007/s10569-008-9180-3. Also paper AAS 09-224.

Campagnola S., Russell R. **Endgame Problem Part 2: The Multi-Body Technique and the T-P Graph**, Journal of Guidance, Control, and Dynamics, Vol. 33, No. 2, Mar/Apr 2010, pp.475-486, DOI: 10.1007/s10569-008-9180-3. Also paper AAS 09-227.

Gawlik E., Marsden J., Du Toit P., Campagnola S. **Lagrangian Coherent Structures in the Planar Elliptic Restricted Three-Body Problem**, Celestial Mechanics and Dynamical Astronomy, Vol. 103, No. 3, Mar 2009, pp.227-249, DOI: 10.1007/s10569-008-9180-3.

Vasile M., Campagnola S. **Design of Low-Thrust Multi-Gravity Assist Trajectories to Europa**, Journal of the British Interplanetary Society, Vol. 62, No.1, January 2009, pp.15-31.

*Conference proceedings (selected)*

Campagnola, S., Boutonnet, A., Schoenmaekers, J., Grebow, D.J., Petropoulos, A. E., Russell, R. P., **Tisserand-Leveraging Transfers**, Paper AAS 12-185, AAS/AIAA Space Flight Mechanics Meeting, Charleston, SC, Jan 2012.

Lantukh, D.V., Russell, R.P., Campagnola S., **Automated Inclusion of V-infinity Leveraging Maneuvers in Gravity-Assist Flyby Tour Design**, Paper AAS 12-162, AAS/AIAA Space Flight Mechanics Meeting, Charleston, SC, Jan 2012.

Y. Kawakatsu, C. Hirose, N. Ishii, and S. Campagnola, **An Orbit Plan toward AKATSUKI. Venus Reencounter and Orbit Injection**, Paper AAS 12-205, AAS/AIAA Space Flight Mechanics Meeting, Charleston, SC, Jan 2012.

Sasaki, S., Fujimoto, M., Yano, H., Takashima, T., Kasaba, Y., Takahashi, Y., Kimura, J., Funase, R., Mori, O., Tsuda, Y., Campagnola, S., Kawakatsu, Y., **Japanese mission plan for Jupiter system: The Jupiter magnetospheric orbiter and the Trojan asteroid explorer**, EPSC-DPS Joint Meeting 2011, held 2-7 October 2011 in Nantes, France. <http://meetings.copernicus.org/epsc-dps2011>, p.1091

Strange N., Campagnola S., Russell R. **Leveraging Flybys of Low Mass Moons to Enable an Enceladus Orbiter**, 2009 Astrodynamics Specialist Conference, Girdwood, AK, paper AAS 09-435.

Bosanac N., Marsden J., Moore A., Campagnola S. **Titan Trajectory Design using Invariant Manifolds and Resonant Gravity Assists**, 20th AIAA/AAS Space Flight Mechanics Meeting, San Diego, GA, February 14-17 2010.

Gawlik E., Marsden J., Campagnola S., Moore A. **Invariant Manifolds, Discrete Mechanics, and Trajectory Design for a Mission to Titan**, Advances in the Astronautical Sciences, Vol. 134, Part I, pp. 1887-1904, Univelt, San Diego, 2009, **John V. Breakwell award**.

Campagnola S., Lo M., Newton P., **Subregions of Motion and Elliptic Halo Orbits in the Elliptic Restricted Three-Body Problem**, Advances in the Astronautical Sciences, Vol. 130, Part I, pp. 1541-1556, Univelt, San Diego, 2008.

Campagnola S., Lo M., **BepiColombo Gravitational Capture and the Elliptic Restricted Three-Body Problem**, Proceedings in Applied Mathematics and Mechanics, Vol.7, N. 1, pp. 1030905-1030906, 2007.

Jehn R., Campagnola S., Garcia D., Kemble S., **Low Thrust Approach and Gravitational Capture at Mercury**, 18th International Symposium on Space Flights Dynamics, Munich, Germany, October 11-15 2004.

D'Amico S., Arbinger C., Kirschner M., Campagnola S., **Generation of an Optimum Target Trajectory for the TerraSAR-X Repeat Observation Satellite**, 18th International Symposium on Space Flights Dynamics, Munich, Germany, October 11-15 2004.

Corral C., Jehn R., Campagnola S., **BepiColombo Launch Window Design Based on a Phasing Loop Strategy**, AIAA/AAS Astrodynamics Specialist Conference, Providence, Rhode Island, August 16-19, 2004, AIAA-2004-5396.

Campagnola S., Corral C., Jehn R., **Design of Lunar Gravity-Assist for the BepiColombo Mission to Mercury**, Advances in the Astronautical Sciences, Vol. 119, Part I, pp. 427-442, Univelt, San Diego, 2004, Paper AAS 04-130.

Khan M., Campagnola S., Croon M., **End-to-End Mission Analysis for a Low-Cost, Two-Spacecraft Mission to Europa**, Advances in the Astronautical Sciences, Vol. 119, Part I, pp. 463-472, Univelt, San Diego, 2004, Paper AAS 04-132.

Pessina S., Campagnola S., Vasile M., **Preliminary Analysis of Interplanetary Trajectories with Aerogravity and Gravity Assist Manoeuvres**, 54th International Astronautical Congress of the IAF, Bremen, Germany, 29 September - 3 October 2003, IAC-03-A.P.08.

Vasile M., Campagnola S., Bernelli-Zazzera F., **Electric Propulsion Options for a Probe to Europa**, Lotus2, 2nd Low Thrust International Symposium, CNES, IAS, Toulouse, France, 18-20 June, 2002.

### *Internal reports (selected)*

Campagnola S., Takashima, T., Kawakatsu Y., **Jovian radiation models for preliminary mission design**, ISAS/JAXA Technical Note, 2010.

Campagnola S., Toyota, H., Kawakatsu Y., **Solar array degradation for the Jupiter Magnetospheric Orbiter**, ISAS/JAXA Technical Note, 2010.

Garcia D., De Pascale P., Campagnola S., Jehn R., Sánchez N., **BepiColombo Mercury Cornerstone Mission Analysis: Alternative Transfer Options and Gravity Field Determination**, Mission Analysis Office WP 476, ESA/ESOC, Darmstadt, Germany, September 2006.

Campagnola S., Garcia D., Jehn R., De Pascale P., Corral C., Croon M., **BepiColombo Mercury Cornerstone Mission Analysis: Launch in 2013**, Mission Analysis Office WP 466, ESA/ESOC, Darmstadt, Germany, November 2005.

Jehn R., Campagnola S., Garcia D., Yáñez A., **BepiColombo Mercury Cornerstone Mission Analysis: Chemical Options**, Mission Analysis Office WP 486, ESA/ESOC, Darmstadt, Germany, August 2005.

Janin G., Boutonnet A., Campagnola S., **Solar Orbiter Mission Analysis**, Mission Analysis Office WP 481, ESA/ESOC, Darmstadt, Germany, March 2005.

Corral C., Jehn R., Campagnola S., **BepiColombo Mercury Cornerstone Mission Analysis: Launch Window for the 2011 Lunar Gravity Assist Option**, Mission Analysis Office WP 464, ESA/ESOC, Darmstadt, Germany, December 2003.

Khan M., Campagnola S., **Europa TRM Mission Analysis: The Jupiter Tour Phase**, Mission Analysis Office TN 33, ESA/ESOC, Darmstadt, Germany, October 2003.

Khan M., Croon M., Campagnola S., **Europa TRM Mission Analysis: The Jupiter Transfer Phase**, Mission Analysis Office TN 32, ESA/ESOC, Darmstadt, Germany, October 2003.

Campagnola S., Corral C., Jehn R., Yáñez A., **BepiColombo Mercury Cornerstone Mission Analysis: Inputs for the Phase of the Definition Study**, Mission Analysis Office WP 452, ESA/ESOC, Darmstadt, Germany, September 2003.

Katzkowski M., Jehn R., Campagnola S., **BepiColombo Mercury Cornerstone Mission Analysis: Trajectory and Recovery Options**, Mission Analysis Office WP 443, ESA/ESOC, Darmstadt, Germany, March 2003.

Campagnola S., **Missioni su Europa: Traiettorie Ottime mediante Propulsione Elettrica Ausiliaria e Flyby Gravitazionali**, MS Thesis, Dipartimento di Ingegneria Aerospaziale, Politecnico di Milano, Italy, June 2002.

## Computer skills

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Operating Systems    UNIX/Linux, Mac OSx, Windows.  
Programming        Matlab, Fortran77, LaTeX, Mathematica, C++

## Fellowships and Awards

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2012-2015	International Top Young Fellowship (JAXA).
2010	Japanese Society for the Promotion of Science (JSPS) Postdoctoral Fellowship.
2010	John V. Breakwell student award from the American Astronautical Society (AAS).
2006-2010	Dean's Fellowship from the Viterbi School of Engineering, University of Southern California.
2003	Young Graduate Trainee fellowship, European Space Agency.

## Miscellaneous

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Reviewer	Celestial Mechanics and Dynamical Astronomy, Journal of the Astronautical Sciences.
Member	AIAA and AAS.