Paolo Racioppa

Aerospace Engineer

Summary of Expertise

I have broad experience in working within the framework of space exploration projects, ESA and NASA/JPL missions in particular. My expertise and studies focused on orbit determination and tracking system technologies for deep space missions, as well as analysis of space links performances and signal processing. I hold excellent skills in developing software tools for orbit determination, simulation and analysis of physical models, and data processing. I also have a strong background in astrodynamics, space environment, satellite telecommunication systems and other spacecraft subsystems.

Working Experience

Oct. 2006 – Present
Roma (RM), Italy

Research Fellow, *Sapienza Università di Roma*
Expert of orbit determination and deep-space tracking systems, radio science analyst at Dipartimento di Ingegneria Meccanica e Aerospaziale (DIMA):

- Determination of the Saturn and Titan gravity field and radio-metric data analysis for the Cassini mission;
- Simulations for incoming mission phases for performance assessment of radio science experiments onboard the Cassini and Juice missions;
- Performance Analysis and definition of requirements for the radio science experiment onboard the Bepi Colombo mission;
- Support to radio science experiment management within the Bepi Colombo project;
- Development of least-squares filter tool (Fortran/Python/Bash) for orbit determination with multi-arc and large data set processing capabilities.
- Development of software library (Fortran) for analysis of gravity fields;

Sep. 2014 – Present
Roma (RM), Italy

Project Engineer–ESA/ESOC Contract, *Sapienza Università di Roma*
Participation in the study "Improvement of Delta-DOR performances for 1 nrad accuracy for precise landing support" – IDE-ONE, founded by ESA:

- Consolidation of the end-to-end error budget for different system configurations and identification of modulation scheme to address phase ripple errors;
- Specification and implementation of a breadboard signal simulator and correlator;

Jun. 2010 – Feb. 2012
Roma (RM), Italy

Project Engineer–ESA/ESOC Contract, *Sapienza Università di Roma*
Participation in the study "Interdisciplinary study on enhancement of end-to-end accuracy for spacecraft tracking techniques" – ASTRA, founded by ESA:

- Assessment of the Doppler, Range and Delta-DOR error budgets for current ESA tracking system by in-depth analysis of flying missions data;
- Identification of critical areas and outline of system architecture updates to improve current performances by one order of magnitude.

Mar. 2009 — Oct. 2010
Roma (RM), Italy

Project Engineer–ESA/ESTEC Contract, *Sapienza Università di Roma*
Participation in the study "Radiocomm signals: A new way of probing the surface of planets" – RC-SIM, founded by ESA:

- Development of a planetary rotation model including polar motion, precession, nutation, and libration effects;
- Link Budget for Mars and Moon landers with direct-to-earth communication capability at X and Ka-band.
- Experiment simulation for the determination of the rotational state by a single lander providing Doppler and Range observables, or a network of landers providing interferometric observables

Feb. 2006 — Jul. 2006
Darmstadt, Germany

Trainee, *European Space Operation Centre (ESOC)*
Working at the Operations-Ground Segment and Signal processing (OPS-GSS) section on the ESA Delta-DOR tracking system:
- Testing, validation and Performance analysis of the software correlator with Venus express, and Mars Express missions data;
- Error Budget for the end-to-end system and comparison with navigation residuals.

Education and awards

Master of Science equivalent

Laurea Specialistica in Ingegneria Astronautica (**Aerospace Engineering**).
Final mark: **110/110 summa cum laude.**
Final project: "Angular position determination of interplanetary spacecrafts by means of VLBI techniques" – Advisor: Prof. Luciano Iess.

Awards

NASA Group Achievement Award to Cassini Radio Science Team – Paolo Racioppa for outstanding contributions leading to the success of the Cassini Radio Science investigation at Saturn.

Languages and personal skills

Mother Tongue(s)

Italian

Other Language(s)

English: full professional proficiency (CEFR level: C1)

Skills

Very good presentation skills. Effective with either team working or personal assignments. Experience in an international environment.

Technical Skills

Proprietary software

Expert with JPL's ODP and MONTE suites for deep-space navigation and orbit determination.

Programming

Proficient with Procedural and Object-Oriented programming:
- Expert with Fortran 95/2003;
- Expert with Bash scripting;
- Expert with Python;
- Very good knowledge and experience with Matlab;
- Competent with C++.

Operating Systems

Very good knowledge and experience of Linux/Unix and Mac OSX platforms.

Office Applications

Very good knowledge and experience with Microsoft Office suite and the LaTeX environment.

Additional Information

Publications

L. Iess, R.A. Jacobson, M. Ducci, D.J. Stevenson, J.I. Lunine, J. W. Armstrong, S.W. Asmar, **P. Racioppa**, N.J. Rappaport, P. Tortora: "*The Tides of Titan*", Science 337, 457-459 (July 2012), DOI: 10.1126/science.1219631
L. Iess, N.J. Rappaport, R.A. Jacobson, **P. Racioppa**, D.J. Stevenson, P. Tortora, J.W. Armstrong, S.W. Asmar: "*Gravity Field, Shape, and Moment of Inertia of Titan*", *Science* 327, 1367-1369 (March 2010), DOI: 10.1126/science.1182583.
N.J. Rappaport, L. Iess, J. Wahr, J.I. Lunine, J.W. Armstrong, S.W. Asmar, P. Tortora, M. Di Benedetto and **P. Racioppa**, "Can Cassini detect a subsurface ocean in Titan from gravity measurements?", Icarus, Volume 194, Issue 2, April 2008, pp. 711-720.

Conference Presentations

P. Racioppa, L. Iess, M. Ducci: "*Titan gravity and tides*", presentation at the X Congresso di Scienze Planetarie, Bormio, 17-21 Jannuary 2011.
P. Racioppa, S. Finocchiaro, L. Iess, P. Tortora: "*The determination of the gravity field and eccentricity tides of Callisto*", presentation at the EPSC 2010, Roma, 20 September 2010.
A. Ardito, L. Iess, **P. Racioppa**: "*Determination of the Saturn and Titan Gravity Fields in the Cassini XXM*", presentation at the 40th Cassini Radio Science Team Meeting, Vilnius, 5-6 June 2008.
M. Mercolino, **P. Racioppa**, C.Tranquilli "*The test of the ESA DDOR correlator*",

presentation at the 4th ESA International Workshop on Tracking, Telemetry and Command, ESOC, Darmstadt, 11-14 September 2007.

Conference Posters

S. Finocchiaro, **P. Racioppa**: "The Determination of Jupiter and Saturn Gravity Fields from Radio Tracking of the Juno and Cassini Spacecraft", poster at the 47th AGU, San Francisco, 15-19 December 2014.