Aaron J. Rosengren, Ph.D.

Contact Information

Section of Astrophysics, Astronomy and Mechanics
Department of Physics
Aristotle University of Thessaloniki
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Education

University of Colorado, Boulder, Colorado USA

Ph.D., Aerospace Engineering Sciences, May 2014

M.S., Aerospace Engineering Sciences, Astrodynamics and Satellite Navigation Focus, December 2012

University of Missouri, Columbia, Missouri USA

B.S., Mechanical Engineering, Aerospace Emphasis, *summa cum laude* & Honors Scholar, May 2010

B.S., Mathematics, *summa cum laude*, May 2010

Research Interests

Astrodynamics, Celestial Mechanics, and Dynamical Astronomy · Applied and Computational Mathematics · Nonlinear Dynamics, Chaotic and Complex Systems · Orbital Debris and Space Situational Awareness

Research Experience

Aristotle University of Thessaloniki, Thessaloniki, Greece

Section of Astrophysics, Astronomy and Mechanics, Department of Physics — **April 2016 to Present**

- Postdoctoral Research Fellow
- Member of the European Commissions Horizon 2020 project "ReDSHIFT — The Revolutionary Design of Spacecraft through Holistic Integration of Future Technologies"
- Research Supervisors: Prof. Kleomenis Tsiganis & Prof. George Voyatzis
- Project Title: *Dynamical mapping of Earth satellite orbits*

National Research Council (CNR), Sesto Fiorentino, Florence, Italy

Institute of Applied Physics "Nello Carrara" (IFAC) — **April 2014 to March 2016**

- Marie Curie Postdoctoral Research Fellow
- Member of the European Commissions Framework Programme 7 project "Stardust — The Asteroid and Space Debris Research and Training Network"
- Research Supervisors: Dr. Giovanni B. Valsecchi & Dr. Alessandro Rossi
- Project Title: *Orbital Evolution and Collision Risk of Space Debris and Near-Earth Objects*

University of Rome Tor Vergata, Rome, Italy

Department of Mathematics — **September 2015 to February 2016**

- Secondment as part of the Stardust project
- Research Supervisors: Prof. Alessandra Celletti & Prof. Giuseppe Pucacco
- Research Topic: *Chaos Near Resonances in Earth Satellite Orbits: Cross-resonance Diffusion and Chaotic Jumping*

Astronomical Observatory, Belgrade, Serbia

Serbian Academy of Sciences and Arts **February 2015 to April 2015**

- Secondment as part of the Stardust project
- Research Supervisor: Dr. Zoran Knežević
- Research Topic: *Identification of Resonant Asteroids using Proper Elements*

University of Colorado, Boulder, Colorado USA

Celestial and Spaceflight Mechanics Lab (CSML) **August 2010 to March 2014**

- Graduate Research Associate
- Member of the Colorado Center for Astrodynamics Research
- Advisor: Prof. Daniel J. Scheeres
- Thesis Committee: Phil Armitage, Moriba Jah, Jay McMahon, Hanspeter Schaub,
- Thesis Title: *Long-term Dynamical Behavior of Highly Perturbed Natural and Artificial Celestial Bodies*

Air Force Research Laboratory, Kirtland AFB, Albuquerque, New Mexico USA

Space Vehicles Directorate **June 2011 to August 2011**

- Associate Mechanical Engineer, Space Scholars Program
- Research Mentor: Dr. Moriba Jah
- Research Topic: *Dynamics of Resident Space Objects Subjected to Solar Radiation Pressure and Thermal Emission Forces*

NASA Langley Research Center, Hampton, Virginia USA

Dynamic Systems and Controls Branch (DSCB) **June 2010 to August 2010**

- Langley Aerospace Research Summer Scholar (LARSS)
- Research Mentor: Carey S. Buttrill, DSCB Head
- Research Topic: *Development of an Inverted Pendulum System Testbed for Learn-to-fly and Control Advances in Rapid Adaption*

Teaching Experience

University of Colorado, Boulder, Colorado USA

Aerospace Engineering Sciences Department **August 2013 to December 2013**

- Course Assistant
- Course: Special Topics – Celestial Mechanics
- Instructor: Prof. Daniel J. Scheeres
- created and taught lectures on advanced celestial mechanics topics related to perturbation theory and satellite dynamics

University of Missouri, Columbia, Missouri USA

Mechanical and Aerospace Engineering Department **August 2008 to May 2010**

- Teaching Assistant
- Course: Mechanical Design I
- Instructors: Prof. Yuyi Lin, P.E. & Prof. Robert Winholtz
- graded homework assignments and exams, managed grade records, and worked in coordination with instructors to prepare solutions to homework problems

The Learning Center **August 2006 to May 2010**

- Mathematics, Physics, and Engineering Tutor
- Courses: single variable calculus (I and II), multivariable calculus, discrete mathematics, differential equations, matrix theory, calculus based physic, statics, and dynamics
- tutored calculus, physics, and engineering courses for Mizzou students who met federal income guidelines, whose parents had not completed an undergraduate degree and/or students from groups underrepresented in undergraduate education
- received the Bonnie Zelenak Excellence in Tutoring Award for Physics Tutoring, 2010

Honors and Awards

- COSPAR Outstanding Paper Award For Young Scientists, 2016
- COSPAR Outstanding Paper Award For Young Scientists, 2014
- Nominated by the Department of Aerospace Engineering Sciences for the 2013-2014 College of Engineering and Applied Science Outstanding Dissertation Award
- DDA/AAS Raynor L Duncombe Prize for Student Research, 2013
- National Science Foundation GRFP Recipient, 2011
- H. Joseph Smead Graduate Fellowship in Aerospace Engineering Sciences, 2010
- College of Engineering and Applied Science Dean's Outstanding Merit Fellowship, 2010 – 2011
- College of Engineering and Applied Science Dean's Graduate Assistantship, 2010 – 2011
- UC Irvine's Summer Undergraduate Research Fellowship (SURF) Scholar, 2009
- Ronald E. McNair Post-baccalaureate Achievement Program Scholar, 2008 – 2009

Publications

Journal Articles (10)

Rosengren, A.J., Daquin, J., Alessi, E.M., Deleflie, F., Rossi, A., and Valsecchi, G.B., "Galileo disposal strategy: stability, chaos and predictability," *Monthly Notices of the Royal Astronomical Society*, 464, 4063, 2017.

Gkolias, I., Daquin, J., Gachet, F., and **Rosengren, A.J.**, "From order to chaos in Earth satellite orbits," *The Astronomical Journal*, 152, 119, 2016.

Celletti, A., Galeş, C., Pucacco, G., and **Rosengren, A.J.**, "Analytical development of the lunisolar disturbing function and the critical inclination secular resonance," *Celestial Mechanics and Dynamical Astronomy*, doi: 10.1007/s10569-016-9726-8.

Alessi, E.M., Deleflie, F., **Rosengren, A.J.**, Rossi, A., Valsecchi, G.B., Daquin, J., and Merz, K. "A numerical investigation on the eccentricity growth of GNSS disposal orbits," *Celestial Mechanics and Dynamical Astronomy*, 125, 71–90, 2016.

Daquin, J., **Rosengren, A.J.**, Alessi, E.M., Deleflie, F., Valsecchi, G.B., and Rossi, A., "The dynamical structure of the MEO region: long-term stability, chaos, and transport," *Celestial Mechanics and Dynamical Astronomy*, 124, 335-366, 2016.

Rosengren, A.J., Alessi, E.M., Rossi, A., and Valsecchi, G.B., "Chaos in navigation satellite orbits caused by the perturbed motion of the Moon," *Monthly Notices of the Royal Astronomical Society*, 449, 3522–3526, 2015.

Rosengren, A.J., and Scheeres, D.J., "Laplace plane modifications arising from solar radiation pressure," *The Astrophysical Journal*, 786, 45, 2014.

Rosengren, A.J., Scheeres, D.J., and McMahon, J.W., "The classical Laplace plane as a stable disposal orbit for geostationary satellites," *Advances in Space Research*, 53, 1219–1228, 2014.
Chosen for the "COSPAR Outstanding Paper Award For Young Scientists" by the Technical Panel on Potentially Environmentally Detrimental Activities in Space

Rosengren, A.J., and Scheeres, D.J., "On the Milankovitch orbital elements for perturbed Keplerian motion," *Celestial Mechanics and Dynamical Astronomy*, 118, 197–220, 2014.

Rosengren, A.J., and Scheeres, D.J., "Long-term dynamics of high area-to-mass ratio objects in high-Earth orbit," *Advances in Space Research*, 52, 1545–1560, 2013.
Chosen for the "COSPAR Outstanding Paper Award For Young Scientists" by the Technical Panel on Satellite Dynamics

Conference Papers (12)

Rosengren, A.J., Amato, D., Daquin, J., and Gkolias, I., "The dynamical placement of satellite constellations and designing for demise," paper will be presented at the *9th International Workshop on Satellite Constellations and Formation Flying*, Boulder, Colorado, 19–21 June 2017.

Rosengren, A.J., Daquin, J., Alessi, E.M., Valsecchi, G.B., Rossi, A., and Deleflie, F., "Galileo disposal orbit strategy: resonances, chaos, and stability," paper presented at the *25th International Symposium on Space Flight Dynamics (ISSFD)*, Munich, Germany, 2015.

Rosengren, A.J., Alessi, E.M., Valsecchi, G.B., Rossi, A., Deleflie, F., and Daquin, J., "Dynamical instabilities in medium Earth orbits: chaos induced by overlapping lunar resonances," paper presented at the *AAS/AIAA Space Flight Mechanics Meeting*, Williamsburg, Virginia, Paper AAS 15–435, 2015.

Rosengren, A.J., Scheeres, D.J., and McMahon, J.W., "The classical Laplace plane and its use as a stable disposal orbit for GEO," paper presented at the *Advanced Maui Optical and Space Surveillance Technologies Conference*, Maui, Hawaii, 2013.

Rosengren, A.J., Scheeres, D.J., and McMahon, J.W., "Long-term dynamics and stability of GEO orbits: the primacy of the Laplace plane," paper presented at the *AAS/AIAA Astrodynamics Specialist Conference*, Hilton Head, South Carolina, Paper AAS 13–865, 2013.

Scheeres, D.J., Sutter, B., and **Rosengren, A.J.**, "Design, dynamics and stability of the OSIRIS-REx sun-terminator orbits," paper presented at the *AAS/AIAA Spaceflight Mechanics Meeting*, Kauai, Hawaii, Paper AAS 13–411, 2013.

Rosengren, A.J., and Scheeres, D.J., "Long-term dynamics of high area-to-mass ratio space debris in GEO," paper presented at the *63rd International Astronautical Congress*, Naples, Italy, 2012.

Rosengren, A.J., and Scheeres, D.J., "Prediction of HAMR debris population distribution released from GEO space," paper presented at the *Advanced Maui Optical and Space Surveillance Technologies Conference*, Maui, Hawaii, 2012.

Rosengren, A., and Scheeres, D., "Long-term dynamics of HAMR objects in HEO," paper presented at the *AIAA/AAS Astrodynamics Specialist Conference*, Minneapolis, Minnesota, Paper AIAA 2012–4745, 2012.

Scheeres, D.J., and **Rosengren, A.**, "closed form solutions for the averaged dynamics of HAMR objects," paper presented at the *62nd International Astronautical Congress*, Cape Town, South Africa, 2011.

Rosengren, A., and Scheeres, D., "Averaged dynamics of HAMR objects: effects of attitude and Earth oblateness," paper presented at the *AAS/AIAA Astrodynamics Specialist Conference*, Girdwood, Alaska, Paper AAS 11–594, 2011.

Scheeres, D., **Rosengren, A.**, and McMahon, J., "The dynamics of high area-to-mass ratio objects in Earth orbit: the effect of solar radiation pressure," paper presented at the *AAS/AIAA Space Flight Mechanics Meeting*, New Orleans, Louisiana, Paper AAS 11–178, 2011.

Conference Abstracts and Posters (14)

Skoulidou, D.K., **Rosengren, A.J.**, Tsiganis, K., and Voyatzis, G., "Cartographic study of the MEO phase space for passive debris removal," poster will be presented at the *ESA/ESOC Seventh European Conference on Space Debris*, Darmstadt, Germany, 18–21 April 2017.

Rosengren, A.J., Skoulidou, D.K., Gkolias, I., Tsiganis, K., and Voyatzis, G., "Coupled radiation and lunisolar resonant effects on Earth satellite orbits," talk will be presented at the 9th Alexander von Humboldt Colloquium on Celestial Mechanics, Bad Hofgastein, Salzburg, Austria, 19–25 March 2017.

Rosengren, A.J., Tsiganis, K., Daquin, J., and Rossi, A., "Galileo disposal criteria based on the lunisolar resonant topology" talk presented at the *Stardust Final Conference on Asteroids and Space Debris*, ESA-ESTEC, Noordwijk, Netherlands, 31 October – 4 November 2016.

Rosengren, A.J., and Daquin, J. "A chaotic approach to passive debris removal: the dynamical clearing of resonant orbits," talk presented at the *2nd Stardust Global Virtual Workshop on Asteroids and Space Debris*, University of Southampton, Southampton, England, 19–22 January 2016.

Gkolias, I., Daquin, J., Gachet, F., and **Rosengren, A.J.**, "Vectorial elements for orbit propagation and the computation of dynamical stability maps," talk presented at *KePASSA: Key Topics in Orbit Propagation Applied to Space Situational Awareness*, Toulouse, France, 28–30 October 2015.

Gachet, F., Gkolias, I., Tsirvoulis, G., **Rosengren, A.J.**, and Daquin, J., "Resonances and chaos in Earth satellite orbits," talk presented at the *3rd Stardust Training School* on Science and Technology Challenges of Space Debris Removal and Asteroid Deflection, Universidad Internacional Menéndez Pelayo (UIMP), Santander, Spain 6–10 July 2015.

Daquin, J., **Rosengren, A.J.**, and Deleflie, F., "Diffusion in the dynamics of navigation satellites," talk presented at the *Chaos, Complexity and Transport Conference*, Marseille, France, 1–5 June 2015.

Rosengren, A.J., Daquin, J., Alessi, E.M., Valsecchi, G.B., Rossi, A., and Deleflie, F., "The onset of dynamical instability and chaos in navigation satellite orbits," talk presented at the *American Astronomical Society Division on Dynamical Astronomy Meeting*, Pasadena, California, 3–7 May 2015.

Rosengren, A.J., Alessi, E.M., Rossi, A., Valsecchi, G.B., and Deleflie, F., "Dynamical instabilities in medium Earth orbits," talk presented at the *2nd Stardust Training School* on Astrodynamics of NEO and Space Debris, University of Rome Tor Vergata, Rome, Italy, 8–12 September 2014.

Rosengren, A.J., and Scheeres, D.J., "The modified Laplace surfaces and the dynamics of dust around Saturn and Uranus," talk presented at the *IAU Symposium 310: Complex Planetary Systems*, Namur, Belgium, 7–11 July 2014.

Rosengren, A.J., and Scheeres, D.J., "Dynamics and stability of GEO orbits and implications for the debris problem," poster presented at the *IAU Symposium 310: Complex Planetary Systems*, Namur, Belgium, 7–11 July 2014.

Rosengren, A.J., Rossi, A., and Scheeres, D.J., "Dynamical behavior of HAMR space debris: implications for the debris problem at GEO," talk presented at the *1st Stardust Global Virtual Workshop on Asteroids and Space Debris*, Strathclyde University, Glasgow, Scotland, 6–9 May 2014.

Rosengren, A.J., and Scheeres, D.J., "The Milankovitch orbital elements and their application to the long-term orbit evolution of planetary satellites subject to radiation and gravitational perturbations," talk presented at the *American Astronomical Society Division on Dynamical Astronomy Meeting*, Paraty, Brazil, 5–9 May 2013.

Rosengren, A., and Scheeres, D., "Averaged dynamics of high area-to-mass ratio space debris in GEO," poster presented at the *ESA/ESOC Sixth European Conference on Space Debris*, Darmstadt, Germany, 22–25 April 2013.

Technical Reports

Tsiganis, K., Skoulidou, D.K., **Rosengren, A.J.**, Voyatzis, G., Rossi, A., Alessi, E.M., Schettino, G., Valsecchi, G.B., and Colombo, C., "Dynamical mapping of Earth satellite orbits," EC Horizon 2020, Grant Agreement No. 687500.

Deleflie, F., Alessi, E.M., **Rosengren, A.J.**, Daquin, J., Valsecchi, G.B., Rossi, A., and Vienne, A., "Choice of initial conditions for GNSS disposal orbits: simulations with STELA and corresponding analysis," ESA/GSP Contract No. 4000107201/12/F/MOS.

Invited Talks

Rosengren, A.J., "Passive debris mitigation and removal using resonances and chaos," invited research seminar at CCAR, University of Colorado, Boulder, Colorado, May 11, 2016.

Rosengren, A.J., "Artificial Earth satellites and the phenomenon of resonance," invited research seminar at IMCCE, Observatoire de Paris, Paris, France, April 27, 2015.

Rosengren, A.J., "The classical Laplace plane as a stable disposal orbit for geostationary satellites," invited research seminar in the School of Aerospace Engineering at the Georgia Institute of Technology, Atlanta, Georgia, December 9, 2013.

Service to Professional Societies

Memberships

- Society of Satellite Professionals International (SSPI), June 2013 to Present
- American Astronomical Society (AAS), Division on Dynamical Astronomy (DDA), February 2013 to Present
- American Astronautical Society (AAS), April 2012 to Present
- The Planetary Society, April 2012 to Present
- Society for Industrial and Applied Mathematics (SIAM), October 2011 to Present
- American Institute of Aeronautics and Astronautics (AIAA), August 2006 to Present

Review Activities

- International Journal of Dynamics and Control, published by Springer, March 2016 (1)
- Celestial Mechanics and Dynamical Astronomy: An International Journal of Space Dynamics, published by Springer, August 2014 to Present (3)
- Advances in Space Research: The Official Journal of the Committee on Space Research (COSPAR), a Scientific Committee of the International Council for Science (ICSU), published by Elsevier, March 2014 to Present (4)

Computer Skills	Fortran, LaTeX, Mathematica, Matlab, Python
Languages	Introductory knowledge in Italian, Greek
Citizenship	United States