Sara C. Spangelo

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Personal/Contact Information

Date of birth: August 27, 1986
Citizenship: Canadian
Email address: spangelo.sara@gmail.com
Website: saraspangelo.com
Cell Phone: 734-834-9040
Work Phone: 626-807-4960
Address: 250 S. Pasadena Ave., Unit 2070, Pasadena, CA, 91105

Research Interests

Analytical modeling, simulation, spacecraft and ground network scheduling, multi-disciplinary optimization, Model-Based Systems Engineering (MBSE), GPS and tracking for small satellites, optimal path planning for autonomous vehicles.

Education

Aerospace Engineering, University of Michigan   Ann Arbor, Michigan, USA
May 2009 – December 2012 (conferred May 2013)
Ph.D. in Aerospace Engineering. Advisors: Professor James Cutler and Professor Amy Cohn
Modeling, simulating, and optimization algorithms for scheduling constellations of small satellite constellations and diverse heterogeneous ground networks towards enhanced communication capacity.

Aerospace Engineering, University of Michigan   Ann Arbor, Michigan, USA
September 2008 – May 2009
M.Sc. in Aerospace Engineering. Advisors: Professor Anouck Girard, Professor Pierre Kabamba, Professor Elmer Gilbert
Developed kinematic and energetic models and optimized path plans for energy-efficient periodic ascending and descending solar UAV flight.

Mechanical Engineering, University of Manitoba   Winnipeg, Manitoba, Canada
September 2004 – May 2008
B.Sc. in Mechanical Engineering, Management Minor. Advisors: Professor Tachie and Professor Birouk. Graduated with Distinction.

Current Position

Systems Engineer, Jet Propulsion Lab (JPL)
Earth, Astronomy, and Physics Missions, Group 312B   Pasadena, California, USA
May 2013 – Present
Model-Based Systems Engineering (MBSE) SysML modeling and analysis, advanced mission studies concepts, supporting Advanced Projects Design Teams (A-Team and Team X).

Experience

Graduate Student Instructor (GSI) for Aero 483 Final Design
Aerospace Engineering, University of Michigan   Ann Arbor, Michigan, USA

January 2012 – April 2012
Responsible for preparing assignments, exams, projects, preparing and delivering lectures and tutorials, course evaluation, office hours.

Radio Aurora Explorer (RAX) Satellite Mission
Aerospace Engineering, University of Michigan   Ann Arbor, Michigan, USA
2009 – 2012
RAX-2 Operations: Simulations, operational plans, and spacecraft command execution.
Position and Time Lead: Performed simulations, developed test plans, performed de-integrated and integrated tests on GPS receiver, LNA, and antenna system. Assessed on-orbit GPS checkout tests.

Summer Researcher, Prof. Zingg's Resarch Group
University of Toronto Institute for Aerospace Studies   Toronto, Ontario, Canada
May 2008 – August 2008
National Science and Engineering Research Council (NSERC) Summer Fellow.

Investigated intelligent globalization techniques to improve solver efficiency for transonic nozzles. Studied adjoint error approximations as a tool for error analysis and mesh refinement in CFD analysis.

Summer Researcher, Prof. Birouk's Research Group
Mechanical Engineering, University of Manitoba   Manitoba, Canada
May 2006 – August 2006
National Science and Engineering Research Council (NSERC) Summer Fellow. Computational Fluid Dynamics experiment: studied turbulent flow in diverging channel using particle imaging velocimeter (PIV).

Summer Internship, Standard Aero Limited   Manitoba, Canada
May 2007 – August 2007
Aeroblue Liquid Teflon Coating Replacement Project: designed and implemented test plans, performed MSDS and chemical analysis in compliance with airworthiness standards.

Awards

Academic

Best Student Paper at the Guidance, Navigation, and Control (GNC) Conference for *Optimization of Single-Satellite Operational Schedules Towards Enhanced Communication Capacity*, Minneapolis, MN, August 2012.

Zonta International Amelia Earhart Fellowship, Accepted at the University of Michigan, 2011-2012.

National Science and Engineering Research Council Postgraduate Scholarship Doctorate Bursary (NSERC PGS D), University of Michigan, 2010.

Dean's Named Fellowship, Department of Aerospace Engineering, University of Michigan, 2008-2009.

National Science and Engineering Research Council Canadian Graduate Scholarship Masters Bursary (NSERC CGS M), University of Manitoba, 2008.

Gold Medal for Highest Standing in Mechanical Engineering, University of Manitoba, Spring 2008.

National Science and Engineering Research Council Undergraduate Student Research Award, 2006 and 2008.

Aaron Akman Scholarship, Overall Highest Academic Standing, 3rd Year Mechanical Engineering, Spring 2007.

Non-Academic
Distinguished Leadership Award, University of Michigan, 2011-2012.

Publications

Refereed Journal Publications

S. Spangelo, J. Cutler, A. Klesh, and D. Boone, "Models and Tools to Evaluate Space Communication Network Capacity", *Accepted to IEEE Transactions on Aerospace and Electronic Systems*, vol. 48, no. 3, pp. 2387-2404, July 2012.

S. Spangelo and E. Gilbert, "Power Optimization of Solar-Powered Aircraft with Specified Closed Ground Tracks", Department of Aerospace Engineering, University of Michigan, *Accepted to Journal of Aircraft*, May 2012.

S.C. Spangelo, M.W. Bennett, D.C. Meinzer, A.T. Klesh, J.A. Arlas, J.W. Cutler, "Design and Implementation of the GPS Subsystem for the Radio Aurora Explorer", *Accepted to Acta Astronautica*, December 2012.

S. Spangelo and J. Cutler, "Analytic Model and Simulation Toolkit for Space Network Communication Capacity Assessment", *Accepted to Journal of Aerospace Information Systems*, December 2012.

D. Dalle and S. Spangelo, "Preliminary Design of Small Satellites for Passive Reentry", *Under review in Journal of Small Satellites (JOSS)*.

Journal Publications in Preparation

S. Spangelo, J. Cutler, A. Cohn, and K. Gilson, "Optimization-Based Scheduling for the Single-Satellite, Multi-Ground Station Communication Problem ", *for publication in Operations Research*, Expected June 2013.

S. Spangelo, D. Kaslow, C. Delp, and G. Soremekum, "Model Based Systems Engineering (MBSE) Applied to CubeSat Mission Operational Scenarios", *for publication in Journal of Systems Engineering*, Expected August 2013.

S. Spangelo and B. Longmier, "BravoSat: Operational Optimization of a CubeSat Mission with Novel Plasma Propulsion Technology, *Journal of Spacecraft and Rockets*, Expected August 2013.

Refereed Conference Proceedings

Presented papers are underlined.

S. Spangelo, D. Kaslow, C. Delp, L. Anderson, B. Cole, E. Foyse, L. Cheng, R. Yntema, M. Bajaj, G. Soremekum, and J. Cutler, "Model Based Systems Engineering (MBSE) Applied to Radio Aurora Explorer (RAX) CubeSat Mission Operational Scenarios", *Accepted for IEEE Aerospace Conference, 2013*, Big Sky, MT, March 2013.

S. Spangelo, D. Kaslow, C. Delp, B. Cole, L. Anderson, E. Fosse, L. Hartman, B. Gilbert, and J. Cutler, "Applying Model Based Systems Engineering (MBSE) to the Design and Operations of CubeSat Missions", *IEEE Aerospace Conference, 2012*, Big Sky, MT, March 2012.

<u>S. Spangelo, J. Cutler, and D. Boone,</u>"Assessing the Capacity of a Federated Ground Station Network", *IEEE Aerospace Conference, 2010*, Big Sky, MT, March 2010.

Other Conferences and Workshops with Proceedings (reviewed abstracts)

D. Dalle and S. Spangelo, "Characterization of Entry to Solar System Atmospheres for Chip-Sized Spacecraft", *Interplanetary Small Satellite Conference*, Pasadena, CA, June 2013.

S. Spangelo and B. Longmier, "BravoSat: Optimizing the Delta-V Capability of a CubeSat Mission

with Novel Plasma Propulsion Technology, *Interplanetary Small Satellite Conference*, Pasadena, CA, June 2013.

J. Arlas and S. Spangelo, "GPS Results for the Radio Aurora Explorer II Cubesat Mission", *AIAA Aerospace Sciences Meeting*, Grapevine, TX, January 2013.

S. Spangelo and J. Cutler, "Optimization of Single-Satellite Operational Schedules Towards Enhanced Communication Capacity", *Guidance, Navigation, and Control (GNC) Conference*, Minneapolis, MN, August 2012.

S. Spangelo and J. Cutler, "Optimal Operational Planning for Interplanetary Small Satellite Exploration Missions Applied to a Phobos Lander Mission", *iCubeSat Workshop*, Boston, MA, May 2012.

D. Dalle and S. Spangelo, "Preliminary Design of Small Satellites for Passive Reentry", *iCubeSat Workshop*, Boston, MA, May 2012.

J. Arlas and S. Spangelo, "GPS Results for the Radio Aurora Explorer II Cubesat Mission", *AIAA Region III Student Conference*, Ann Arbor, MI, March 2012. *(First Place Winner in Student Competition)*

S. Spangelo and J. Cutler, "Integrated Approach to Optimizing Spacecraft Vehicles and Operations", *International Astronautical Congress*, Cape Town, South Africa, October 2011.

M. Johnson and S. Spangelo "Crowdsourcing Space Exploration with Spacecraft-on-Demand", *International Astronautical Congress*, Cape Town, South Africa, October 2011.

J. Cutler, J. Springmann, S. Spangelo, and H. Bahcivan, "Initial Flight Assessment of the Radio Aurora Explorer", *Small Satellite Conference*, Logan, UT, August 2011.

Y. Lee, J. Springmann, S. Spangelo, and J. Cutler, "Satellite Dynamics Simulator Development Using Lie Group Variational Integrator", *AIAA Modeling and Simulation Technologies Conference, 2011*, Portland, OR, August 2011.

S. Spangelo and J. Cutler, "Small satellite operations model to assess data and energy flows", *AIAA/AAS Astrodynamics Specialist Conference, 2010*, Toronto, Canada, August 2010.

S. Spangelo, A. Klesh, and J. Cutler, "Position and Time System for the RAX Small Satellite Mission", *AIAA/AAS Astrodynamics Specialist Conference, 2010*, Toronto, Canada, August 2010.

S. Spangelo, E. Gilbert, A. Klesh, A. Girard, and P. Kabamba, "Solar-Powered Aircraft: Energy-Optimal Path Planning And Perpetual Endurance", *AIAA Guidance, Navigation, and Control Conference, 2009*, Chicago, IL, August 2009.

S. Spangelo, S Fabbro, N. Lekic and M. Birouk, "Effects Of Nozzle Geometry On The Near-Field Characteristics Of A Liquid Jet", *Iclass 2009, 11th Triennial International Annual Conference On Liquid Atomization And Spray Systems*, 2009.

Invited Articles
S. Spangelo, "Reflections by Sara Spangelo", Department of Mechanical Engineering, Graduate Studies Newsletter, University of Manitoba, vol. 2, no. 3, March/ April 2010.

Invited Presentations/ Posters

Separate from Conference Presentations.

"Modeling and Simulation of CubeSat Mission: Model-Based Systems Engineering (MBSE) Behavioral Modeling and Execution, Integration of MagicDraw, Cameo Simulation Toolkit, STK, and Matlab using ModelCenter", Sara Spangelo, Hongman Kim, and Grant Soremekun, *presented at Lunch*

and Learn, Jet Propulsion Laboratory (JPL), Pasadena, CA, and *Phoenix Integration Workshop*, El Segundo, CA, May 29/30 2013.

S. Spangelo, D. Kaslow, C. Delp, L. Anderson, R. Yntema, M. Bajaj, G. Soremekum, and J. Cutler, "Using MBSE in an Operations Environment (CubeSat Challenge Team)", presentation at *International Workshop (IW)*, INCOSE, January 2013.

S. Spangelo, "How I Can Contribute to JPL's success", presentation at Jet Propulsion Lab (JPL), Pasadena, CA, December 2012.

S. Spangelo and J. Cutler, "Optimizing Satellite Operations: Near-Earth to Interplanetary Missions", poster at *Small Satellites: A Revolution in Space Science at Keck Institute for Space Studies*, Pasadena, CA, July 2012.

S. Spangelo, D. Kaslow, C. Delp, B. Cole, L. Anderson, E. Fosse, B. Gilbert, L. Hartman, T. Kahn, and J. Cutler, "Challenge team status: MBSE and CubeSat", *International Workshop (IW)*, INCOSE, January 2012.

"Modeling, Simulation, and Optimization Space Networks Towards Enhanced Communication Capacity", presentation at *AIAA/NASA Ames Plug-n-Play Mission Operations Workshop*, San Jose, CA, May 2011.

"Enabling the Next Generation of Small Satellite Missions by Optimization of Communication Networks", presentation at *CubeSat Conference*, San Luis Obispo, CA, April 2011.

"BOLD FLIGHT at Michigan", presentation at *Jet Propulsion Laboratory Seminar*, Jet Propulsion Laboratory, Pasadena, CA, April 2011.

"Assessing and Optimizing Communication Network Capacity", *Women in Aerospace Symposium*, presentation at Massachusetts Institute of Technology, Cambridge, MA, January 2011.

"Assessing Satellite Network Communication Capacity", presentation at *CubeSat Conference*, San Luis Obispo, CA, May 2010.

"Assessing the Capacity of a Federated Ground Station Network", presentation at *Flight Dynamics and Controls Seminar*, University of Michigan, September 2009.

"Assessing the Capacity of a Federated Ground Station Network", poster at *Engineering Graduate Symposium*, University of Michigan, September 2009.

Teaching and Mentoring

Separate from GSI Experience.

Guest Lecture in Aerospace Engineering, University of Michigan:

- Aircraft Dynamics and Control (Aerospace 348), Fall 2012
- Introduction to Aerospace Engineering (Aero 201), Fall 2011

Supervisor- Mentoring numerous undergraduate and graduate students doing research and engineering work in the Michigan Exploration Laboratories (MXL), including mentoring an undergraduate write an award-winning paper, University of Michigan, Summer 2010-present.

Lunch with a Graduate/Undergraduate Student, University of Michigan College of Engineering, 2010 and 2011.

Tutor- Engineering, University, High School Calculus, Elementary Math and Science Courses, Various High Schools and University of Manitoba, 2003-2008.

Dance Instructor- Shelley Shearer School of Dance, Classical Ballet, Jazz, Preschool Classes, Winnipeg, Manitoba, 2004-2008.

Professional Affiliations and Committees

IEEE and AIAA Student Member.

Aerospace Engineering Representative for College of Engineering Graduate Student Advisory Committee (GSAC), University of Michigan, 2009-2010.

Referee for *Journal of Aircraft*, March 2012; *Computers & Operations Research*, July 2010; *Journal of Aerospace Computing, Information, and Communication*, April 2010.

Elected Rackham Graduate School Student Government Division II Science & Engineering Representative, University of Michigan, 2009.

Member of University of Michigan Engineering Council (UMEC), University of Michigan, 2008-2009.

Elected Executive Member of University of Manitoba American Society of Mechanical Engineers (ASME), University of Manitoba, 2007-2008.

Activities

Professional

- Organizer for Interplanetary Small Satellite Workshop, Pasadena, CA, June 2013.
- Organizer for Second Annual Jet Propulsion Laboratory (JPL) Intern CubeSat Workshop, Pasadena, CA, August 2012.
- Organizer for First Interplanetary CubeSat Workshop (iCubeSat), Boston, MA, May 2012.
- Principal Investigator for University of Michigan-Jet Propulsion Laboratory (UM-JPL) Mission Design Challenge (Winner with proposed "DUST" mission), University of Michigan, April 2011-January 2012.
- Participant in Interplanetary Small Satellite Workshop, Jet Propulsion Laboratory, Pasadena, CA, January 2012.
- Completed Engineering Graduate Student Instructor (GSI) Teacher Training Program, University of Michigan, January 2012.
- Member of Space Systems Working Group (SSWG) Towards Developing SysML Models of Small Satellites (with members from academia, industry, and JPL), May 2011-present.
- GPS and Communication Lead for High Altitude Balloon Group, Atmospheric, Oceanic and Space Systems Space Instrumentation Class (AOSS 584), University of Michigan, Ann Arbor, Spring 2009.
- Organizer/Tester, Flight Dynamics and Controls Aerospace Engineering Qualifying Exam Preparation Sessions, University of Michigan, Winter/Fall 2010.
- Organizer/Facilitator for Flight Dynamics and Control (FDC) in Aerospace Engineering Student Seminar Series, University of Michigan, 2009-2011.

Academic Panels

- Panelist for following Panel Sessions at University of Michigan:
  - "PhD Panel for Incoming Graduate Students", College of Engineering, September 2009 and August 2012.
  - "PhD Panel for Undergraduate Summer Students", College of Engineering, Summer 2010.

     – SROP Panel Discussion: Preparing for Grad School, Rackham Graduate School, July 2011.
- Host for Panels in College of Engineering, University of Michigan:
  - "Alumni Panel: Academia and Industry", October 2010.
  - "Top 10 Habits of a Successful Scientist", Dr. Michael Zigmond, May 2010.
  - "NSF Fellowship Application Workshop", August 2009.

Outreach

- Speaker on "Undergraduate Research and Design Projects" at University of Michigan State of the Union Conference, Ann Arbor, MI, March 2012.
- Volunteer with GradSWE Outreach Opportunity Middle School Science Fair (March 2012), "Let's Read Math" (January 2012), Hands-On Children's Museum (Fall 2010 and Spring 2011).
- Founder of University of Michigan College of Engineering Running Group, 2009-2012.
- Volunteer with Hispanic Association of Professional Engineers promoting engineering to Middle School Students, Spring 2009.

Other Interests and Activities

- Sports: Avid runner, swimmer, biker, enjoys triathlons, frisbee, yoga.
- Participated in Zero-G Flight Research Program, Fall 2011.
- Graduate of Imperial Classical Ballet Exam Program.
- Canadian Red Cross Aqua Leader Program Certified.

Languages

Fluent in French and conversational Spanish.

Technical Skills

Optimization and Simulation Tools: Excel, CPLEX, C++, Matlab Optimization Toolboxes, System Tool Kit (STK), MagicDraw SysML, Phoenix Integration, Simulink.

Programming: C++, Java, Matlab, STK/Connect (interfaces Matlab with STK)

Applications: LaTeX, Microsoft Office, HTML, and other common productivity packages for Windows and Linux platforms