

DANIEL L. OLTROGGE

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EDUCATION

Master of Science in Aerospace Engineering, University of Southern California, 1987

Bachelor of Science in Aerospace Engineering, Iowa State University, 1985

EXPERIENCE

2020-present: CSSI Director and Director, COMSPOC Integrated Operations, COMSPOC Corporation, Colorado Springs, CO

- Director of AGI's Center for Space Standards and Innovation research group.
- Program Manager for Space Data Center, providing on-demand SSA for global space community spanning all orbit regimes, including 60% of operational GEO satellites.
- Developed international standards in collision avoidance, orbit life estimation & space ops.

2018-2020: Director, Center for Space Standards and Innovation (CSSI), Analytical Graphics, Inc., Colorado Springs, CO

- Directed and managed AGI's 4-person Center for Space Standards and Innovation research group.
- Founder and Administrator, Space Safety Coalition (spacesafety.org)
- Program Manager for Space Data Center, providing on-demand SSA for global space community spanning all orbit regimes, including 60% of operational GEO satellites.

2010-2018: Senior Research Astrodynamist and SDC Program Manager, Analytical Graphics, Inc., Colorado Springs, CO

- Member of AGI's 5-person Center for Space Standards and Innovation research group.
- Extensive research and operations in Space Situational Awareness, EMI/RFI, Conjunction Assessment, astrodynamics, small satellites, mission design, and standards compliance
- Worked with space operators from many different countries globally.
- Program Manager for Space Data Center, providing on-demand SSA for global space community spanning all orbit regimes, including 60% of operational GEO satellites.
- Developed international standards in collision avoidance, orbit life estimation & space ops.

2003-Present: CEO and Senior Analyst, 1Earth Research, LLC, Colorado Springs, CO



Oltrogge, D.L., Center for Space Standards and Innovation

27 May 2021

- Founder and Senior Analyst of a technical consulting firm leveraging advanced techniques and algorithms from the space industry toward the improvement of both space and terrestrial processes.
- Extensive mission design, launch and early orbit operations, systems engineering, flight operations & tracking for CubeSat, small satellite, and University Nanosat programs.
- Develop software and international standards for space operations, debris mitigation & astrodynamics.
- Space and terrestrial modelling for satellites and Remotely Piloted Vehicles (RPVs).
- CFO; Contracts Officer; designed/operated multiple computer networks; FSO.

2005-2011: Lead Systems Engineer, SkySentry, LLC, Colorado Springs, CO

- Engineering expertise to SkySentry LLC (High Altitude Airships & Missile Defense Agency)
- Missile fly-out modelling, constellation coverage, intercept dynamics, STK simulations
- Communications modelling, relay contention, tools interfaces
- Missile defense; post-engagement breakup modelling; Airship weather modelling.
- Led development of heavier-than-air 6-DoF model for Army Battle Lab federated tool suite.
- Managed the implementation of statistical weather (from 1948 to present)

2000-2003: Senior Project Engineer, The Aerospace Corporation

- Effective supervision of resources and innovative ideas and process resulted in improved modelling capabilities, performance assessments and robustness.
- Lead Technical Analyst in Space Operations Support Office (SOPSO). Provided vision and direction to all phases of SOPSO activities, leading teams from two to fifteen people.
- Engineering team technical lead for advanced analysis tool technologies:
 - Worldwide Radio Frequency (RF) Impingement & Interference software 'EMTR_RF'
 - Optimal burn reconstruction and performance assessment tool 'AVALON'
 - Conceived & developed nation's COLA & RFI tool suite "Collision Vision."
 - Conceived & developed system-of-systems satellite constellation performance assessment tool 'BLINE', now a principal National rapid concept assessment tool.
- NRO Tier III Award for anomaly investigation and resolution for critical system
- Detected and mitigated severe re-contact threat for new National satellite.

1995-1999: Project Engineer, The Aerospace Corporation, Peterson Air Force Base, Colorado Springs, CO

- Principal Technical Analyst for Air Force Space Command Directorate of Requirements, Requirements Analysis Center. Developed system requirements and independently assessed system performance. Directed requirements tracking & analysis, analysis of alternatives and trade studies.



- Five years Air Force Space HQ executive staff; policy, advocacy, consensus building
- Requirements tracking between EELV Requirements & Spec. documents (DOORS); identified unmet and extraneous requirements, saving millions.
- Missile Warning/Space Surveillance Network performance assessment

1985-1995: Engineering Specialist, The Aerospace Corporation, El Segundo, CA

- Lead engineer for high-priority projects
- Led and mentored numerous operations teams for launch, early orbit, and on-orbit activities
- Developed interdisciplinary, integrated satellite operations tool; adopted by government as operational spacecraft control software.
- Independently verified software & ascent trajectories for multi-billion-dollar programs.
- Created a novel, highly efficient ephemeris reconstruction and satellite tracking tool 'CPLANE' that is fifteen times faster and much more accurate than other methods.
- Pioneered system-of-systems satellite constellation performance assessment tool 'BSPACE;' developed industry-unique optimal tasking algorithms, satellite coverage and sensor models.
- Created innovative covariance-based ground antenna search and acquisition software.
- Developed integrated numerical 6-Degrees-of-Freedom (position, attitude under full range of perturbations; magnetic and aero-torque spin control) simulations.
- Developed antenna signal strength & link analysis software for launch vehicles.
- Analyzed all facets of launch, early orbit, on-orbit and disposal/re-entry operations.

TRAINING AND CERTIFICATIONS

Analytical Graphics, Inc. (AGI) "Certified Rocket Scientist" – STK expert qualified status
2006-2007

bmdBenchmark Training Course ○ Georgia Technical Research Institute ○ 2005

Small Business Innovative Research Course, University of Colorado at Colorado Springs,
2003

Nx Level Business Development Course, University of Colorado at Colorado Springs, 2003

ArcGIS 8.2 Certification Course ○ University of Colorado at Colorado Springs ○ 2003

Satellite Tool Kit Beginner and Advanced Courses ○ Analytic Graphics, Inc. ○ 1998-2006

Satellite Tool Kit Introductory Course ○ Analytic Graphics, Inc. ○ 1998



Oltrogge, D.L., Center for Space Standards and Innovation

27 May 2021

Microsoft Access User's Course O Peterson Air Force Base O 1997

PROFESSIONAL ASSOCIATIONS:

Sr. Member, American Institute of Aeronautics and Astronautics (AIAA), 1982 – present

Member, AIAA Astrodynamics Standards Technical Review Committee

Member, International Standards Organization, Space Operations Working Group, 2003 - present.

Deputy Convener, International Standards Organization, Orbital Debris Mitigation Working Group, 2011 - present.

Member, The Consultative Committee for Space Data Systems (CCSDS) Navigation Working Group, 2014 - present.

Member, American Astronautical Society (AAS), 2003 - present

Member, International Academy of Astronautics (IAA), 2015 - present

Member, Sigma Gamma Tau (Aerospace Engineering Honor Society)

HONORS AND AWARDS:

STK Certified Rocket Scientist, Analytical Graphics, Inc., June 2007

Recipient of over 40 distinct commendations from government and commercial customers for exemplary performance, distinguished service, critical support, and key contributions:

- Picosatellite Operations Lead for Popular Science's 100 "Best of What's New in 2000"
- Twice nominated for President's Award for RF and Collision Avoidance tools development
- NRO Tier III Award Feb 2002 and two NRO Director's Team Awards (2001 & 2002)



Authored and presented over 50 professional papers and presentations, as well as technical journal articles and two commissioned chapters for technical textbooks Space Systems Modelling and Simulation and Small Satellites: Past, Present and Future.

BOOK CHAPTERS:

1. Oltrogge, D.L. and Gist, R.G., Collision Avoidance and Radio Frequency Interference, Chapter 15 of book entitled, ***Space Systems Modeling and Simulation (SMSS)***, ISBN 1-884989-15-2, The Aerospace Press/AIAA, 2004.
2. Oltrogge, D.L. and Hast, S.L., Small Satellite Mission Design and Operations, Chapter 2 of book entitled, ***Small Satellites: Past, Present and Future***, The Aerospace Press/AIAA, 2008.
3. Oltrogge, D.L. and Cooper, J.A., Space Situational Awareness & Space Traffic Management, Chapter in book entitled, ***The Space Debris Peril: Pathways to Opportunities***, CRC Publishing, 2020.

PATENTS:

1. Patent No.: US 2017/0096242 A1, "Probability and Frequency of Orbital Encounters," 6 April 2017, Salvatore Alfano and Daniel Oltrogge.
2. Patent No.: US 10,558,320, "Probability of Collision Topology," 11 February 2020, Salvatore Alfano and Daniel Oltrogge.
3. Patent No.: US 10,551,994 B2, "Probability of Collision Bounding Surfaces," 4 February 2020, Salvatore Alfano and Daniel Oltrogge.

Lead/Co-lead editor on international standards:

1. Oltrogge, D.L., H. Klinkrad, D. Finkleman, Jean-Claude Benech, Alex da Silva, George Fujita, Carmen Pardini, Yuriy Stryzhak, "Space systems — Determining orbit lifetime," International Standards Organization Draft International Standard 27852, 3 September 2009.
2. Oltrogge, D.L., lead editor, Orbit Data Message, CCSDS 502.0-B-2, <https://public.ccsds.org/Pubs/502x0b2c1.pdf>, 2015-2022.
3. Swinburne, B. and Oltrogge, D.L., Conjunction Data Message, CCSDS 508.0-B-1, <https://public.ccsds.org/Pubs/508x0b1e2c1.pdf>, 2019-present.

Oltrogge, D.L., Center for Space Standards and Innovation

27 May 2021

4. Oltrogge, D.L., "ISO Space Systems – Design, Testing and Operation of a Spacecraft Large Constellation," 2020-present.
5. Oltrogge, D.L., "ISO NWIP: Space systems — Space Traffic Coordination and Management," 2020-present.

REFEREED PUBLICATIONS:

1. Hast, S. L., Oltrogge, D.L. and Hart, M.J., "Compact Finite Burn Targeting and Reconstruction Algorithm," *Journal of Guidance, Control and Dynamics*, Vol. 19, No. 4, July-August 1996.
2. Finkleman, D., Oltrogge, D.L. and Stokes, H., "Space Standards Establish Norms for Space Operations," *International Standards Organization Magazine*, 15 November 2011.
3. Oltrogge, D.L., "Efficient Solutions of Kepler's Equation via Hybrid and Digital Approaches," *Journal of Astro Sci JASS-D-15-00005*, Volume 62, Issue 4, pp 271-297, December 2015.
4. D.L. Oltrogge, S. Alfano, C. Law, A. Cacioni, T.S. Kelso, "A comprehensive assessment of collision likelihood in Geosynchronous Earth Orbit," *Acta Astronautica* (2018), doi:10.1016/j.actaastro.2018.03.017.
5. Alfano, S. and Oltrogge, D., "Probability of Collision: Valuation, variability, visualization, and validity," *Acta Astronautica* (2018), doi:10.1016/j.actaastro.2018.04.023.
6. Alfano, S and Oltrogge, D.L., "Volumetric Assessment of Encounter Probability," *Acta Astronautica* 2018, <https://doi.org/10.1016/j.actaastro.2018.09.030>, 1 October 2018.
7. Oltrogge, D.L. and Alfano, S., "The Technical Challenges to Better Space Situational Awareness and Space Traffic Management," *Journal of Space Safety Engineering*, <https://doi.org/10.1016/j.jsse.2019.05.004>, May 2019.
8. Oltrogge, D.L. and Christensen, I.A., "Space governance in the new space era" *Journal of Space Safety Engineering*, <https://doi.org/10.1016/j.jsse.2020.06.003>, July 2020.

NON-REFEREED PUBLICATIONS:

1. Davis, R. and Oltrogge, D.L., "Computer Simulation of Orbital Mechanics", *International Astrodynamic Congress*, Stockholm, Sweden, October 1985.
2. Oltrogge, D.L., "Forward Prediction Capability of the NORAD and SCF Propagators for the ITV Mission," *Aerospace Technical Operating Report to ITV Conference*, 16 September 1987.
3. Oltrogge, D.L., "User's Guide to the 6-D SPIN Program," *Aerospace Technical Operating Report*, 15 November 1991.
4. Chao, C.C., Strizzi, J.D., Oltrogge, D.L., Johnson, C.J., and Williams, S.D., "Improved Reentry Impact Point Prediction Using NORAD Elements and the LIFETIME program," Paper AAS 94-159, *AAS Space Flight Mechanics Conference*, Cocoa Beach, Florida, February 1994.

5. Hast, S. L., Oltrogge, D.L. and Hart, M.J., "A Compact Finite Burn Targeting and Reconstruction Algorithm," Paper AIAA-94-3744-CP, AIAA Astrodynamics Conference, Scottsdale, AZ, summer 1994.
6. Oltrogge, D. L., "RF Power Impingement Analysis," REEF Conference, Chantilly, VA, 1995.
7. Oltrogge, D. L. and R. G. Gist, "The Collision Vision Prototype Assessment System," 16th Space Control Conference at MIT Lincoln Laboratory, April 14-16, 1998.
8. Oltrogge, D. L., "Launch and On-Orbit RF Power Impingement Characterization," 16th Space Control Conference at MIT Lincoln Laboratory, April 14-16, 1998.
9. Oltrogge, D. L., "RF Power Impingement Analysis and Worldwide Characterization," REEF Conference, Chantilly, VA, 14 Mar 1997.
10. Oltrogge, D. L. and Gist, R.G., "The Collision Vision Prototype Assessment System," 16th Space Control Conference, 1 May 1997.
11. Oltrogge, D.L. and Jamison, James, "Initial Post-Launch Station Acquisition of Nanosatellites," Second International Conference on Integrated Micro/Nanotechnology for Space Applications, Pasadena, California, 11-15 April 1999.
12. Oltrogge, D.L., Warner, L. and Joshi, R., "SSN Optical Augmentation (SOA) Cost Benefits Analysis," 17th Space Control Conference at MIT Lincoln Laboratory, April 1999.
13. Oltrogge, D. L. and Bustillos, A.C., "RF Power Impingement Analysis and Worldwide Characterization," Frequency Managers Group Conference, Baltimore, Maryland, 1999.
14. Gist, R.G. and Oltrogge, D.L., "Collision Vision: Covariance Modeling and Intersection Detection for Spacecraft Situational Awareness," Paper AAS-351, AAS/AIAA Space Flight Mechanics Conference, Girdwood, Alaska, August 1999.
15. Oltrogge, D.L. and Gist, R.G., "Collision Vision: Situational Awareness for Safe and Reliable Space Operations," Paper IAA-99-IAA.6.6.07, 50th International Astronautical Congress, Amsterdam, The Netherlands, 4-8 Oct 1999.
16. Gist, R.L. and Oltrogge, D.L., "Aspects of High-Fidelity Collision Avoidance Analysis for Space Launch," 2nd NRO/AIAA Workshop on Space Launch Integration, Chantilly, VA, 3 May 2000.
17. Oltrogge, D.L., "Spiral Scan Acquisition/Tracking Method for Picosats," Aerospace Forum on Space Debris, Collision Avoidance, and Reentry Hazards, The Aerospace Corporation, 1-3 November 2000.
18. Peterson, G.E., Gist, R.G. and Oltrogge, D.L., "Covariance Generation for Space Objects using Public Data," Paper AAS 01-113, AAS/AIAA Space Flight Mechanics Meeting, Santa Barbara, California, 11-14 February 2001.
19. Oltrogge, D.L., Raman, K. and Chan, J., "Experiences with Situational Awareness for Communications Satellite Operators," Paper AIAA 2001-0075, 19th AIAA International

Oltrogge, D.L., Center for Space Standards and Innovation

27 May 2021

Communications Satellite Systems Conference and Exhibit, Toulouse, France, 17-20 April 2001.

20. Oltrogge, D.L. and Dichmann, D., "Improved Covariance-Based Search & Acquisition Strategies for Launch & Early Orbit," 3rd NRO/AIAA Workshop on Space Launch Integration, Chantilly, VA, 23 July 2001.
21. Gist, R.G. and Oltrogge, D.L., "Risk Management of Unintentionally Collocated Geosynchronous Spacecraft," Paper AAS-01-321, 2001 AIAA/AAS Astrodynamics Specialist Conference, Quebec City, Quebec, Canada, 30 July – 4 August 2001.
22. Oltrogge, D.L., "Collision Avoidance & RF Interference Aspects of Space Situational Awareness," 2001 Amos Technical Conference, Maui, HI, 10 September 2001.
23. Oltrogge, D.L., Alfano, S. and Gist, R.G., "Satellite Mission Operations Improvements Through Covariance-Based Methods," Paper AIAA 2002-1814, SatMax 2002: Satellite Performance Workshop, Arlington, VA, 22 April 2002.
24. Oltrogge, D.L., "Satellite Threat Monitoring for Communications Satellite Operators," Paper AIAA 2002-2020, 20th AIAA International Communications Satellite Systems Conference and Exhibit, Montreal, Quebec, Canada, 12-15 May 2002.
25. Hayes, E.W., et al (Oltrogge), "The BSpace Algorithm: A Statistical Model of Satellite Constellation Performance," AIAA, 16 Aug 2004.
26. Finkleman, D. and Oltrogge, D.L., "Progress in International Space and Astrodynamics Standards," Paper AAS 06-234, 20th AAS/AIAA Space Flight Mechanics Conference, Tampa, FL, 24-26 January 2006.
27. Oltrogge, D.L. and Chao, C.C., "Standardized Approaches for Estimating Orbit Lifetime after End-of-Life," Paper AAS 07-261, 2007 AAS/AIAA Astrodynamics Specialist Conference, Mackinac Island, MI, 19-23 August 2007.
28. Finkleman, D., Oltrogge, D.L., Faulds, A. and Gerber, J., "Analysis of The Response of A Space Surveillance Network To Orbital Debris Events," Paper AAS 08-127, 2008 AAS/AIAA Astrodynamics Specialist Conference, Galveston, TX 27-31 January 2008.
29. Oltrogge, D.L., "AstroHD: Astrodynamics Modeling with a Distinctly Digital Flavor," Paper AIAA-2008-7065, 2008 AAS/AIAA Astrodynamics Specialist Conference, Honolulu, HI, 20 August 2008.
30. Oltrogge, D.L. and Finkleman, D., "Consequences of Explosions and Collisions in the GEO Belt," Paper AIAA-2008-7375, 2008 AAS/AIAA Astrodynamics Specialist Conference, Honolulu, HI, 21 August 2008.
31. Finkleman, D. and Oltrogge, D.L., "Short Term Consequences of Orbital Debris Events (An Orbital Debris Tool Kit)," Paper AIAA-2008-6777, AAS/AIAA Astrodynamics Specialist Conference, Honolulu, HI, 20 August 2008.

32. Finkleman, D., Oltrogge, D.L. et al, "Space Debris Birth to Death: Analysis from Concern to Consequences," AMOS 2008 Space Situational Awareness Conference, Maui, HI, 16-19 September 2008.
33. Oltrogge, D.L., "Breakup Modeling With 1Earth's DEBBIE Module and STK," AGI User's Conference, Chicago IL, 7-10 October 2008.
34. Oltrogge, D.L., "Space Debris and the SSA Picture," AGI User's Conference, Chicago IL, 7-10 October 2008.
35. Finkleman, D. and Oltrogge, D.L., "Approaches to Near Term Collision Risk Assessment," The Fifth European Conference on Space Debris, Darmstadt, Germany, 26 Mar 2009.
36. Finkleman, D. and Oltrogge, D.L., "The Spectrum of Satellite Breakup and Fragmentation," AMOS 2009 Space Situational Awareness Conference, Maui, HI, 2-5 September 2009.
37. Oltrogge, D.L., "RF Interference Inferences Using Antenna Patterns," 2010 InfoWarCon Conference, Washington D.C., 13 May 2010.
38. Finkleman, D. and Oltrogge, D.L., "Twenty-five Years, more or less: Interpretation of the LEO Debris Mitigation 25-Year Post-Mission Lifetime Guideline," Paper AIAA-2010-7822, Toronto, Canada 3 August 2010.
39. Oltrogge, D.L., Kelso, T.S. and Seago, J.H., "Ephemeris Requirements for Space Situational Awareness," Paper AAS 11-151, 2011 Space Flight Mechanics Conference, New Orleans, LA, 14 February 2011.
40. Oltrogge, D.L. and Leveque, K., "An Evaluation of CubeSat Orbital Decay," 2011 CubeSat Workshop, Cal Poly University, 25 April 2011.
41. Oltrogge, D.L., "Know Your Space Population - Opportunities for More Effective Operations," 2011 Improving Our Vision SSA Conference, Luxemburg, 28 June 2011.
42. Oltrogge, D.L., "Space Data Actionability Metrics for SSA," 2011 Improving Our Vision SSA Conference, Luxemburg, 29 June 2011.
43. Oltrogge, D.L. and Alfano, S., "Determination of Orbit Cross-Tag Events and Maneuvers with Orbit Detective," Paper AAS 11-413, Girdwood AK, 1 August 2011.
44. Oltrogge, D.L. and Kelso, T.S., "Getting to Know Our Space Population from The Public Catalog," Paper AAS 11-416, Girdwood AK, 1 August 2011.
45. Oltrogge, D.L., "Maneuver Event Detection and Reconstruction Using Body-Centric Acceleration/Jerk Optimization," Paper AAS 11-578, Girdwood AK, 3 August 2011.
46. Oltrogge, D.L. and Leveque, K., "An Evaluation of CubeSat Orbital Decay," Paper SSC11-VII-2, 2011 Small Sat Conference, Logan UT, 2 August 2011.
47. Oltrogge, D.L., "User Requirements Analysis for Astro Standards," Presentation to the Committee for the Assessment of the U.S. Air Force's Astrodynamics Standards, National Research Council, 7 February 2012.

Oltrogge, D.L., Center for Space Standards and Innovation

27 May 2021

48. DalBello, R. and Oltrogge, D.L., "Managing Risk in Space," Federation of American Scientists Public Interest Report, 12 March 2012.
49. Finkleman, D. and Oltrogge, D.L., "Commercial Collaboration for Collision Avoidance and Flight Operations," SpaceOps 2012 Conference, Stockholm, Sweden, 29 May 2012.
50. Oltrogge, D.L., "SSA in Tag Clouds: SSA Improvements Using a Holistic Approach," 2012 AAS/AIAA Astrodynamics Specialist Conference, Minneapolis, MN, 14 Aug 2012.
51. Oltrogge, D.L. and Rashid, H., "Effective Strategies for Satellite Communications RFI Mitigation," ESTEL Conference, Rome, Italy, 22 October 2012.
52. Oltrogge, D.L., "Effective Strategies for RFI Mitigation," Satellite Interference Reduction Group, Dubai, 18 Nov 2012.
53. Kato, A., Lazare, B., Oltrogge, D., and Stokes, H., "Standardization by ISO to ensure the sustainability of space activities," ESA Space Debris, Darmstadt, Germany, 25 April 2013.
54. Smith, S. and Oltrogge, D., "Framework for Informed and Actionable SSA," Improving Space Operations Workshop, San Antonio, TX, 31 April 2013.
55. Oltrogge, D., "Debris Mitigation Strategies, Standards and Best Practices with Sample Application to CubeSats," Improving Space Operations Workshop, San Antonio, TX, 31 April 2013.
56. Oltrogge, D., Kelso, T.S., Alfano, Vallado and Griesbach, "Order-of-Magnitude Actionability Characterization for SSA," Improving Space Operations Workshop, San Antonio, TX, 31 April 2013.
57. Oltrogge, D.L., "Efficient Solutions of Kepler's Equation Via Hybrid and Digital Approaches," Paper AAS 14-228, Santa Fe, NM, 16 January 2014.
58. Oltrogge, D.L., "QB50 Proposed Deployment ConOps," Cal Poly CubeSat Workshop, 25 April 2014.
59. Houlton, Brendan and Oltrogge, Dan, "Commercial Space Operations Center (COMSPOC): A Commercial Alternative for Space Situational Awareness (SSA)," 30th Space Symposium, Technical Track, Colorado Springs, CO 21 May 2014.
60. Alfano, Sal and Oltrogge, Dan, "Volumetric Assessment of Encounter Probability," AIAA/AAS Astrodynamics Specialist Conference, San Diego, CA 8 August 2014.
61. Oltrogge, D.L. and Ramrath, J., "Parametric Characterization of SGP4 Theory and TLE Positional Accuracy," AMOS 2014, Maui HI, 11 September 2014.
62. Oltrogge, D.L., North, P. and Nicholls, M., "Multi-Phenomenology Observation Network Evaluation Tool (MONET)," AMOS 2014 SSA Conference, Maui HI, 11 September 2014.
63. Oltrogge, D.L., "Improving SSA with COMSPOC, Data Fusion and Best Practices," SSA Workshop, 17 November 2014.

64. Oltrogge, D.L., "Space Debris and Keeping It at Bay," Univ. of Maryland CODER Workshop, 19 November 2014.
65. Oltrogge, D.L., "COMSPOC Update and Operational Benefits," 31st Space Symposium, Colorado Springs, CO, 13-14 Apr 2015.
66. Oltrogge, D.L., "COMSPOC Overview," 21st Improving Space Operations Support Workshop, Pasadena CA, 5-6 May 2015.
67. Oltrogge, D.L., "Space Data Association and SDA Conjunction Assessment Services," 21st Improving Space Operations Support Workshop, Pasadena CA, 5-6 May 2015.
68. Oltrogge, D.L., "SDA EMI/RFI Mitigation Functions," 21st Improving Space Operations Support Workshop, Pasadena CA, 5-6 May 2015.
69. Oltrogge, D.L., "Improved CA via the Commercial Space Operations Center (COMSPOC)," 1st International Conjunction Assessment Workshop, Paris France, 19-20 May 2015.
70. Oltrogge, D.L., "Current State of Conjunction Monitoring for Satellite Operators and the Steps Forward," 1st International Conjunction Assessment Workshop, Paris France, 19-20 May 2015.
71. Alfano, Sal and Oltrogge, Dan, "Volumetric Encounter Analysis Enhancements," 2015 Astrodynamics Specialist Conference, Vail CO, AAS 15-581, 23 Aug 2015.
72. Oltrogge, D.L., "Improved SSA and RFI Mitigation via the Commercial Space Operations Center (COMSPOC)," International Space Traffic Management Discussion, FCC, 7 Aug 2015.
73. Oltrogge, D.L., "Space Monitoring Presentation: Improved SSA and RFI Mitigation via COMSPOC," ITU-invited informational briefing for World Radio Conference (WRC) 2015, Geneva Switzerland, 30 Nov 2015.
74. Oltrogge, D.L. and Braun, V., "Using Space Population Models to Generate Representative Space Object Catalogs," AAS 2016 Space Flight Mechanics conference, AAS 16-233, Napa CA, 16 Feb 2016.
75. Oltrogge, D.L., "The Myths and Realities of CubeSat Collision Risk," 2016 Spring CubeSat Developer's Workshop, California Polytechnic University, 23 April 2016.
76. Oltrogge, D.L., "Current SSA Realities and Improved SSA & RFI Mitigation via COMSPOC," SSA Panel, SpaceOps 2016 Conference, Daejeon, Korea, 18 May 2016.
77. Oltrogge, D.L., "The Myths and Realities of Rideshare Collision Risk, and What We Can Do About It," 2016 Small Payload Rideshare Symposium, Seattle WA, 7 June 2016.
78. Alfano, S. and Oltrogge, D.L., "Probability of Collision: Valuation, Variability, Visualization, and Validity," AAS/AIAA Astrodynamics Specialist Conference, Long Beach, CA, 13 September 2016.
79. Oltrogge, D.L. and Alfano, S., "Collision Risk in Low Earth Orbit," IAC-16, A6,2,1,x32763, 67th International Astronautical Congress, Guadalajara, Mexico, 26-30 September 2016.

Oltrogge, D.L., Center for Space Standards and Innovation

27 May 2021

80. Oltrogge, D.L., "Developing the New Orbit Comprehensive Message (CCSDS 502.0-B-2/ISO 26900 Orbit Data Message)," JSpOC SSA Operator's Workshop, Boulder, CO, 4 November 2016.
81. Oltrogge, D.L., "Realities and Myths of Small Satellite Collision Risk," JSpOC SSA Operator's Workshop, Boulder, CO, 5 November 2016.
82. Oltrogge, D.L., "Importance of Realistic Inputs in Collision Probability Valuation, Visualization and Validity," AGI's 2016 International User Conference, Rome, Italy, 16 November 2016.
83. Oltrogge, D.L., "Assessing Warning Rates and Collision Risk in LEO, and Why You Should Care," AGI's 2016 International User Conference, Rome, Italy, 17 November 2016.
84. Oltrogge, D.L., "Pushing toward a 200,000 Object Catalogue with COMSPOC: How, When, & Why," AGI's 2016 International User Conference, Rome, Italy, 18 November 2016.
85. Vallado, D.A. and Oltrogge, D.L., "Fragmentation Event Debris Field Evolution Using 3d Volumetric Risk Assessment," ESA Space Debris Conference, ESDC-17-738, Darmstadt, Germany, 24 April 2017.
86. Stokes, H., Bondarenko, A., Destefanis, R., Fuentes, N., Kato, A., LaCroix, A., Oltrogge, D.L., and Tang, M., "Status of The ISO Space Debris Mitigation Standards," ESA Space Debris Conference, ESDC-17-979, Darmstadt, Germany, 24 April 2017.
87. Oltrogge, D.L., "LEO Collision Risk," 2017 Spring CubeSat Developer's Workshop, California Polytechnic University, 27 April 2017.
88. Oltrogge, D.L., "The Commercial Space Operations Center (COMSPOC)," ITU Satellite Communication Symposium 2017, 29-30 May 2017, Bariloche, Argentina.
89. Oltrogge, D.L. and Vallado, D.A., "Application of New Debris Risk Evolution And Dissipation (DREAD) Tool to Characterize Post-Fragmentation Risk," 2017 Astrodynamics Specialist Conference, Stevenson WA, AAS 17-600, 22 August 2017.
90. Oltrogge, D.L., Alfano, S., Law, C., Cacioni, A. and Kelso, T.S., "A Comprehensive Assessment of Collision Likelihood in Geosynchronous Earth Orbit," IAC-17,A6,2,4,x39125, 2017 International Astronautical Congress, Adelaide, Australia, 26 September 2017.
91. Oltrogge, D.L., "An Abbreviated Comprehensive Assessment of Collision Risk in Geosynchronous Earth Orbit," Interference Reduction Group Annual Meeting, 24 October 2017, Brighton, UK.
92. Oltrogge, D.L. and Alfano, S., "Satellite Operator Safety-of-Flight State-of-Health," CNES CA Workshop, Paris, 8 November 2017.
93. Oltrogge, D., Johnson, T. and D'Uva, A.R., "Sample Evaluation Criteria for Space Traffic Management Systems," 1st IAA Conference on Space Situational Awareness (ICSSA), 13-15 November 2017, Orlando, FL, USA.

94. Alfano, S. and Oltrogge, D.L., "Full Characterization of Satellite Conjunction Walk-ins," AAS Space Flight Mechanics Conference, 8 January 2018, Orlando, FL.
95. Oltrogge, D.L., "International Standards Landscape Addressing End-of-Life Phase," European Workshop on Satellite End-of-Life, CNES Headquarters, Paris France, 25 January 2018.
96. Berry, D.S., and Oltrogge, D.L., "The Evolution of the CCSDS Orbit Data Messages," The 15th International Conference on Space Operations, Marseilles, France, 28 May 2018.
97. Oltrogge, D.L., "The "We" Approach to Space Traffic Management," The 15th International Conference on Space Operations, Marseilles, France, 28 May 2018.
98. Oltrogge, D.L., "Regulatory evaluation of a large constellation: The SpaceX case study," Defence Satellites 2018, Eutelsat, Paris France, 5 June 2018.
99. Oltrogge, D.L., "Marshalling Space Traffic Management requirements and expectations in the international context" Security in Outer Space: Rising Stakes for Civilian Space Programmes, European Space Policy Institute Autumn Conference, 28 September 2018.
100. Oltrogge, D.L., "Announcement of GVF space industry-led endorsement of best practices for sustainable space activities," International Astronautical Congress, Bremen Germany, 2 October 2018.
101. Kelso, T.S., and Oltrogge, D.L., "The Need for Comparative SSA," IAC-18-A6.7.8, International Astronautical Congress (IAC), Bremen, Germany, 1-5 October 2018.
102. Oltrogge, D.L., "Commercial Development of Best Practices for the Sustainability of Space Operations," Reinventing Space Conference, London, 31 October 2018.
103. Oltrogge, D.L., "Commercial Development of Best Practices for the Sustainability of Space Operations," Space Commerce Conference and Exposition (SpaceCom), Houston, TX USA, 27 November 2018.
104. Oltrogge, D.L., Yamato, G. and Rashid, H., "Addressing Small Satellite Communications Issues," Latin America CubeSat Workshop, Ubatuba, Brazil, 3 December 2018.
105. Oltrogge, D.L., "International Organization for Standardization (ISO) activities for long-term space sustainability," UN COPUOS STSC, Vienna, Austria, 13 February 2019.
106. Oltrogge, D.L. and Cooper, J.A., "Practical considerations and a realistic framework for a Space Traffic Management system," 18th Australian Aerospace Congress, Melbourne, Australia, 24-28 February 2018.
107. Oltrogge, D.L., "International Aspects of Space Traffic Management," 2019 Space Traffic Management Conference, Austin, Texas, 26-27 February 2019.
108. Oltrogge, D.L., "Space Standards at the ISO Level," ESA-ECSL Space Debris Workshop: Regulation, Standards and Tools, 20 March 2019, Darmstadt, Germany.

Oltrogge, D.L., Center for Space Standards and Innovation

27 May 2021

109. Oltrogge, D.L., "The GVF Best Practices for Space Sustainability Document," ESA-ECSL Space Debris Workshop: Regulation, Standards and Tools, 20 March 2019, Darmstadt, Germany.
110. Oltrogge, D.L. and Vallado, D.A., "Debris Risk Evolution And Dispersal (DREAD) for Post-fragmentation Modeling," 2019 Hypervelocity Impact Symposium, Destin, FL, USA, 14-19 April 2019.
111. Oltrogge, D.L., "Practical Considerations for Space Traffic Management," 10th IAASS Conference, El Segundo, CA 15-17 May 2019.
112. Oltrogge, D.L., Kelso, T.S. and Carrico, T., "Characterizing the India ASAT Debris Evolution Using Diverse, Complementary Tools," AAS 19-889, AAS/AIAA Astrodynamics Specialist Conference, Portland, ME, August 2019.
113. Oltrogge, D.L., "Role of standards in satellite servicing," Global Satellite Servicing Forum, Arlington, VA, 1 October 2019.
114. McKnight, D., Oltrogge, D.L., Alfano, S., Shepperd, R., Speaks, S. and Macdonald, J., "The cost of not doing debris remediation," IAC-19,A6,2,7,x48725, 70th International Astronautical Congress, 22 October 2019, Washington, D.C.
115. H. Stokes et al, "Evolution of ISO's Space Debris Mitigation Standards," International Orbital Debris Conference, 12 December 2019.
116. Oltrogge, D.L. and Christensen, I.A., "Space Governance in the New Space Era," International Orbital Debris Conference, 12 December 2019.
117. Alfano, S., Oltrogge, D.L., and Shepperd, R., "LEO constellation encounter and collision rate estimation: An update," 2nd IAA Conference on Space Situational Awareness, IAA-ICSSA-20-0021, 14 January 2020.
118. North, P., Zimmer, P., Kelso, T.S., Oltrogge, D.L., Hall, R., and Cooper, J., "SSA degradation from large constellations: A Starlink-based case study," 2nd IAA Conference on Space Situational Awareness, 14 January 2020.
119. Oltrogge, D.L., "The Space Safety Coalition in the context of international space cooperation," United Nations Committee for the Peaceful Use of Outer Space (UN COPUOS) Science and Tech Subcommittee (STSC), 5 February 2020, Vienna, Austria.
120. Oltrogge, D.L., Kelso, T.S., North, P. and Zimmer, P., "SSA degradation from large constellations: a Starlink-based case follow-on study," IAA-UT-STM-02-07, IAA-UT Space Traffic Management Conference, 19-20 February 2020.
121. Daley, M., Stillwell, R., Wauthier, P., Oltrogge, D., Kelso, TS, Jah, M., and Nield, G., "Space Traffic Coordination and Management Special Session," AIAA ASCEND Conference, 21 October 2020.

U.S. GOVERNMENT TESTIMONY



1. Oltrogge, D.L., "CubeSat Orbital Debris Policy Solutions and SSA," Committee on Achieving Science Goals with CubeSats, National Academy of Sciences, Engineering and Medicine, Washington DC, 30 Oct 2015.
2. Oltrogge, D.L., "Space Situational Awareness: Key Issues in An Evolving Landscape," House Subcommittee on Space and Aeronautics, 11 February 2020, 2318 Rayburn House Office Building.
3. Stillwell, R., Jah, M., Oltrogge, D.L., and Nield, G., "AIAA STM Working Group Discussion with Senate Commerce Committee Staff," 8 April 2020.
4. Stillwell, R., Jah, M., Oltrogge, D.L., and Nield, G., "AIAA STM Working Group Discussion with House SST Staff," 8 April 2020.

KEYNOTES/COLLOQUIA

1. Oltrogge, D. L., "GSOC Colloquium: Collision Avoidance in Space," German Space Operations Center, Oberpfaffenhofen, Germany 29 Sept 1999.
2. Oltrogge, D.L., "Covariance-Based Mission Operations," Stanford University and Naval Post-Graduate Engineering Schools, April 2000.
3. Oltrogge, D.L., "University of Michigan Colloquium: Space Operations," Ann Arbor, MI, 4 Apr 2012.
4. Oltrogge, D.L., "COMSPOC: The Commercial Solution for Space Situational Awareness (SS)," ASOPS class lecture, 9 July 2014.
5. Oltrogge, D.L., "Space is a Dangerous Place," Space Vision 2014 Conference, Univ. North Carolina, 31 October 2014.
6. Oltrogge, D.L., "Space Debris Seminar," University of Southampton, Southampton, UK, 10 February 2017.
7. Oltrogge, D.L., "Conjunction Junction: A Space Debris Seminar," Pentagon, 16 May 2017.
8. Oltrogge, D.L., "Space Debris Risk and Mitigation Options," Seminar to students of Politecnico di Milano, 22 Mar 2018, Milan, Italy.
9. Oltrogge, D.L., "Ideal mix of treaties, guidelines, regulations and industry best practices for space sustainability," 8th Satellites End of Life and Sustainable Technologies Workshop, 22-23 January 2020, CNES, Paris, France.
10. Oltrogge, D.L., "The Space Safety Coalition in the context of international space cooperation," U.S. Mission to UN, 5 February 2020, Vienna, Austria.
11. Oltrogge, D.L., "Dodging Debris: Space Traffic Coordination and Management," Secular Hub, Guest lecture, 17 October 2020.

INVITED PANELIST/SPEAKING ENGAGEMENT

1. Oltrogge, D.L., "Aerospace Collision Avoidance Activities," Center for Orbital Reentry and Debris Studies (CORDS) Technical Forum, The Aerospace Corporation, 1-3 November 2000.
2. Oltrogge, D.L., "Space Debris Observation Needs for Actionable SSA," Panel Presentation, 2011 AMOS SSA Conference, Maui, HI, 15 September 2011.
3. Oltrogge, D.L., "Defining the Space Traffic Management Problems – Why Finding a Solution is Exceedingly Complicated," Federal Communications Bar Association Continuing Legal Education on Space Traffic Management, 4 April 2018.
4. Oltrogge, D.L., "Space Traffic Management Lessons Learned and Suggested Solutions," Spring 2018 Meeting Of The Aeronautics And Space Engineering Board, Focus Session on Orbital Debris," 1 May 2018.
5. Oltrogge, D.L., "Protecting DoD COMSATCOM in our challenging space environment," COMSATCOM Mission Assurance Panel, DoD SATCOM Conference 2018, Alexandria, VA, 12 December 2018.
6. Oltrogge, D.L., "India ASAT intercept characterization," AIAA-Los Angeles/Las Vegas New Space mini-conference, Hawthorne Memorial Center, 6 April 2019.
7. Oltrogge, D.L., "Sustainability of LEO: interference and deorbit assurance," US Chamber of Commerce Small Satellite Workshop, 9 July 2019.
8. Oltrogge, D.L., "Space Traffic Management and Space Situational Awareness," Association of Space Explorers XXXII Congress, Rice University, Houston, Texas USA, 17 October 2019.
9. Oltrogge, D.L., "Characterization of global space governance," IAC 2019 Special Session: "Space Traffic Management: Working Together to Enhance Safety and Sustainability," 23 October 2019.
10. Oltrogge, D.L., "Addressing Space Traffic Management at Multinational, national and industry levels," World Space Forum, 22 November 2019.
11. Oltrogge, D.L., "Knowledge and monitoring of the space environment via commercial means," European Union Ad-Hoc Seminar on Security, Safety, Sustainability: Promoting Good Behavior in Outer Space, 9 December 2019.
12. Oltrogge, D.L., "The Space Safety Coalition in the context of international space cooperation," ANSI Commercial Space Industry Standardization Coordination Meeting, Washington, D.C., 31 January 2020.
13. Oltrogge, D.L., "How the commercial industry can help with LTS implementation," Secure World Foundation, Panel on LTS Guideline Implementation, 5 February 2020.
14. Oltrogge, D.L., "Space Debris Coordination: What is Needed to Realize Space Policy Directive 3 ?," Satellite 2020 Government and Military Forum, 10 March 2020.
15. Oltrogge, D.L., guest of The Space Show hosted by Dr. David Livingston, 20 March 2020.

16. Oltrogge, D.L., COMSPOC SSA & STCM Capabilities, IAF Space Security Committee Meeting, 23 March 2020.
17. Oltrogge, D.L., "Incentivizing compliance with orbital debris measures," The Aerospace Corporation's Space Policy Show, 27 May 2020.
18. Oltrogge, D.L., "Space Safety Coalition aspirational best practices," Astroscale web event regarding FCC Rules and Orders for Space Debris mitigation, 23 April 2020.
19. Oltrogge, D.L., "ISO standards for orbital debris mitigation," CONFERS workshop, 19 May 2020.
20. Oltrogge, D.L., "Steps industry can take to address long-term sustainability of space activities," Secure World Foundation, Capacity-building for space sustainability, 23 July 2020.
21. Oltrogge, D.L., "Space flight safety: Looking back at the past decade, looking ahead at the next five years," Secure World Foundation Webinar, 29 July 2020.
22. Oltrogge, D.L., "Space safety coalition: space industry's contributions to sustainability," Rand Responsible Space Behavior Workshop, 2 September 2020.
23. Oltrogge, D.L., "The Space Data Center's decade of Safety of Flight Services: Contributions to Space Traffic Management," AMOS Conference Spotlight Session, 3 September 2020.
24. Oltrogge, D.L., "AMOS Dialogue: S&T priorities for improving SSA and STM, 21 September 2020.
25. Oltrogge, D.L., "Update on 2020 STCM-relevant standards and industry best practices," 2020 International SSA Data Operator Exchange Workshop, AMOS conference, 22 September 2020.
26. Oltrogge, D.L., "Space industry contributions to a holistic approach to space governance," Space Information Sharing and Analysis Center (Space ISAC) Summit, 16 October 2020.
27. Oltrogge, D.L. et al, "Space Traffic Coordination and Management Demonstration," Gnosis SSA Data Management Workshop, 4 November 2020.

SOFTWARE DEVELOPMENT EXPERIENCE

Created many software tools to perform multi-discipline engineering analyses, including:

1. **EMTR_RF**, software and utilities I wrote to process a 200,000-emitter worldwide database & compute RF environment experienced by launching and/or on-orbit vehicles;
2. **SPIN** – "Special Perturbations Integration" S/W to integrate orbit and attitude (6 DoF).
 - High fidelity orbit integration, including a blowdown propulsion model;

- High fidelity attitude integration, (magnetic torquing, ring-dampers, aero torquing);
 - Ground station contacts with refraction and obscurae;
 - Relative motion and collision assessment;
 - Oltrogge, D.L., "User's Guide to the 6-D SPIN Program," 15 November 1991.
3. **OPUS** – Orbit Propagation and Utility Software.
- Optimal maneuver reconstruction and orbit/covariance propagation;
 - 'Eigenmorphing,' the 'morphing' of error covariances between known event times to best represent error growth/dynamics during periods of unknown perturbations;
 - Covariance-based antenna scanning and search/acquisition plans;
 - Export of ephemerides, facilities and satellite data for import into STK;
4. **Collision Vision** – I was the project leader in the creation of the official DoD/National launch collision avoidance toolset.
5. **BSPACE, BLINE** – Original programmer and algorithm team member for the system-of-systems constellation performance assessment tool suite, adopted in the NRO's Director's Demo Tool and used for systems constellation performance assessments for many programs of national significance.
- Very fast, accurate constellation performance metrics which facilitate optimization;
 - Digitized collector satellite and relay supply times versus on-ground requirements;
 - Probability of Cloud Cover (PCC) using NCAR 10-year climatological model;
 - Conceived & implemented "Valley Fill" optimal accommodation algorithm;
6. **LIMEAWAY** – Created operational satellite attitude selection program.
- Created digitized attitude representation of higher resolution than the similar implementation in STK attitude model in use today;

- Used innovative bitmasks to store time-varying constraint violation data;
 - Integrated power, thermal & orbit disciplines into single spacecraft systems model;
7. **RF Interference** – Created Radio Frequency Interference modules for Collision Vision.
- Carrier over Noise + Interference; detailed 3-D antenna models.
8. **Benchmark/STK/Qualnet (BSQ) Program Interface** – Co-developing joint simulation environment program which will interface between Benchmark, STK & Qualnet S/W.
- Defined object classes to contain missile, network, event, radar and C2BMC objects;
 - Devised recursive object structure to hold missile parent/child relationships;
9. **“DEBris Breakup from Impact of Engagement (DEBBIE)** – Implemented impact equations based on empirical NASA Evolve and ESA breakup models.
- Interfaces with STK; Conserves mass as well as linear and kinetic energy;
10. **“Computation of Aero-vehicle Ephemeris Subject to Aerodynamic Reactions (CAESAR)**
–Airship flight 6DoF model incorporating rudimentary thruster control laws.
- Incorporates winds aloft based upon random draws of historical data;
11. **“QPROP” Orbit Lifetime Model** – Implements Gaussian Quadrature for orbit decay due to atmospheric drag, Solar Radiation Pressure and 3rd-body perturbations.
- Highly efficient propagator; used in development of ISO Orbit Lifetime standard;
12. **AstroHD Digital Astrodynamics Framework** – Implements a high-precision, memory-mapped (dense) equal angles distribution framework. Framework permits increases in computations and storage by up to 45%. Developed and proved framework utility by implementing a digital gravity model, realizing >600% increase in speed for the same accuracy and also facilitating tremendous orbit propagation accuracy improvements.
- Can store any three-dimensional data;
 - Excellent way to discretize fragmentation events and maintain physics laws.

13. **“DistroND” Statistical Distribution and Stochastic Framework** – Implements a framework (again memory-mapped) to permit the extensive statistical examination of multivariate relationships for billions of data points. Permits stochastic modeling upon population of the framework.

- When coupled with the AstroHD framework, permits stochastic propagation;
- Applied extensively to characterize atmospheric weather;
- Natural characterization of collision threat parameters and close approach geometries.

14. **“Winds at High Altitude Modeling” (WHAM)** – Stochastically simulates the winds as they effect aerostats, airships and UAVs.

- Permits very rapid simulation of thousands of potential air platform trajectories.

15. **“Analysis and Visualization for Orbit Insertion Deconfliction” (AVOID)** – Comprehensive and efficient Launch Collision Avoidance (LCOLA) assessment tool.

- Fast runtime;
- Simultaneously assesses both miss distance-based and probability-based thresholds.
- Avoids numerous shortcomings introduced by discretization sampling approaches commonly used.
- Provides graphical output of underlying topologies.

