David Gerhardt, PhD

Systems Engineer

Mission-driven technical leadership with end-to-end experience

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Education

May 2014 — Ph.D., "Small Satellite Passive Magnetic Attitude Control," Aerospace Engineering Sciences, University of Colorado at Boulder

Dec. 2011 — M.S., Aerospace Engineering Sciences, University of Colorado at Boulder

May 2008 — B.S., Aerospace Engineering, Virginia Polytechnic Institute and State University

Work Experience

1/2019 – present — **First Mode**, Seattle, Washington
Principal Systems Engineer

Lead Systems Engineer for projects decarbonizing ultra-class (500 tonne) Haul Trucks

- Lead SE for world's first zero-emission ultra-class Haul Truck. This proof of concept used a 2 MW powerplant (800 kW of hydrogen fuel cells + 1.05 MWh of battery) to provide for propulsive + ancillary loads. The truck supplemented haulage at the Mogalakwena platinum mine in South Africa for over a year.
  - Carried design from paper study through truck operation in an active mine env.
  - With customer, continually validated balance of schedule vs. performance vs. risk
  - Worked across functional teams to find minimum requirements set
  - Established technical documentation set incl. reqs / budgets / conops / P&IDs
  - Owned fault architecture & behaviors; worked with SW team to implement & verify
  - Owned real-time engineering display to quickly identify & resolve complex issues
  - Led powerplant- and truck-level verification test campaigns, culminating in loaded hill climb & dump demonstration for hundreds of journalists, politicians, and VIPs
- Lead SE for next generation of zero-emission ultra-class Haul Trucks (in progress)
  - Carried design from initial concepts through verification test campaign
  - Represent truck for teams developing test facilities & refueling station

3/2018 – 12/2018 — **Orbital Wisdom LLC**, Seattle, Washington
Founder / Consultant

Systems engineering and ADCS development to support space missions

- Requirements decomposition & tool development for Blue Moon lunar lander
- Operational ADCS support for 6U CubeSat: UKF tuning & real-time TLE estimation

10/2016 – 2/2018 — **Planetary Resources, Inc.**, Redmond, Washington
Principal Systems Engineer

Systems engineering, mission design, and technical leadership for space missions

- Lead Systems Engineer for a commercial asteroid resource exploration mission
  - Provided technical leadership from initial objectives to pre-PDR
  - ConOps / trajectory analysis for single-launch, multi-probe deep-space mission
  - Led requirements elicitation & analysis across functional teams
- Launch and Early Operations Phase (LEOP) development for Arkyd-6 6U CubeSat

3/2014 – 4/2016

GomSpace A/S, Aalborg, Denmark
Systems Engineer

Lead Systems Engineer for three nanosatellite missions at various project phases

- GOMX-3 (3U), the first ESA In-Orbit Demonstration CubeSat (success)
  - Carried design from statement of work to in-orbit operations
  - Developed and maintained requirements, budgets, technical analysis, etc.
  - Defended design by leading multiple reviews with ESA mgmt. & contractors
  - Led configuration, integration, testing, and operation of EM & FM satellite models
- SEAM (3U) an FP7-funded scientific CubeSat (lost at launch)
  - Carried design from statement of work through integration & test
  - Coordinated between 8 international companies to develop coherent design
- GOMX-4A/B, sister ESA / Danish 6U CubeSats (success)
  - Carried design from Statement of Work through PDR
  - Adapted 3rd party prop. module to in-development internal 6U platform
  - Mentored student intern in system engineering role over 6 month period

8/2009 – 1/2014

University of Colorado, Boulder, Colorado
Systems Engineer

Led 60+ students through the creation and operation of CSSWE, a 3 kg satellite for space weather investigation. The satellite surpassed all mission goals and made science measurements for 438 days, nearly 5× the full mission success duration.

- Lead Systems Engineer from proposal through in-orbit operations
- Developed and maintained requirements, technical budgets, and risk analysis
- Designed, implemented, and tested Passive Magnetic Attitude Control system
- Planned & executed integration and system testing incl. day-in-the-life, calibration, end-to-end communication, TVAC, and vibe
- Created & maintained autonomous commanding system for UHF ground station
- Designed an Extended Kalman Filter for attitude determination of a PMAC satellite
- Oversaw ground operations and performed anomaly analysis & correction

Professional Service

2017 – 2020	Advisor to the first Guatemalan satellite university team Quetzal-1
Aug 2017	Judge for AAS/AIAA Astrodynamics Specialist Conference Student Competition
June 2017	Reviewer for University of Washington's DUBSAT-1 CubeSat PDR
2016	Reviewer for IEEE Transactions on Aerospace and Electronic Systems
2011 – 2013	AP Calculus Tutoring
2007 – 2008	Vice President, Sigma Gamma Tau Aerospace Honor Society at Virginia Tech

Engineering Tenets

These beliefs, accrued throughout my career, are core to how I operate as engineer.

1. **Involve thy customer.** The customer is useful to prevent wasted effort on unnecessary development. I will regularly check-in with the customer to ensure performance / quality / cost / schedule are balanced according to their priorities.
2. **Words matter.** Words are the best method we have to program humans; having a shared technical language is critical to getting the job done. I lean towards the pedantic in explicitly defining & agreeing upon language.
3. **Communication is a responsibility.** Every engineer has a responsibility to communicate their approach so that others can review it; this is critical to uncovering issues. I will ask you where that info is written down.
4. **Keep it Simple Stupid.** Simple is often best. I will start from a simple design / model / test / etc, and look for ways to simplify wherever possible.

5. **Everything is quantifiable.** Decisions can be made based on math rather than feelings. I strive to translate high-level language into numbers to justify decisions.
6. **Garbage in = Garbage out.** Results are only as good as the inputs & process they depend on. I will question your sources of information and ask why we trust each source.

Favorite Tools

- MATLAB / Simulink
- Excel
- Systems Tool Kit (STK) / NASA GMAT
- Linux (vim > emacs)
- git
- CAD (SolidWorks > Inventor)
- Python
- C/C++
- LabVIEW
- LaTeX

Journal Articles

1. X. Li, S. Palo, R. Kohnert, **D. Gerhardt**, L. Blum, Q. Schiller, D. Turner, W. Tu, N. Sheiko, and C.S. Cooper. "Colorado Student Space Weather Experiment: Differential flux measurements of energetic particles in a highly inclined low Earth orbit" in Dynamics of the Earth's Radiation Belts and Inner Magnetosphere, *Geophys. Monogr. Ser.*, Vol. 199, edited by D. Summers et al., 385–404, AGU, Washington, D.C., 2012, doi: 10.1029/2012GM001313
2. X. Li, S. Palo, R. Kohnert, L. Blum, **D. Gerhardt**, Q. Schiller, and S. Califf, "Small Mission Accomplished by Students – Big Impact on Space Weather", *Space Weather*, Vol. 11, 2013, doi: 10.1002/swe.20025
3. X. Li, Q. Schiller, L. Blum, S. Califf, H. Zhao, W. Tu, D.L. Turner, **D. Gerhardt**, S. Palo, S. Kanekal, D.N. Baker, J. Fennell, J.B. Blake, M. Looper, G.D. Reeves, and H. Spence, "First Results from CSSWE CubeSat: Characteristics of Relativistic Electrons in the Near-Earth Environment During the October 2012 Magnetic Storms", *J. Geophys. Res. Space Physics*, Vol. 118, 2013, doi: 10.1002/2013JA019342
4. **D. Gerhardt**, S. Palo, Q. Schiller, L. Blum, X. Li, and R. Kohnert, "The Colorado Student Space Weather Experiment (CSSWE) On-Orbit Performance", *Journal of Small Satellites*, Vol. 3, No. 1, 2014.
5. **D. Gerhardt** and S. Palo,"Volume Magnetization for System-Level Testing of Magnetic Materials within Small Satellites", *Acta Astronautica*, Vol. 127, 2016. doi: 10.1016/j.actaastro.2016.05.017
6. S. Nag, J. Rios, **D. Gerhardt**, and C. Pham, "CubeSat Constellation Design for Air Traffic Monitoring", *Acta Astronautica*, Vol. 128, 2016, doi: 10.1016/j.actaastro.2016.07.010
7. K. Zhang, X. Li, Q. Schiller, **D. Gerhardt**, H. Zhao, and R. Millan, "Detailed characteristics of radiation belt electrons revealed by CSSWE/REPTile measurements: Geomagnetic activity response and precipitation observation", *J. Geophys. Res. Space Physics*, Vol. 122, 8434–8445, 2017, doi: 10.1002/2017JA024309
8. G. Nies, M. Stenger, J. Krcl, H. Hermanns, M. Bisgaard, **D. Gerhardt**, B. Haverkort, M. Jongerden, K. Larsen, and E. Wognsen, "Mastering Operational Limitations of LEO Satellites - The GOMX-3 Approach", *Acta Astronautica*, 151, 726 - 735, 2018, doi: 10.1016/j.actaastro.2018.04.040