David Gerhardt, PhD

Systems Engineer

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

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Work Experience

2019.01 – 2024.08

First Mode, Seattle, Washington
Principal Systems Engineer

Engineering Leader for projects decarbonizing ultra-class (500 tonne loaded) 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 replace the Diesel Genset & 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
  - 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 customer-focused Fuel Cell Electric Vehicle retrofit product
  - Carried design from initial concepts through verification test campaign
  - Delegated ownership of Controls, Engineering Display, and requirements
  - Managed interface to manufacturing, test facilities, bizdev, and company leadership
- Technical Lead for customer-focused Hybrid Electric Vehicle retrofit product
  - Carried design from initial concept through verification test campaign
  - Negotiated system requirements with customer product representative
  - Served as technical authority managing significant design evolution
  - Defended design & incorporated feedback to obtain OEM letter of support

2018.03 – 2018.12

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

2016.10 – 2018.02

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

2014.03 – 2016.04 **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

2009.08 – 2014.01 **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

Education

2014.05 Ph.D., "Small Satellite Passive Magnetic Attitude Control,"
Aerospace Engineering Sciences, University of Colorado at Boulder

2011.12 M.S., Aerospace Engineering Sciences, University of Colorado at Boulder

2008.05 B.S., Aerospace Engineering, Virginia Polytechnic Institute and State University

Professional Service

2017 – 2020	Advisor to the first Guatemalan satellite university team Quetzal-1
2017.08	Judge for AAS/AIAA Astrodynamics Specialist Conference Student Competition
2017.06	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

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. **(Almost) 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
- JAMA
- 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