

# RICHARD S. BLOMQUIST, PhD

Denver, CO 80237 • [www.richardblomquist.com](http://www.richardblomquist.com) • 412-580-6083 • [rblomquist6@gmail.com](mailto:rblomquist6@gmail.com)

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## ROBOTICS, AEROSPACE, AND MECHANICAL ENGINEER

Experience in NASA, industry and academia creating cutting-edge electromechanical systems. Known for innovative design concepts and insightful analysis, geared toward solving the most difficult technical challenges. Able to rapidly execute tasks and mobilize forces. Consistently focused on the needs of the customer. Cognizant of all aspects of a project, with the goal of system-wide optimization. Desires work that changes the world.

Robotics	System Design, Fab, Assy & Test	Computational Modeling
Multidisciplinary Engineering	Mechanical Hardware & Processes	Proposal Writing
Mechatronic Systems	Project Leadership	GD&T

**Languages and Packages:** Matlab, Mathematica, Python, Fortran, SolidWorks, NASTRAN, Femap, ADAMS, Autolev

## PROFESSIONAL EXPERIENCE

### Contractor, Mechanical Engineering

**2017 to Present**

Conducted structural finite element analysis of state-of-the-art opto-mechanical systems for aerospace customers using Femap and NASTRAN. Developed redesign concepts and generated reports.

### Senior Aerospace Engineer

**2016 to 2017**

Altius Space Machines, Inc., Broomfield, CO

Robotics. Solar Sails. Centripetally stabilized space system expert

- Team leader, electromechanical systems, overseeing multidisciplinary team developing robotic hardware and communications systems for the space launch industry
- Program Manager -- Heliogyro system design, analysis, fabrication and proof of concept testing. Environmental qualification testing.

Principal Investigator of NASA SBIR entitled, "Solar Cube 2U: A Heliogyro Propulsion System for CubeSats", generating blade assembly hardware, testing deployment and pitch actuation.

Mentor, directing interns on an internal R&D robotics project for possible implementation on the International Space Station.

### Researcher, Heliogyro Solar Sail and Planetary Rovers

**2009 to Present**

Collaboration with Altius Space Machines, Broomfield, CO, Red Canyon Engineering & Software, Denver and Space Dynamics Laboratory (Utah State University), Logan, UT

- World-leading expert of heliogyro dynamics and heliogyro spacecraft designs.
- Derived 3D analytical models of heliogyro rotor blades that enable a broad array of NASA solar sail missions. Structural dynamics, loads, pitch control algorithms computed and validated, comparing computational analysis with test performance data. Generated own computer code for the analysis. The accuracy and completeness of the models surpasses other existing work on the subject.
- Program Manager, Solar Cube Project, Red Canyon Team leader, NASA Cube Quest Challenge. Assembled a team for leading edge spacecraft development, to flight-verify an advanced heliogyro propulsion system. Developed mission concept. Organized the work plan, schedule, and budget. Negotiated workforce delegation. NASA SBIR proposal author. Space Act negotiator for NASA facility use.
- Generated a CubeSat spacecraft design for Solar Cube. Oversaw prototype design and fabrication, as well as the heliogyro ground test validation method, procedure, hardware/sensor/motor selection, and operations

- Recruited and teamed with Space Dynamics Laboratory (USU) for flight validation proposal. Developed mission concept, conducted analysis. Proposal author.
- Generated advanced spacecraft designs and simulations that open up otherwise inaccessible solar system locations for exploration.
- Dissertation and Master's thesis currently referenced by NASA.
- Pursuing multiple international patents

**Contractor, Mechanical Engineering**

**2014 to 2015**

Red Canyon Engineering & Software, Denver, CO

- As a subcontractor, conducted design, stress analysis, structural dynamics analysis, thermal analysis, and solder fatigue analysis of a single board computer/H frame assembly, using SolidWorks and NASTRAN. Generated drawings using AMSE Y14.5 GD&T, supported design reviews, and designed support hardware. Responsible for vibration testing, including test procedure generation, post-test reporting.

**Cognizant Engineer, Deployment Systems**

**1990-1995, 2001**

Jet Propulsion Laboratory, Pasadena, CA

- Complete responsibility from concept to delivery of spacecraft deployment systems. Accomplished design, analysis, fabrication, assembly, testing and documentation of deployment hardware, negotiating requirements and interfaces, presenting design reviews, while maintaining schedule and \$1.6M budget.
- Successfully developed the Alpha Proton X-Ray Spectrometer Deployment Mechanism (ADM), an anthropomorphic arm and wrist mounted on the NASA Sojourner Rover. The ADM operated flawlessly, positioning the instrument on 15 Martian rock and soil locations. Received the National Space Act Board award.
- Designed the set of deployment mechanisms for the NASA Scatterometer (NSCAT), which correctly deployed six stick antennas within extremely tight tolerances on Japan's ADEOS spacecraft in low Earth orbit. Precise placement allowed NSCAT to measure 268,000 near-surface wind vectors over global oceans each day.
- As a member of the Galileo high-gain antenna anomaly tiger team, rapidly created a 700 degree-of-freedom dynamic model of the antenna and replicated the cause of the anomaly, thus playing a key role in determining the cause of the failed antenna deployment on the billion dollar spacecraft and helping to save the mission.
- Other special assignments
  - Mechanical design representative to Mars Pathfinder Science Team;
  - Dynamics analyst for Topex/Poseidon GPS antenna, verifying design and preventing rework;
  - Shroud, container venting analyst on NSCAT, Cassini, TIMI projects.
- In 2001, recruited as an expert from academia to participate on an advanced concepts solar sail team for a mission to the Heliopause.

**Project Manager**

**1999-2001, 2006**

Robotics Institute, Carnegie Mellon University, Pittsburgh, PA

- Project manager, Solar Blade Solar Sail project.
- Led a team, including a dozen students, in the technical development, analysis, and fabrication of a mechanical prototype.
- Generated a mission plan, reviewed and approved by the Aerospace Corporation, for a space demonstration.
- Raised over \$250,000 for the project from military, public, and private sources.
- Created a strong presence in the solar sail community.
- Recruited by NASA to review solar sail proposals.

**Supervisor, Icebreaker Lunar Rover project**

- In 2006, supported a student-run effort to develop and test a rover for work on the moon. Proposal writer.

**Consultant** 2001

Redzone Robotics, Pittsburgh, PA

- Demonstrated conceptual feasibility of an autonomous motorcycle for military use.
- Generated a preliminary design layout, trade-off study, and power plant investigation.

## EDUCATION

### **Doctor of Philosophy in Robotics, Carnegie Mellon University**

Dissertation: Heliogyro Control

Project Manager, Solar Blade Solar Sail Project

Design Lead, Polaris Lunar Rover student project

Lead Writer, Discovery Proposal, Nexus lander/rover mission to Nereus

Teaching Assistant, Lunar Rover Course

Pertinent Coursework: Computer Vision, Lunar Rover Design

### **Master of Engineering in Bioengineering, University of Utah**

Whitaker Fellow

Teaching Assistant for Bioengineering Lab, using LabVIEW, oscilloscopes, other electrical bench instruments to develop op-amps, filters, data acquisition systems, sensors, etc. The resultant breadboards were used for heart rate monitoring, EMG analysis, incontinence monitoring, and other projects.

Pertinent Coursework: Introduction to Robotics, Robot Calibration I & II, Robot Manipulators, Analog & Digital Bioinstrumentation, Biomechanics I & II, Bioengineering Lab, Classic Controls, State-Space Controls, Digital/Analog Interfaces

Developed a unique laser-enabled calibration method for a PUMA robot.

### **Master of Science in Aeronautics & Astronautics, Massachusetts Institute of Technology**

Emphasis: Space systems design

Thesis: Optimal Design of a Heliogyro Solar Sail for Earth Orbit Escape

Draper Fellow, C. S. Draper Laboratory . FEA, structural modeling, thermal and dynamic analysis of space systems using NASTRAN, PATRAN, and FORTRAN.

Pertinent Coursework: Finite Element Analysis, Advanced Mathematics, Satellite Engineering, Advanced Flight Dynamics & Control

### **Bachelor of Science Honors in Mechanical Engineering, Cum Laude, University of Utah**

Minor: Japanese

Emphasis: Aeronautics

Honors Thesis: Design of a Drug Enforcement Interceptor Aircraft

Letterman in Track and Cross-Country. 5-time All WAC student-athlete

Pertinent Coursework: Electronics & Instrumentation, Numerical Analysis, Engineering Mathematics, Mechanisms, Machine Design

## PUBLICATIONS

- *Solar Cube: A Heliogyro Propulsion System for CubeSats*, Fourth International Symposium on Solar Sailing, 2017, Kyoto, Japan, January 17<sup>th</sup>-20<sup>th</sup>, 2017.
- Heliogyro Control, PhD Dissertation, Carnegie Mellon University, 2009.

- Developments of Solar Blade Solar Sail, SSI High Frontier/Space Manufacturing Conference XV, May, 2001.
- Solar Blade Nanosatellite, SSI High Frontier/Space Manufacturing Conference XIV, May, 1999.
- Icebreaker Lander and Rover Design for Lunar Ice Exploration, 2003, ANS 8th Intl. Topical Mtg. on Robotics & Remote Systems, April 25-29, 1999.
- A Benign, Automatically Resetting Rotary Release Mechanism Utilizing A Low-Temperature-Melting Alloy, NASA Tech Brief NPO 19579, February, 1996.
- The Alpha-Proton-X-Ray Spectrometer Deployment Mechanism -- An Anthropomorphic Approach to Sensor Placement on Martian Rocks and Soil, 29th Aerospace Mechanisms Conference, 1995.
- Design Study of a Solid-State Heliogyro Solar Sail, Master's Thesis, MIT, 1990.