SOLOMON WESTERMAN

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PROFESSIONAL EXPERIENCE

Rocket Lab Ltd (Rocket Lab) — December 2013 - Present
Guidance, Navigation & Control Engineer — (Auckland, NZ)

Ground-up development of the Guidance, Navigation, and Control System for the Electron Launch Vehicle. Working independently due to ITAR restrictions, I brought the GNC system from blank-slate to fully operational GNC flight code and HITL system in 5 months.

- Low-cost, portable, highly configurable Hardware-in-the-Loop (HITL) system development with Real Time Linux, analog I/O, digital I/O, sensor serial protocols, and low latency (3ms) RS485 bidirectional communication.
- In-house development of a 6-DOF simulator, written in C++, to validate the GNC algorithms. Highly configurable and fast; built ground-up with monte-carlo and HITL capability.
- Development and testing of highly robust minimal configuration guidance code to guide the Electron Launch Vehicle to orbit.
- Testing and performance validation of inertial sensors (including MEMS) and off-the-shelf GPS receivers.
- Responsible for all detailed 6-DOF analyses - pad drift, maximum allowable winds, vehicle alignment, performance validation, control design with slosh and bending, etc.
- Expendable vehicle trajectory design; in-house development of custom trajectory optimisation software.

Space Exploration Technologies (SpaceX) — June 2009 - March 2013
Guidance, Navigation & Control Engineer — (Hawthorne, CA)

- GNC lead for Crewed Dragon capsule, moving the design through conceptual design to PDR for the abort engines
  - Trajectory design for crew survivability in all phases of ascent
  - Control system design; delivered actuator requirements to Propulsion and Avionics
  - Supported cold and hot-flow testing of actuator to refine model used in control analysis
- Trajectory design and optimisation for the Falcon 9 Launch Vehicle
  - Design and optimisation of multi-vehicle problems in POST2
  - Designed and deployed a trajectory revision control system intended for high flight rate and rapid estimation of flight performance margin
  - Development of standard deliverables to Aerodynamics, Structures, Thermal, Propulsion and Mission Operations departments
  - Design trade studies for vehicle sizing
  - Familiar with customer ascent constraints and geostationary transfer orbit optimisation

- 6-DOF Simulator development
  - As part of a group, developed a 6-DOF simulation of the Dragon vehicle in C++ using all in-house libraries
  - Validation of environmental, sensor, and integration models
  - Experience with architectures of interfacing a 6-DOF simulator to Software-in-the-Loop and Hardware-in-the-Loop simulations
- Propellant Utilization on the Falcon 9 Launch Vehicle
  - Sensor error characterisation
  - Algorithm development, testing, and implementation in flight code
  - Supported testing in hot-fire testing with propellant utilisation in-the-loop
- Mission Operations experience
  - Primary Navigation operator of a shift for Dragon C2
  - Primary Cape Canaveral Navigation operator for Dragon C1
  - Experience with Falcon 9 launch operations, including vehicle alignment and day-of-launch wind analysis
  - GUI development in C++/Qt
- INS/GPS hardware testing, simulation, and performance characterisation
- Implemented Guidance and Navigation algorithms on the Dragon C1 and C2 Vehicle
- Guidance and Control design for VTVL Vehicles

Boeing Space Exploration Summer 2008
Space Shuttle Entry Guidance and Control Engineer (Internship) (Houston, TX)

- Implemented an updated Atmosphere and wind model (GRAM) in the Shuttle Descent Analysis Program (SDAP)
- Updated model saved significant time by removing iteration from day-of-flight entry analysis

NASA Marshall Space Flight Center Summer 2007
Summer Researcher (Internship) (Huntsville, AL)

- Analysis on the performance degradation due to thermal environment and lighting conditions on the Advanced Video Guidance Sensor (AVGS) on Orbital Express
- Solar Sail trajectory design

EDUCATION

Bachelor of Science, Aerospace and Astronautical Engineering with Highest Distinction
Purdue University, West Lafayette, IN May 2009
GPA: 3.98/4.00
Specialty: Dynamics & Control, Rocket Propulsion

ONLINE COURSES

Coursera - Machine Learning (Stanford) - Complete December 2014
Coursera - Computational Investing (Georgia Tech) - Complete November 2014

GNC EXPERIENCE

- State space system modeling with Matlab and Simulink
- Estimation with Kalman filters and LQG techniques
- Classical control analysis techniques: Root locus, Bode plots, feedback control loops, low and high frequency structural mode stabilization
- Modern control analysis techniques
- 3DOF, 6DOF Dynamic simulations; Extensive involvement with development of a 6-DOF capsule docking simulation written in C++ working with a team to develop simulator to model endoatmospheric, exoatmosphirc, low and medium Earth orbit flight
- Modeling of various non-linear behavior of sensor and actuators, including hydraulics, DC motors, and pressure sensors
- Experience with performance analysis on automated rendezvous and docking primarily with the Orbital Express advanced video guidance sensor.
- Launch Vehicle navigation, guidance, and control algorithm design, implementation, testing and verification
- Spacecraft navigation, guidance, and control algorithms; experience with atmospheric entry dynamics and control.
- Inertial sensor modelling and testing, performance verification
- GNSSS sensor modelling and testing, performance verification
- Digital and analog filter design and hardware implementation
- Familiar with Aerospace hardware testing standards (Qualification and Acceptance testing)
- Experience with in-flight mission operations, operator for Dragon C1 mission and trained operator for the Dragon C2 mission
- Optimal trajectory design and guidance algorithm development with POST3D and POST2
- Aerodynamic modelling in control system design
- Gyrocompass alignment
- Flight code validation and verification, Unit testing, Process control

PROPULSION EXPERIENCE

- Thrust Vector Control (TVC) system frequency response requirements
- Cold-gas thrust control sizing
- Hands-on experience with small solid rocket motor design, fabrication, and testing.
- Flight testing experience, post-flight performance analysis.
- Solid propellant mixing procedures and safety.
- Theoretical design of large solid and liquid chemical propulsion systems.
- Theoretical design of electric propulsion (electrostatic, electrothermal, electromagnetic) and nuclear propulsion (nuclear-thermal, nuclear-electric).

TOOLS

- Excellent technical writing ability
- Comfortable working in Linux development environment
- Adept in programming with C/C++
- MATLAB/Simulink
- POST3D, POST2, Astos, custom trajectory optimizer development
- LaTeX

- Revision control

HANDS-ON-EXPERIENCE

- Performance testing with a high-performance Inertial Measurement Unit with integrated GPS. Designed functional test procedure to determine gyro and accelerometer bias, white noise term, and long-term bias stability.
- GPS performance testing and knowledge of test-setup, both with simulated RF input and live-sky testing
- Students for the Exploration and Development of Space (SEDS) Hybrid Rocket Project vehicle integration lead
- Solid Rocket Motor complete design/fabrication
- High Power Rocketry vehicle construction, electronics (7+ years)
- Cycling custom bike design and construction

STUDENT PROJECTS

- Hybrid Rocket Project 18 foot rocket and hybrid motor designed, built, tested by students
  - Integration lead
  - Trajectory development of 6 DOF rocket simulation in Simulink
  - Aerodynamics, Mass Properties, Dynamics model
- Particle Image Velocimetry (PIV) Determine velocity field around arbitrary objects in low Reynolds number flows with low-cost optical technique
  - Team leader
  - Software development

REFERENCES

- Andy Heaton (256) 544-3839
  - Aerospace Engineer, NASA Marshall Space Flight Center
  - Mentor during summer 07
- Dr. Ivana Hrbud (765) 494-3423
  - Assistant Professor of Aerospace Engineering, Purdue University
- Jim Harder (281) 226-8541
  - Shuttle Entry GN&C Manager, Boeing Space Exploration
  - Manager during summer 08
- Paul Forquera (310) 363-6000
  - Manager at SpaceX, 2009-2013