

Education

University of Southern California - Viterbi School of Engineering

- Ph.D., Aerospace Engineering *August 2015*
 - Dissertation: “*High Temperature Latent Heat Thermal Energy Storage to Augment Solar Thermal Propulsion for Microsatellites*”
 - Recipient of the William F. Ballhaus, Jr. Prize for Excellence in Graduate Engineering Research
 - M.S., Aerospace Engineering – Combustion & Energy Systems Emphasis *December 2011*
 - B.S., Aerospace Engineering *May 2010*
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Academic Experience

University of Southern California - Viterbi School of Engineering

Department of Aerospace and Mechanical Engineering

- Associate Professor of Aerospace and Mechanical Engineering Practice** *August 2023 – Present*
- Senior Lecturer** *August 2018 – July 2023*
- Full Time Lecturer** *August 2015 – July 2018*

- Courses Taught: AME 341L a&b “Mechoptronics”, AME 441L a&b “Senior Projects”, AME 490 “Directed Research”, AME 491 “Undergraduate Design Projects II”

- Faculty Advisor: USC Recumbent Vehicle Design Team, *2015-Present*
USC Advanced Spacecraft Propulsion and Energy Laboratory, *2018-Present*

Teaching Assistant *August 2013 – May 2015*

- AME 341b, AME 441a

USC In-Space Propulsion Research (InSPR) Laboratory, Los Angeles, CA

Principal Investigator *January 2022 – Present*

- On campus laboratory developing novel diagnostics for advanced in-space propulsion research
- Provide hands-on research experience for current team of BS & MS students
- Current projects include a test bench for rapid catalyst aging, transient laminar flowmeters, and “flat-sat” ground test hardware
- Diagnostic support and lab facilities (thrust stands, vacuum chambers, etc.) are available for the USC AME community

USC Collaborative High Altitude Flow Facility, Los Angeles, CA

Laboratory Manager *February 2010 – May 2018*

- Managed operation and maintenance of USC’s largest vacuum science facility and the USC Solar Furnace Facility
- Directed a team of 3-8 undergraduates completing AFRL and USC related research tasks
- Oversaw the construction and integration of a \$350k liquid nitrogen cryogenic system for 9’ x 18’ vacuum chamber
- Supervisor and sponsor of multiple AME 441 projects such as radiometric thrust measurements & CCD solar flux mapping

Research Assistant *January 2007 - January 2010*

- Prototyping and experimental data collection supporting the AFRL Advanced Concepts Group
- Responsible for the operation and construction of cooling systems, vacuum facilities, high power lasers and NI hardware

Professional Experience

Gilpin Aerospace (Consultant), Los Angeles, CA

Lockheed Martin / Geneva Technologies Inc.

August 2018 – December 2021

- Independent test engineer supporting multiple advanced development projects at LMCO
- Successfully designed, built, and delivered two thrust stand systems and provided continuous operations support

JACOBS Inc.

March 2020 – December 2021

- Operated an independent commercial laboratory for the continued development of μN thrust diagnostics
- Designed, built, and delivered a 1 N – 22 N thrust stand system for AFRL/Edwards with automated calibration and analysis

ERC Inc., Edwards AFB, CA

Advanced Spacecraft Propulsion Consultant

August 2015 – March 2020

- Developed a novel thrust stand system capable of simultaneous thrust (μN) and mass loss ($< mg$) measurements of Electrospays
- Responsible engineer on multiple hot-fire test programs for thrust measurement, data reduction and post testing analysis
- Provided on-site support for industry partners at Aerojet Rocketdyne & MOOG

Thrust Stand Engineer

January 2013 – August 2015

- Designed, built and verified a novel torsional thrust stand system for direct impulse measurements of monopropellant thrusters offering 2 N steady-state measurement capability while maintaining < 10 mNs I-bit resolution
- Automated data analysis and post processing for thousands of thruster firings across multiple test campaigns
- Frequent travel to industry partner facilities to install thrust stand hardware, oversee operations, establish data collection methods and troubleshoot thruster integration with the on-site team

Co-Op

August 2010- August 2015

- Ph.D. Co-Op with the Air Force Research Laboratory (AFRL) “High Payoff Spacecraft Propulsion Technology Group”
- Designed and built the USC Solar Furnace Facility capable of 1kW power delivery with concentration ratios exceeding 4000:1
- Performed >100 solar furnace tests to investigate asymmetrical freezing in molten silicon test articles
- Modeled the effects of geometry on thermal gradients and phase front location using MATLAB and SolidWorks Simulation
- Used STAR-CCM+ to study transient convective coupling under conditions relevant to solar thermal propulsion
- Presented data for the AFRL High Energy Advanced Thermal Storage program at domestic and international conferences

Intern, AFRL Advanced Concepts Group

May 2008 - August 2010

- Conducted and post-processed hundreds of pulsed plasma thruster firings establishing performance trends for energy utilization
- Developed fully automated thrust stand calibration system process to characterize PPT impulse delivery
- Demonstrated the ability of a piezoelectric hammer to expand torsional thrust stand diagnostic range
- Designed and built a 1 MW pulse forming network to drive a high efficiency capillary discharge type pulsed plasma thruster

Journal Publications

- Gilpin, M.R., H. Wei, and N.M Pahlevan. *Womersley’s Solution for the Measurement of Volume Flow Rates in Transient Laminar Flow Tubes*. Physics of Fluids. Vol 34. No 11. 22, October 2023 ([Link](#))
- Gilpin, M.R., W.A. McGehee, N. Ivan Arnold, M.R. Natisin, and Z.A. Holley. *Dual-Axis Thrust Stand for the Direct Characterization of Electro spray Performance*. Review of Scientific Instruments. Vol. 93. No. 6, June 2022. ([Link](#))
- Pancotti, A.P., M.R. Gilpin, M. Hilario. *Comparison of Electrostatic Fins with Piezoelectric Impact Hammer Techniques to Extend Impulse Calibration Range of a Torsional Thrust Stand*. Review of Scientific Instruments. Vol. 83. No. 3, March 2012. ([Link](#))

Conference Papers and Presentations

- **Invited Speaker:** Gilpin, M.R. *USC's Recumbent Vehicle Design Team*. 9th Annual Student Shop Managers Consortium. Los Angeles, CA, July 11-13, 2023.
- **Invited Speaker:** Gilpin, M.R. *Ultra-High Temperature Space Power Applications*. 1st International Workshop on Ultra-High Temperature Thermal Energy Storage, Transfer and Conversion. Madrid, Spain, November 14, 2019.
- Gilpin, M.R., M.R. Natisin, C. Marin, M.D. Eschen, and H.L. Zamora. *Dual-Axis Torsional Thrust Stand for Simultaneous Direct Measurement of Thrust and Mass Loss*. 36th International Electric Propulsion Conference, Vienna, Austria, September 15-20, 2019. IEPC-02019-139.
- Gilpin, M.R., D.B. Scharfe, M.P. Young. *Experimental Investigation of Latent Heat Thermal Energy Storage for Bi-Modal Solar Thermal Propulsion*. 12th International Energy Conversion Engineering Conference, Cleveland, OH, July 28-30, 2014. AIAA-2014-3832.
- Gilpin, M.R., D.B. Scharfe, M.P. Young. *Phase-Change Thermal Energy Storage and Conversion: Development and Analysis for Solar Thermal Propulsion*. 48th AIAA/ASME/SAE/ASEE Joint Propulsion Conference, Atlanta, GA, July 29 – August 1, 2012.
- D.B. Scharfe, M.P. Young, M.R. Gilpin, T. Rexius. *Augmentation of Solar Thermal Propulsion Systems via Phase Change Thermal Energy Storage and Thermal Electric Conversion*. Space Propulsion 2012, Bordeaux, France, May, 2012.
- Gilpin M.R., D.B. Scharfe, A.P. Pancotti. *Molten Boron Phase-Change Thermal Energy Storage to Augment Solar Thermal Propulsion Systems*. 47th AIAA Joint Propulsion Conference, San Diego, CA July 31 – August 3, 2011.
- Pancotti, A.P., M. Young, M.R. Gilpin. *Effect of Ignition Techniques on a Capillary Discharge Based Pulsed Plasma Thruster*. 45th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit, Denver, Colorado, Aug. 2-5, 2009. AIAA-2009-5280.

Book Chapters

- Gilpin, M.R. “*Ultra-High Temperature Space Power Applications*” in A. Datas (ed.) *Ultra-High Temperature Energy Storage, Transfer and Conversion*, Elsevier, September 2020.

Professional Activities

Manuscript Reviewer: *Review of Scientific Instruments, Acta Astronautica, Sensors and Actuators A. Physical*

Memberships: *AIAA, ASME*

Honors and Awards

- William F. Ballhaus, Jr. Prize for Excellence in Graduate Engineering Research
- ARCS Foundation Scholar

May 2015
August 2008 – May 2015

Student Development

AIAA Region VI Student Conference – Project Advisor

- 2021: 2nd Place “*A Novel Staged Warm Gas Thrust for CubeSats*”
Spencer Powers, Connor Powers, Michael Mastrangelo, Kamyar Zarkoub, Spencer Wing
- 2021: 3rd Place “*UAV Flight Disruption via Acoustic Forcing*”
Miles Kay, Emma Roberson, Criss Edwards, Miranda Costigan

- 2020: 2nd Place “*Design and Construction Method of a Low-Voltage Bradbury-Nielsen Gate*”
Brandon Dillon, Lorenzo Laxamana, Kevin Sampson, David Torre
- 2018: 1st Place “*Spray Cone Formation from Pintle-Type Injector Systems in Liquid Rocket Engines*”
James Blakely, Johann Freeberg, Jacob Hogge
- 2017: 1st Place “*Design of a Paddle-Driven Wave Generator*”
Henry Miskaryan, David Freeman, Andrew Lindo
- 2016: 1st Place “*Attenuation of Vortex Noise Generated by UAV Propellers at Low Reynolds Numbers*”
Niko Intravartolo, Timothy Sorrells, Nazareth Ashkharian, Ryan Kim
- 2016: 2nd Place “*Design and Optimization of an Autonomous Projectile Trajectory Estimate and Interception System*”
Martin Keyt, Harlan Raine, Henry Bard, Matthew Del Toro

AME 490, Undergraduate Directed Research – Project Advisor

- 2016: Michelle Shadpour, “Thermal Energy Storage for the University of San Diego”

Ph.D. Dissertation Committee Member

- 2021: Fiona Leverone, “Bi-Modal Solar Thermal Propulsion and Power System: Modeling and Optimization for the Next-Generation of Small Satellites” – Delft University of Technology, Delft, Netherlands

Non-Advisement Design Team Actives

- 2020: USC NASA RASCAL Thermal Control System Sub-Group – Invited Design Reviewer
- 2017-Present: SC Racing – Invited Design Reviewer
- 2020-2021: FAA Smart Airport Student Competition Team – Advisor of Record
- 2019-2020: USC Solar Car – Invited Design Reviewer

Outreach & Other Involvement

- 2020-Present: Viterbi Admitted Students Faculty Roundtable Panelist
- 2017-Present: AME Sophomore Transition Event Panelist
- 2017-Present: “Career Day” speaker at multiple local KIPP Elementary & Middle Schools
- 2015-Present: USC Explore Tours
- 2018-2019: Organizer of the Annual AME Senior Project Expo

University Service

School Level

- 2020-Present: Undergraduate Viterbi Awards Selection Committee
- 2020-2022: AME Representative to the Engineering Curriculum Committee

Department Level

- 2022-Present: AME Strategic Planning Committee
- 2015-Present: AME Undergraduate Awards Committee
- 2022-2023: AME 3-4 Unit Curriculum Conversion Committee
- 2018, 2019: AME NNT Merit Review Committee
- 2018: AME Full-Time Lecturer Search Committee (resulting in two full-time hires)

External Research Support – Total: \$438,000

Title: *JACOBS Subcontract “USC 1”*

PI: Matthew Gilpin

Agency: JACOBS Solutions Inc. / AFRL RQRS

Period: 4/2023– 9/2024

Amount Total: \$150,000

Major Objectives: Development and diagnostic support for “flat-sat” testing of in-orbit refueling components. Application testing of USC developed transient flowmeter concept using ASCENT propellant. Continued support and novel solutions for AFRL thrust measurement hardware.

Title: *Advanced Chemical Spacecraft Propulsion I*

PI: Matthew Gilpin

Agency: Air Force Research Lab

Period: 1/2022– 11/2022

Amount Total: \$175,000

Major Objectives: Delivery of multiple spacecraft diagnostic components including test bench for in-orbit fuel transfer, test bench for rapid simulated aging of catalyst and continued development of thrust stand diagnostics to support multiple AFRL development programs.

Title: *Womersley Flow Meter Project*

PI: Matthew Gilpin & Niema Pahlevan

Agency: Air Force Research Lab

Period: 5/2019 – 11/2021

Amount Total: \$113,000

Major Objectives: Development and experimental validation of a novel transient flowmeter concept using Womersley’s laminar flow solution to characterize propellant flows.

Research Interests

Novel Diagnostic Development, Thrust Stands, Transient Laminar Flow Measurement, Latent Heat Thermal Energy Storage, Convective Coupling in High Temperature Heat Exchangers, Effective Energy Storage Density, Spacecraft Propulsion, Energy Systems

Media

- USC LAA, *2019 Hubbard Award Student Spotlight: Carlos Marin*, 2019 ([Link](#))
- Viterbi News, *USC Student Team Places 4th at the Human Powered Vehicle Challenge*, April 2018 ([Link](#))
- Viterbi News, *Senior Mechanical Engineers Win 1st Place at AIAA Conference*, April 2018 ([Link](#))
- USC News, *A Fascination With Flight Leads USC Graduate Conor Cimo to the Space Industry*, May 2018 ([Link](#))
- Viterbi News, *Senior Design Projects Win Big at AIAA Conference*, April 2017 ([Link](#))
- Viterbi News, *Who Will Aid The Sick? Fight Air Pollution? Power Our Spacecraft?*, May 2016 ([Link](#))