

Andrew Thoesen

Department of Mechanical Engineering
Arizona State University
501 E Tylor Mall
Tempe, AZ, 85287

(970) 640-5720
Andrew.Thoesen@gmail.com
www.AndrewThoesen.com

Education

- PhD Mechanical Engineering, Arizona State University** 2013-2019
Advisor: Dr. Hamid Marvi
- B.S. Mechanical Engineering, Purdue University** 2006-2010

Research Experience

Post-Doctoral Researcher, Arizona State University, BIRTH Lab 1/2020-present

- Investigating excavation designs for patentable lunar excavator
- Managing team of five undergraduate researchers within lab on multiple projects and student competitions
- Continuing theoretical model development for predictive scaling for vehicle testing

Graduate Researcher, Arizona State University, BIRTH Lab 5/2016-12/2019

- Investigating interfaces of wheeled and helical geometries with granular media for force and propulsion characteristics
- Utilizing EDEM (DEM) and Adams (MBD) software to model granular surfaces with high fidelity to categorize and optimize mobility designs
- Performing analogous experiments with BIRTH Lab's regolith bed to compare design parameters and fidelity of simulations
- Developing theoretical model for scaling of wheeled and helical geometries and investigating applications to simulants

Machine Learning and Instrument Autonomy Group, Jet Propulsion Laboratory 10/2018-1/2019

- Integrated terramechanics knowledge into machine learning models for sensor-embedded wheel
- Performed field testing of wheel in granular medias to acquire slip and sinkage data for machine learning models
- Researched and downselected string potentiometer instrument for additional data acquisition
- Researched granular media properties to help inform predictive qualities such as cohesion, angle of repose, and grain size distribution

Granular Media Regolith Operations Lab, NASA Kennedy Space Center 6/2017-8/2017

- Investigated simulation capabilities for mobility and excavation of granular media using EDEM simulation software
- Deconstructed and rebuilt RASSOR 2.0 lunar mining robot arms
- Created lunar simulant testbed setup parts utilizing CREO (CAD)

Graduate Researcher, Arizona State University, SpaceTReX Lab

6/2014-5/2016

- Researched asteroid excavation and in-situ resource utilization approaches
- Led design effort for payload of AOSAT1, a 3U CubeSat centrifuge lab intended to examine microgravity effects on regolith
- Developed experiment chamber, instrument placement, and door deployment mechanism designs

Graduate Researcher, Arizona State University, BioMechatronics Lab

8/2013-5/2014

- Implemented registration algorithms to join multiple point clouds for purpose of eliminating shadow effects
- Integrated computer vision into the ASU BioMechatronics Lab with Microsoft Kinects using a Linux-based ROS interface
- Future project direction included recording and characterizing human to robot interaction at the time of Dr. Santos' departure from ASU to UCLA.

Visiting Scholar, Purdue University

06/2011-12/2011

- Researched feed-forward control for residual vibration reduction.
- Used a genetic algorithm to find optimal proportional, integral, and derivative gains for a wire bonder feeder for circuitry.
- Showed through preliminary results that predictive feed-forward control with an approximated linear model created softer acceleration spikes than simple closed loop control

Awards

ASU-NASA Space Grant Fellowship	1/2019-5/2019
GPSA Travel Grant (\$750)	3/2018
ICRA 2018 Travel Grant (\$250)	3/2018
MSC Adams 2017 Simulating Reality Contest, 2 nd place in University Category	8/2017
ASU-NASA Space Grant Fellowship	12/2017-5/2018
ASU-GPSA Outstanding Mentorship Award	3/2017
ASU-SESE Outstanding Teaching Assistant Award	4/2016
ASU-NASA Space Grant Fellowship	8/2014-1/2015
MAE Research Assistantship (NSF Award #1264444)	1/2014-6/2014
MAE Teaching Assistantship	8/2013-12/2013

Teaching, Outreach, and Service Experience

Barrett Undergraduate Honors Thesis Committee Member

Sierra Ramirez, *Asteroid Mobility Using Screw Powered Vehicles*

Elizabeth Breden, *Space Junk: Finding Feasible Solutions for Space Debris Removal*

Morris K Udall Middle School Career Day

12/7/17

Arizona Statewide Science Standards Working Group (invitation only)

9/6/17, 10/18/17

Arizona Science and Engineering Fair, Judge

4/12/2017

Arizona State University, NASA Space Grant Fellowship Project 1/2018-5/2018, 1/2019-5/2019

- Created 15-week fellowship project for Title 1 Greenway Middle School to perform NASA-approved middle school science experiments and build robotic arms
- Worked with 29 middle-schoolers in two-hour sessions once a week to perform the weekly experiments and assembly of robotic arms
- Project concluded with class visit to ISTB4/LROC centers to explore space science and engineering

Arizona State University, SESE Teaching Assistant 1/2017-12/2017

- Assisted four teams of undergraduate science students to complete their capstone projects by adding engineering expertise
- Ordered and managed parts for project builds
- Projects include sponsorship by Planetary Resources and inclusion in HASP program

Arizona State University, SEMTE Teaching Assistant 8/2016-12/2016

- Taught six MAE318 Introductory Controls lab sections
- Completed five experiments with approximately 100 students and 35 lab reports per experiment
- Taught two independent lectures during the semester

Arizona State University, SESE Teaching Assistant 8/2014-8/2016

- Helped create the class structure and content for ASU's new multidisciplinary CubeSat design class
- Guided student satellite designs to conform with CubeSat Design Specification
- Prepared team for class CDR with JPL's Team Xc
- Taught ASU's School of Earth and Space Exploration capstone lab and assisted with student builds, ordered parts, and helped guide them to a HASP project completion

Scottsdale Center for the Arts, Mentor Residency 9/2014-2/2015

- Created 5-week project with Scottsdale Center for the Arts and Title 1 Greenway Middle School to build working models of the lunar rover and other lunar designs
- Worked with 37 middle-schoolers in two classes and 10 teams to assemble battery-powered gearboxes and design models
- Student projects presented on 2/25/15 during the *Ferenc Pavlics: Revolution to the Moon* event at SCA

Arizona State University, SEMTE Teaching Assistant 8/2013-12/2013

- Taught four laboratory sections MAE491 Experimental Mechanical Engineering
- Graded 25 lab reports per experiment of average length 10-12 pages single spaced
- Held weekly help sessions for greater depth on topics of thermodynamics and fluid mechanics

Work Experience

LyondellBasell Industries, Reliability and Project Engineer January 2012—July 2013

- Directed major improvement projects for our catalyst site including installation of new centrifugal pumps and redesign for the main reactor movable suction leg
- Calculated fluid and mechanical stress requirements for projects
- Coordinated contractors for various tasks including crane lifts, insulation of equipment, and minor projects

- Oversaw hydraulic fracturing operations at remote locations
- Performed quality control tests on hydraulic fracturing material
- Calculated pressure and flow rate for fracturing fluid in underground piping

Publications and Presentations

Peer Reviewed Journal Papers

Toesen, A., McBryan, T., Green, M., Martia, J., Mick, D., Marvi, H. (2020) Helical Granular Scaling Theory in Lunar Simulant. *Manuscript submitted to Physical Review E.*

Toesen, A., McBryan, T., Mick, D., Green, M., Martia, J., & Marvi, H. (2020). Comparative performance of granular scaling laws for lightweight grouser wheels in sand and lunar simulant. *Powder Technology, Vol. 373, 336-346*

Toesen, A., McBryan, T., Green, M., Martia, J., Mick, D., Marvi, H. (2020) Revisiting Scaling Laws for Robotic Mobility in Granular Media. *IEEE Robotics and Automation Letter, 5(2), 1319-1325.*

Toesen, A., McBryan, T., & Marvi, H. (2019). Helically-Driven Granular Mobility and Gravity-Variant Scaling Relations. *RSC Advances, 9(22), 12572-12579.*

Toesen, A., Ramirez, S., & Marvi, H. (2019). Screw-generated forces in granular media: Experimental, Computational, and Analytical Comparison. *AIChE Journal, 65(3), 894-903.*

Lightholder, J., **Toesen, A.,** et al (2017). Asteroid origins satellite (AOSAT) I: an on-orbit centrifuge science laboratory. *Acta Astronautica, 133, 81-94.*

Peer Reviewed Conference Papers

Toesen, A., McBryan, T., Green, M., Martia, J., Mick, D., Marvi, H. (2019) Revisiting Scaling Laws for Robotic Mobility in Granular Media. *International Conference on Robotics and Automation (ICRA), May 2020*

Carpenter, K., **Toesen, A.,** et al. (2019) Exobiology Extant Life Surveyor (EELS) *Manuscript accepted to 2020 Earth and Space Conference, Conference cancelled due to COVID-19*

Toesen, A., Ramirez, S., Marvi, H. " Screw-Powered Propulsion in Granular Media: An Experimental and Computational Study" *International Conference on Robotics and Automation (ICRA), May 2018*

Nallapu, Ravi Teja, **Toesen, Andrew** et al. "Optimized Bucket Wheel Design for Asteroid Excavation." *67th International Astronautical Congress, September 2016*

Thangavelautham, J., **Toesen, A.,** Gadau, F., Hutchins, G., Alizadeh, I., "Low-Cost Science Laboratory in Microgravity Using a CubeSat Centrifuge Framework" *65th International Astronautical*

Congress, Toronto, Canada, September 2014

Patents

H. Marvi, **A. Thoesen**, M. Green, “Systems and Methods for a Multi-Modal Screw Propelled Excavation” U.S. Provisional Patent, 62/940,016, November 2019

Public Talks

A. Thoesen, M. Green, D. Mick, T. McBryan, H. Marvi, “Development of a Screw Propelled Vehicle for Mobility on the Lunar Simulant BP-1,” *Southwest Robotics Symposium*, Tempe, AZ, January 2019.

A. Thoesen. “Space Engineering: A Journey Through the Impossible”, *TEDxASU*, Tempe, AZ. March 2018

A. Thoesen, S. Ramirez, H. Marvi, “Revisiting Screw-propelled Vehicles Utilizing Experimental and Computational Methods,” *Southwest Robotics Symposium*, Tempe, AZ, January 2018.

A. Thoesen, S. Ramirez, H. Marvi, “Assessing Screw-Generated Force in Glass Beads Utilizing Experiments, DEM, and Analytical Methods,” *Southwest Robotics Symposium*, Tempe, AZ, January 2018.

A. Thoesen, “An Evening with Asteroids” *Scottsdale Public Library Fall Civic Center Lecture Series*, Scottsdale, AZ. Sept 2016

A. Thoesen. “Here comes the BOOM” Panel member, *Phoenix Comicon 2016*. Phoenix Convention Center, Phoenix. June 2016

A. Thoesen. “Asteroids: Gold Mines, Gas Stations, or Just Plain Cool?” Talk, *Ignite Phoenix Event #18*. Scottsdale Center for the Arts, Phoenix. April 2016

A. Thoesen, EDEM Researcher Spotlight, Article, *Subsurface Asteroid Exploration*
<https://www.edemsimulation.com/spotlight/subsurface-asteroid-exploration/>

Conference Posters

A. Thoesen, M. Green, D. Mick, T. McBryan, H. Marvi, “Development of a Screw Propelled Vehicle for Mobility on the Lunar Simulant BP-1,” *Southwest Robotics Symposium*, Tempe, AZ, January 2019.

A. Thoesen, S. Ramirez, H. Marvi, “Revisiting Screw-propelled Vehicles Utilizing Experimental and Computational Methods,” *Southwest Robotics Symposium*, Tempe, AZ, January 2018.

A. Thoesen, S. Ramirez, H. Marvi, “Assessing Screw-Generated Force in Glass Beads Utilizing Experiments, DEM, and Analytical Methods,” *Southwest Robotics Symposium*, Tempe, AZ, January 2018.

A. Thoesen, H. Marvi, “Simulated novel approaches to asteroid mobility,” *TEDxASU symposium*, Tempe, AZ, March 2017.

A. Thoesen, H. Marvi, “Simulated novel approaches to asteroid mobility,” *International Mechanical Engineering Congress & Exposition*, Phoenix, AZ, November 2016.

A. Thoesen, A. Chandra, L. Raura, A. Warrent, E. Aspfaug, J. Thanga “Asteroid Origins Satellite I: An Orbit Planetary Science Laboratory” *Interplanetary Small Satellite Conference*; April 2016; Pasadena, CA

A. Thoesen, C. Hrdina, V. Santos “Low-cost 3D Scene Reconstruction for Activities of Daily Living Using Multiple Camera Angles” Poster, *Rehabilitation Robotics*; March 2014; Tempe, AZ