

Symposium on *Extraordinary Engineering Impacts on Society*

National Academy of Engineering
August 18-19, 2022



Alice M. Agogino

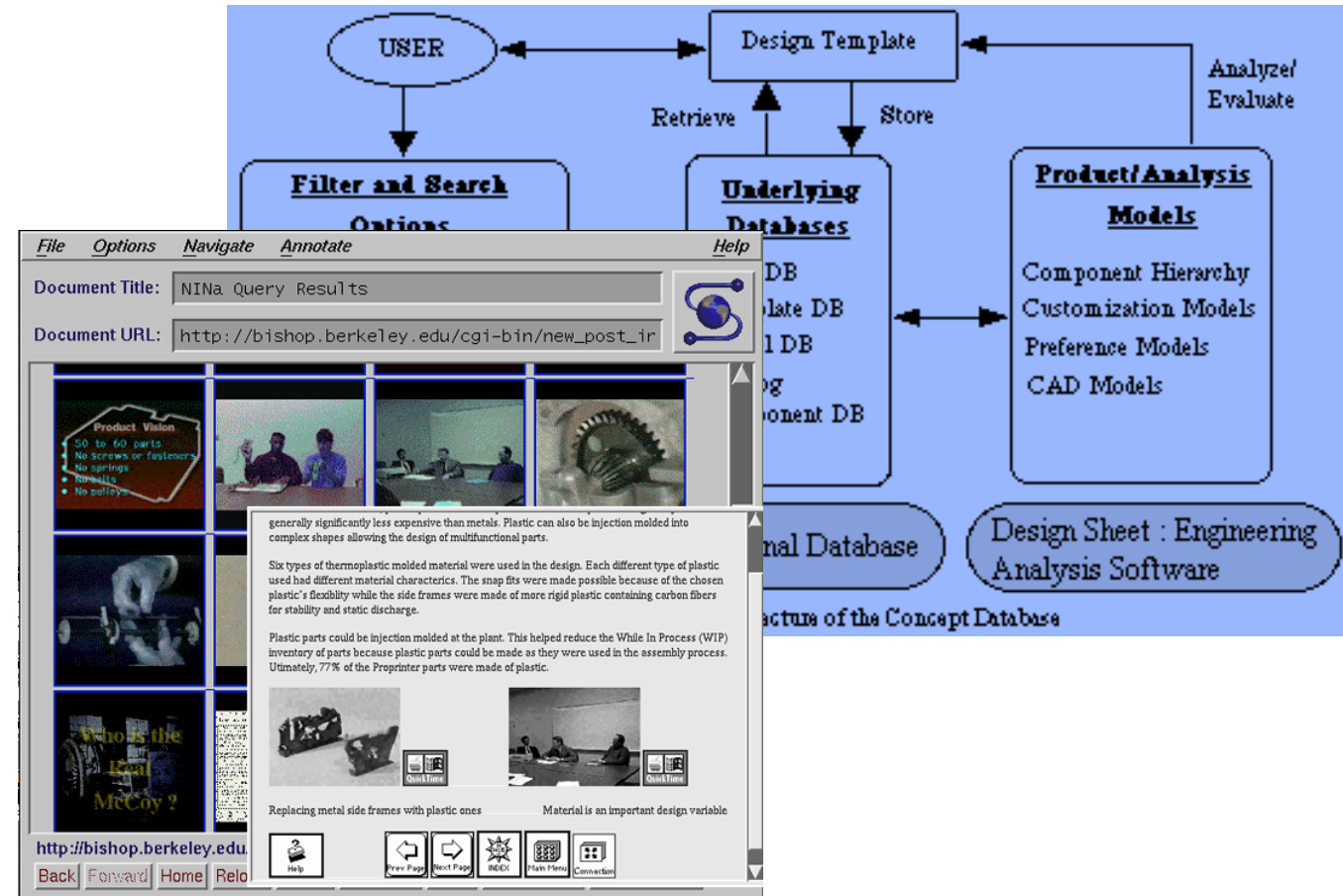
- Roscoe and Elizabeth Hughes Professor Emeritus of Mechanical Engineering
- Chair of the Graduate Group in Development Engineering
- Education Director of the Blum Center for Developing Economies
- University of California at Berkeley
- CEO of Squishy Robotics , Inc.



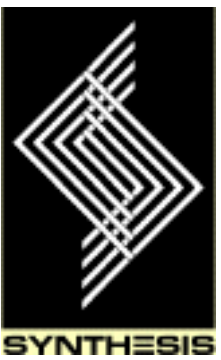
Concept Database

Started with NSF Presidential Investigator award

			Current Design Model								New Model				
			Evaluation Model	obj	-										
				c				45							
			Performance												
Decisions			Classification	Cost	Weight	max	D _{outer}	L _{outer}	P _{rated}	T _{stall}	no load	D _{bore}	Weight _{ctrl}	Noise _{RF}	T _{con}
1	Yes	Component													
2	Rot	Motor Type													
3	DC	Power Source													
Current Options (dec.)	yes	Frame?													
	no														
	yes	Brush?													
	no														
	yes	Rare Earth?													
	no														



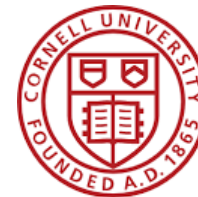
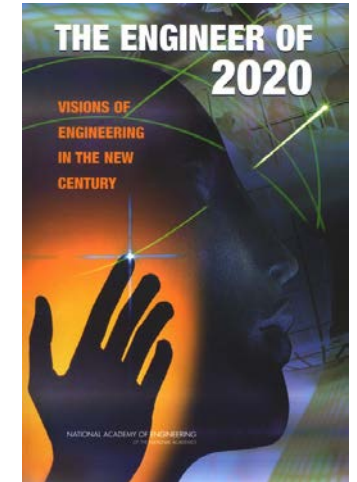
- 8451622 Presidential Young Investigator Award: Research on Expert Systems in Automated Manufacturing, Knowledge Acquisition, and Design Methodologies
- 9300025 Concept Database: A Design Information System for Concurrent Engineering with Application to Mechatronics Design



Synthesis Engineering Education Coalition

NSF-funded Synthesis Coalition was a union of eight diverse institutions funded by the National Science Foundation to design, implement and assess new approaches to undergraduate engineering education that emphasize

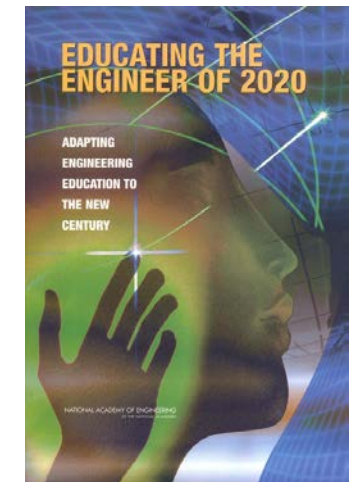
- multidisciplinary synthesis, teamwork and communication,
- hands-on and design, prototyping, and laboratory experiences,
- open-ended problem formulation and solving,
- examples of “best practices” from industry through multimedia case studies.
- Inclusive and diversifying practices.



Cornell University

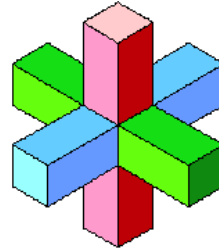
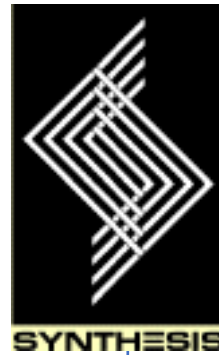


TUSKEGEE
UNIVERSITY



Engineering Education Multimedia Design Portfolio

Alice M. Agogino



SPATIAL REASONING
SPATIAL REASONING

- Using the National Engineering Education Delivery System as the Foundation for Building a Test-Bed Digital Library for Science, Mathematics, Engineering and Technology Education
- 0532808 Collaborative Research: A Comprehensive Pathway for K-Gray Engineering Education

PEOPLE PRODUCT STRATEGY

WELCOME | TABLE OF CONTENTS **START HERE**

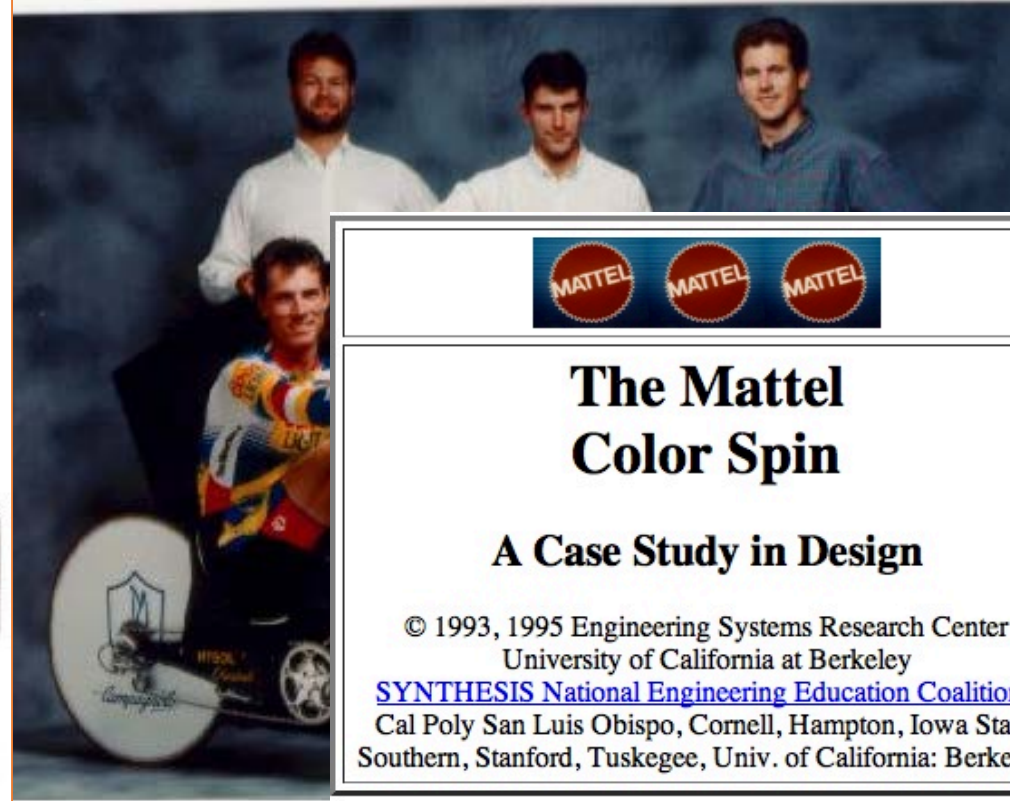
INTRODUCTION
INDUSTRY CORPORATION
PEOPLE
PRODUCT
STRATEGY

QUIZ & ASSIGNMENT
VIDEO LIBRARY
GUESTBOOK
ACKNOWLEDGEMENTS
REFERENCE & CREDITS

HOME | SITEMAP | SEARCH | FEEDBACK | HELP



The 1991 Human Powered Vehicle



MMCSWEB
MultiMedia Case Studies
in Engineering Design



The Mattel Color Spin

A Case Study in Design

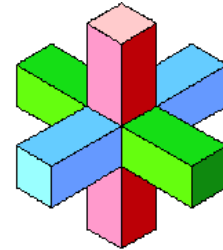
© 1993, 1995 Engineering Systems Research Center
University of California at Berkeley
[SYNTHESIS National Engineering Education Coalition:](#)
Cal Poly San Luis Obispo, Cornell, Hampton, Iowa State,
Southern, Stanford, Tuskegee, Univ. of California: Berkeley.



Multimedia cases of engineering design, including industrial design, design for assembly, design for manufacture, customer-driven design, design trade-offs, design for environment service & ergonomics, social implications of design, history of technology.

The multimedia cases were used for K-12 outreach, as well as introduction to engineering, freshman design and senior design classes.

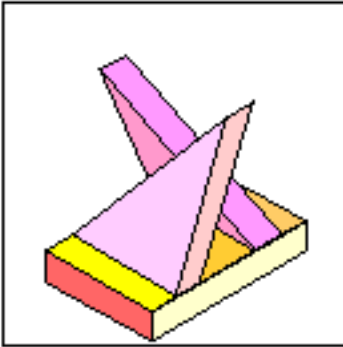
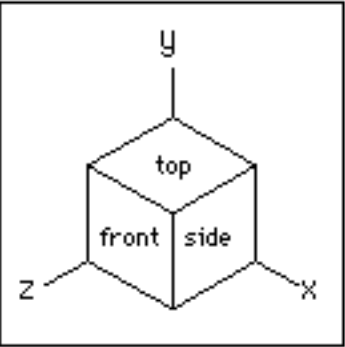
Spatial Reasoning Software Removed Gender Differences



SPATIAL REASONING
SPATIAL REASONING

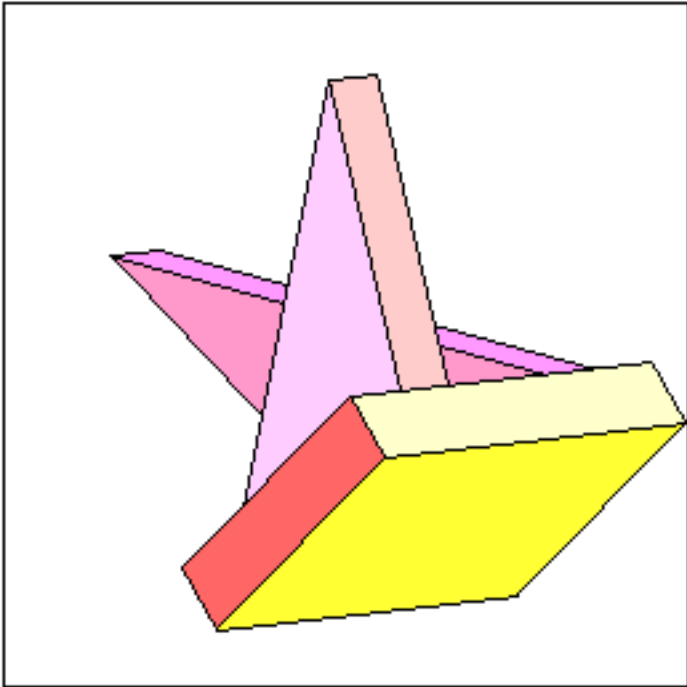
2 Pronged Wedge

Isometric View:



• Click - On & Drag - the object on the right to manipulate it about any axis in the plane of the screen.

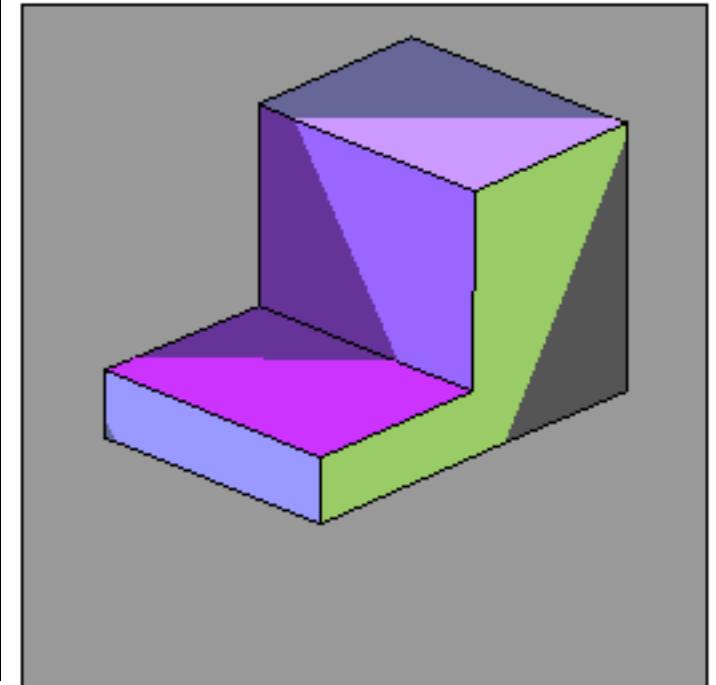
• Click - Outside & Drag - the object on the right to rotate it about an axis normal to the plane of the screen.



Top Side Isometric
Front Mix Up Last

Display Options:
☒ Solid Model
☐ Hidden Line
☐ Wire Frame

ket-2



Engineering Pathway

Turn Ideas Into Reality - Learn. Connect.
Create.

Welcome to the Engineering Pathway!



EP ON THE GO



Verizon 4:16 PM 92%



UC Botanical Garden at Berkeley



About:

The UC Botanical Garden is a non-profit research garden and museum for the University of California at Berkeley, having a notably diverse pl

([...more](#))

What and Where?

Place:

UC Botanical Garden

Location:

200 Centennial Drive, Berkeley, California 94720-
United States

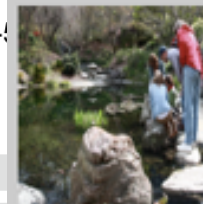
Related Resources:

Collection:



EP on the Goal:
Mobile Learning
with Augmented
Reality

UC Botanical Garden at Berkeley 1.18 mi



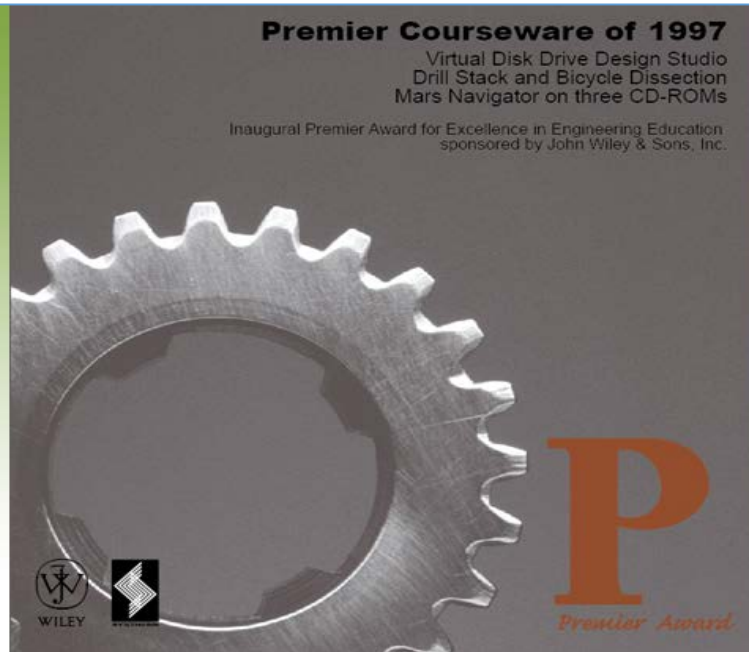
The UC Botanical Garden is a non-profit research garden and museum for the University of California at Berkeley, having a notably diverse plant collection ...



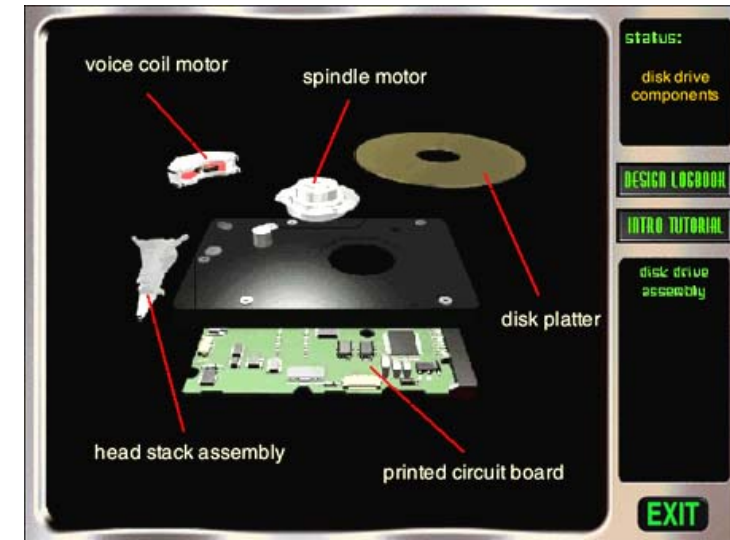
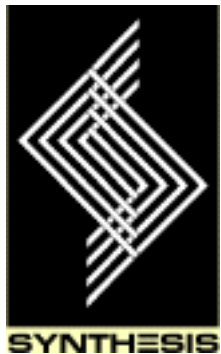
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www
prev

www



1
9
9
7



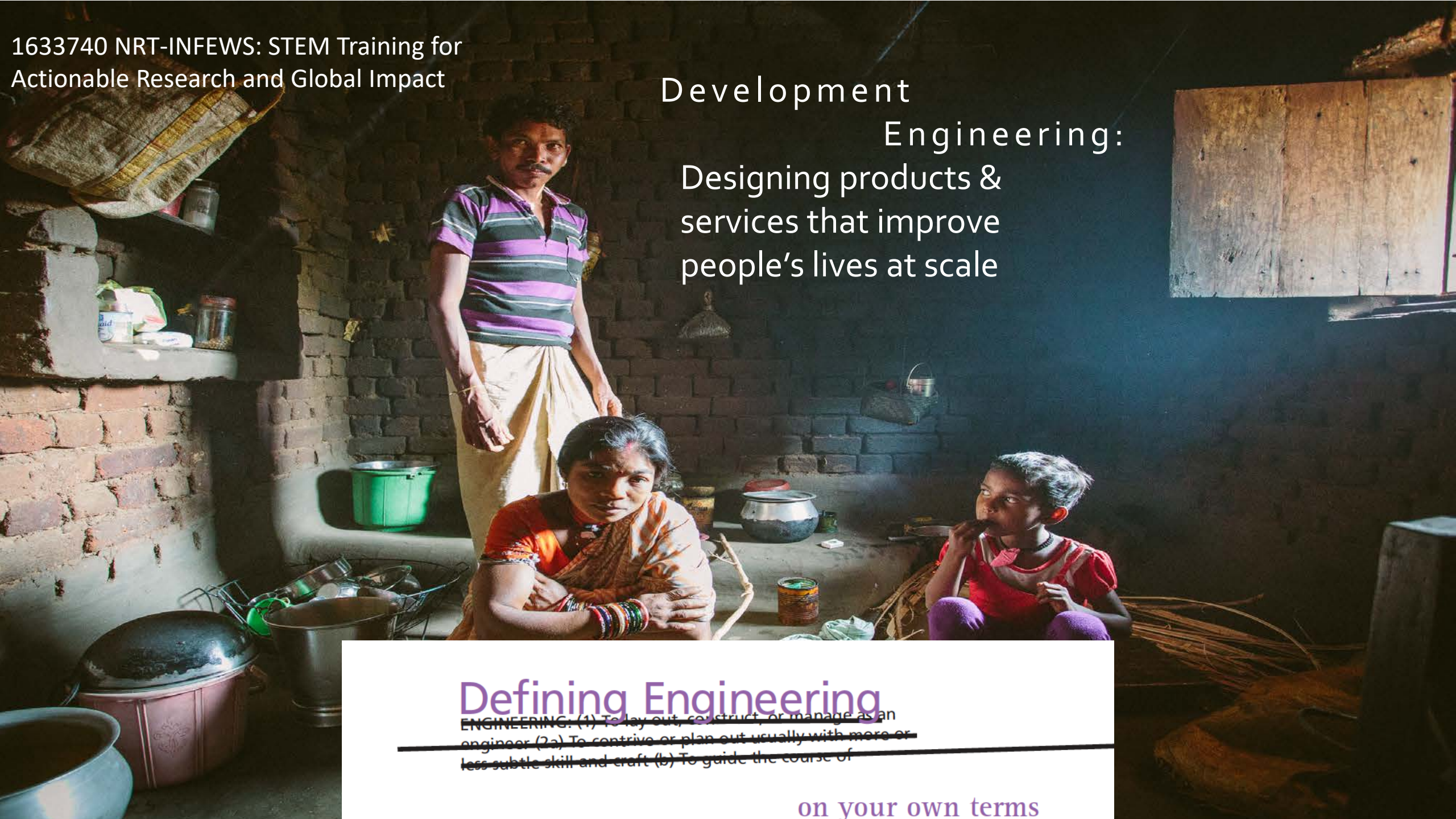
The [Virtual Disk Drive Design Studio](#) is an educational game using interactive multimedia to introduce students to the world of mechatronics design. It won the Premier Award for Excellence in Engineering Courseware in 1997.



Community-Based Design: Girls, Inc. Pinoleville Pomo Nation

0428935 DISTINGUISHED TEACHING SCHOLAR, Designing for Diversity

Development
Engineering:
Designing products &
services that improve
people's lives at scale



Defining Engineering

~~ENGINEERING: (1) To lay out, construct, or manage as an engineer (2a) To contrive or plan out usually with more or less subtle skill and craft (b) To guide the course of~~

on your own terms

The world needs changing. Development Engineering provides the career path.
Learn more about UC Berkeley's groundbreaking degree.



Learn More




Development Engineering Master

Sponsored · 

How do I change from a standard tech job to a transformative one?
Find out about UC Berkeley's Master of Development Engineering



 **DEVELOPMENT
ENGINEERING**
UC BERKELEY

Master of Development Engineering
UC Berkeley's 3-Semester Master's Program

**UC Berkeley
Master of Development Engineering
Info Session**

Tuesday, November 10th
8am PST
For more information
and registration:
developmentengineering.berkeley.edu/

BLUM CENTER
FOR DEVELOPING ECONOMIES

DEVELOPMENT
ENGINEERING
UC BERKELEY



DEVELOPMENT
ENGINEERING
UC BERKELEY

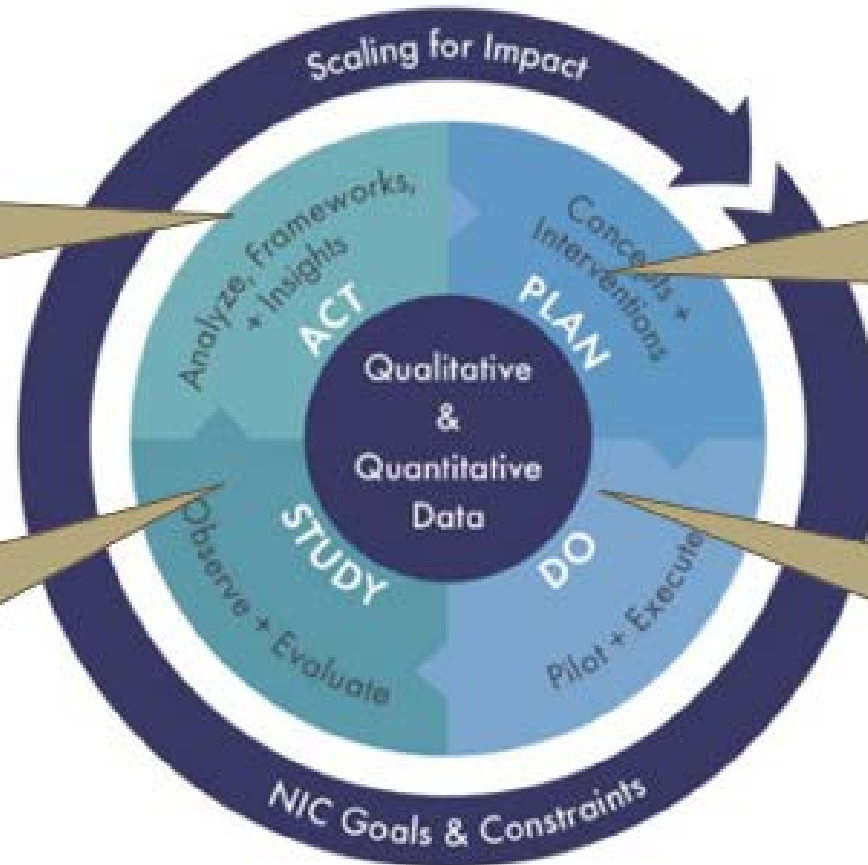
Master of Development Engineering
UC Berkeley's 3-Semester Master's Program



Native Foods, Energy, Water Systems Alliance

Gathering:
Creating an action
plan

Evaluation team
meetings with each of
the stepping stone
Collecting benchmark
data



Preparing the ground:
Learning about each
of the wise practices

Who,
Seed, water,
Planting:
Building the network
Establishing
connection



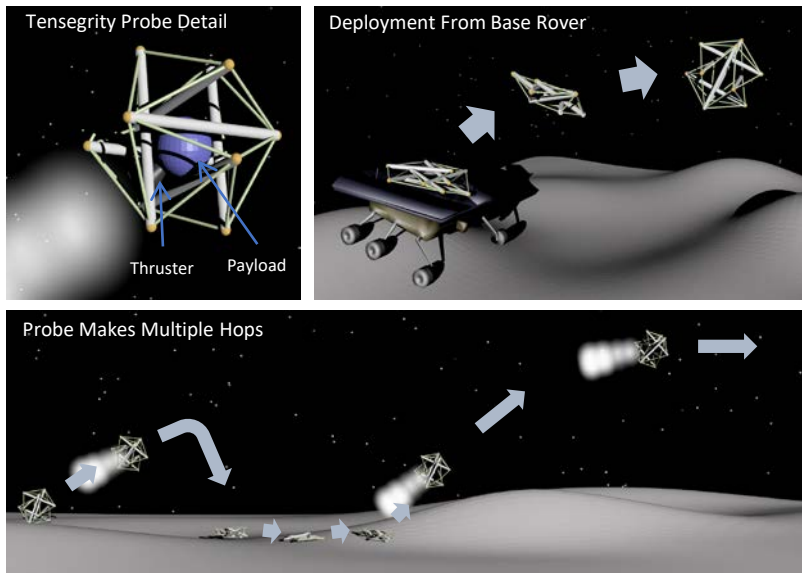
ANNUAL SUMMARY SLIDE – YEAR 4

NASA Early Stage Innovations (ESI14) – Grant NNX15AD74G

TITLE	Precision Hopping/Rolling Robotic Surface Probe Based on Tensegrity Structures		
PI	Alice M. Agogino (PI)	UNIVERSITY	UC Berkeley

RESEARCH OBJECTIVES AND RELEVANCE TO NASA

- Develop tensegrity probe capable of rolling and hopping
- Enables low cost, highly reliable, highly capable ground probes
- Enables mobility through sandy surfaces, hilly terrain, caves
- Enables fast traversal for short missions
- Enables compact storage as secondary payload

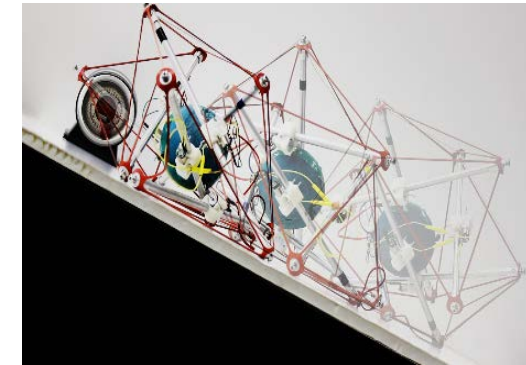
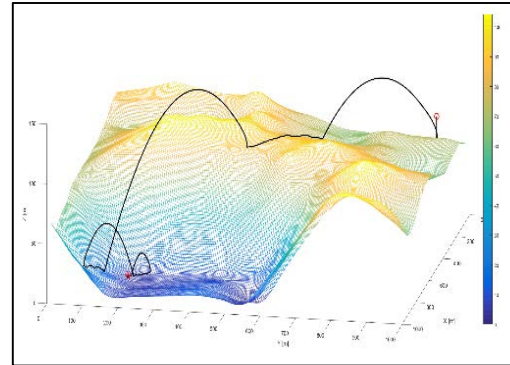


TECHNICAL APPROACH

- Add thruster to ball-shaped tensegrity robot
- Make multiple flying hops towards destination
- Robot then rolls to precise destination
- Tensegrity structure protects payload
- Tensegrity ball enables locomotion through:
 - Sandy surfaces
 - Down steep craters

TEAM MEMBERS AND AFFILIATIONS

- PI: Alice Agogino – University of California Berkeley
- Collaborator: Terry Fong, NASA Ames Research Center

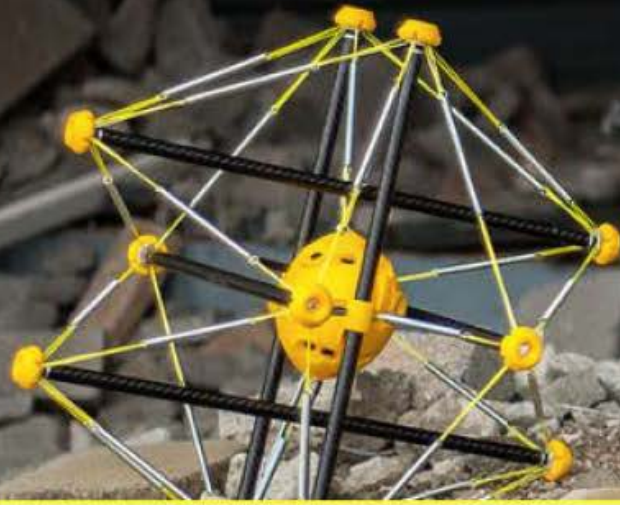


SIGNIFICANT ACCOMPLISHMENTS

- Developed hopping & rolling mission profile that:
 - Allows for low-cost cold gas thruster
 - Minimizes shock to payload within tensegrity structure
 - Validated thru simulation in flat and hilly terrain
- Designed & simulated gimbaled thrust control assuming noisy vector control
- Developed lattice platform for flexibility & rapid prototyping
- Developed hardware prototype for testing & validation: TT-3, TT-4, TT-4_{mini}, TT-5, TT-5_{Meso}
- Developed circuit board & sensor systems needed for ground mobility
- Simulation with hopping-bouncing restitution for path-planning missions
- Performed uphill “walking” on 24 degree slopes
- Demonstrated successful drop tests from 122 m from aerial drone
- Developed, analyzed, and tested different control strategies for dynamic rolling locomotion

- NSF I-Corp and NASA NNX15AD74G-Agogino Precision Hopping/Rolling Robotic Surface Probe Based on Tensegrity Structures
- 1927010 SBIR Phase II: Rapidly Deployable Mobile Sensor Robots for Disaster Response and Monitoring

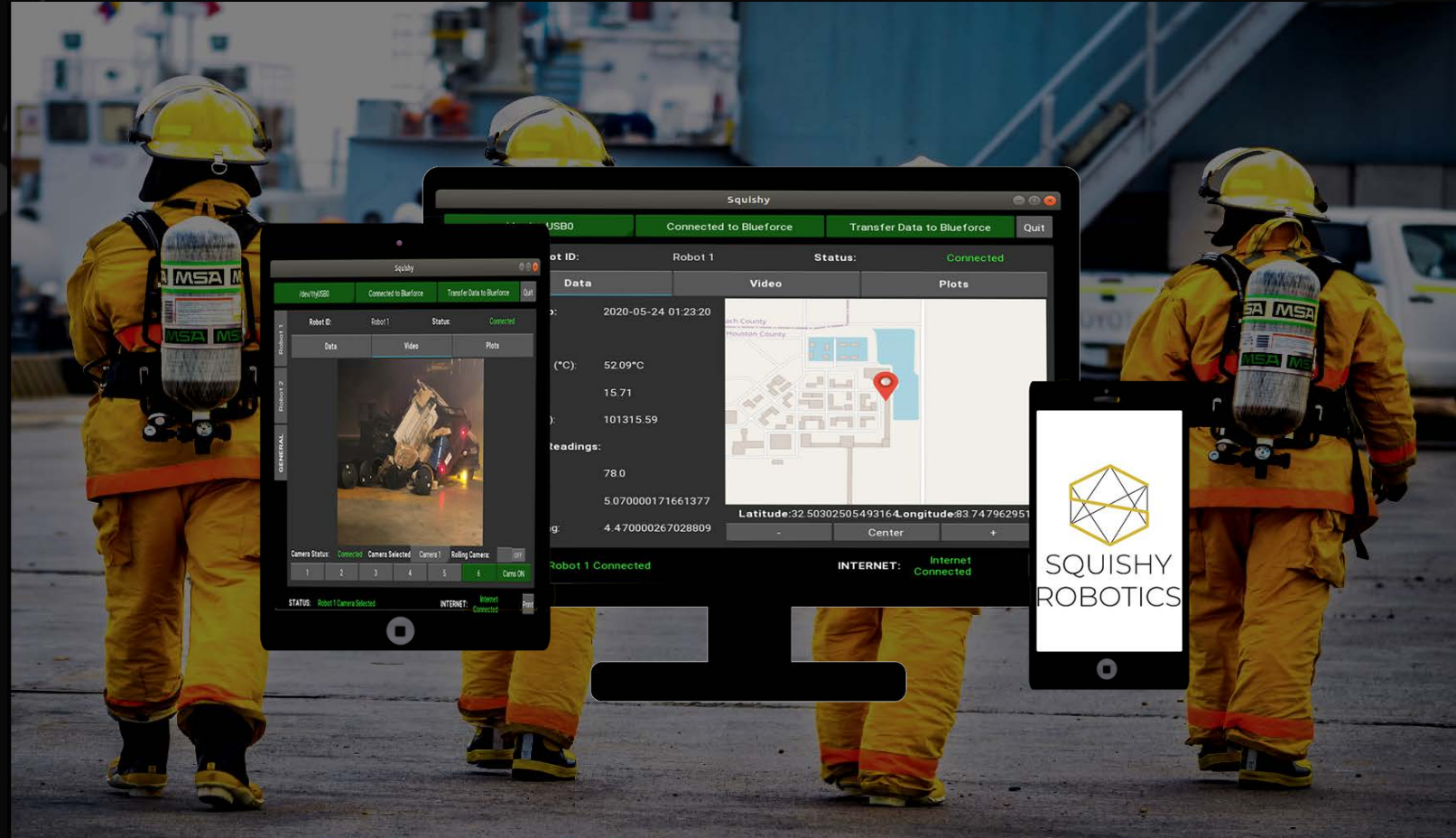
1927010 SBIR Phase II:
Rapidly Deployable Mobile
Sensor Robots for Disaster
Response and Monitoring



THE SQUISHY ROBOTS THAT COULD SAVE THE WORLD

These bots are built to work in space, but first we need their help here on Earth.

When every second counts...



Life-saving, Cost-saving Information in Real Time

When every second counts...



Early Detection & Prevention of Wildland Fires

A large group of approximately 40 people, including students and faculty, are posed on the exterior stairs of a modern building with large glass windows. The group is diverse in age and ethnicity. In the foreground, a woman wears a bright green blazer, a man wears a blue and white checkered shirt, and a woman on the right wears a blue hoodie with "BERKELEY" in yellow. The text "Thanks to Extraordinary Impactful Students" is overlaid in white in the center.

Thanks to Extraordinary Impactful
Students

NSF (and one NASA) Awards

- 8451622 Presidential Young Investigator Award: Research on Expert Systems in Automated Manufacturing, Knowledge Acquisition, and Design Methodologies
- 9300025 Concept Database: A Design Information System for Concurrent Engineering with Application to Mechatronics Design
- 9625456 SYNTHESIS: An NSF Engineering Education Coalition
- 9817406 Using the National Engineering Education Delivery System as the Foundation for Building a Test-Bed Digital Library for Science, Mathematics, Engineering and Technology Education
- 0532808 Collaborative Research: A Comprehensive Pathway for K-Gray Engineering Education
- 0428935 OFFICE OF MULTIDISCIPLINARY AC, EngEd-Engineering Education, DISTINGUISHED TEACHING SCHOLAR, Designing for Diversity
- 1633740 NRT-INFEWS: STEM Training for Actionable Research and Global Impact
- 2120001 NSF INCLUDES Alliance: Broadening Career Pathways in Food, Energy, and Water Systems with and within Native American Communities (Native FEWS Alliance)
- NSF I-Corp and NASA NNX15AD74G-Agogino Precision Hopping/Rolling Robotic Surface Probe Based on Tensegrity Structures
- 1927010 SBIR Phase II: Rapidly Deployable Mobile Sensor Robots for Disaster Response and Monitoring