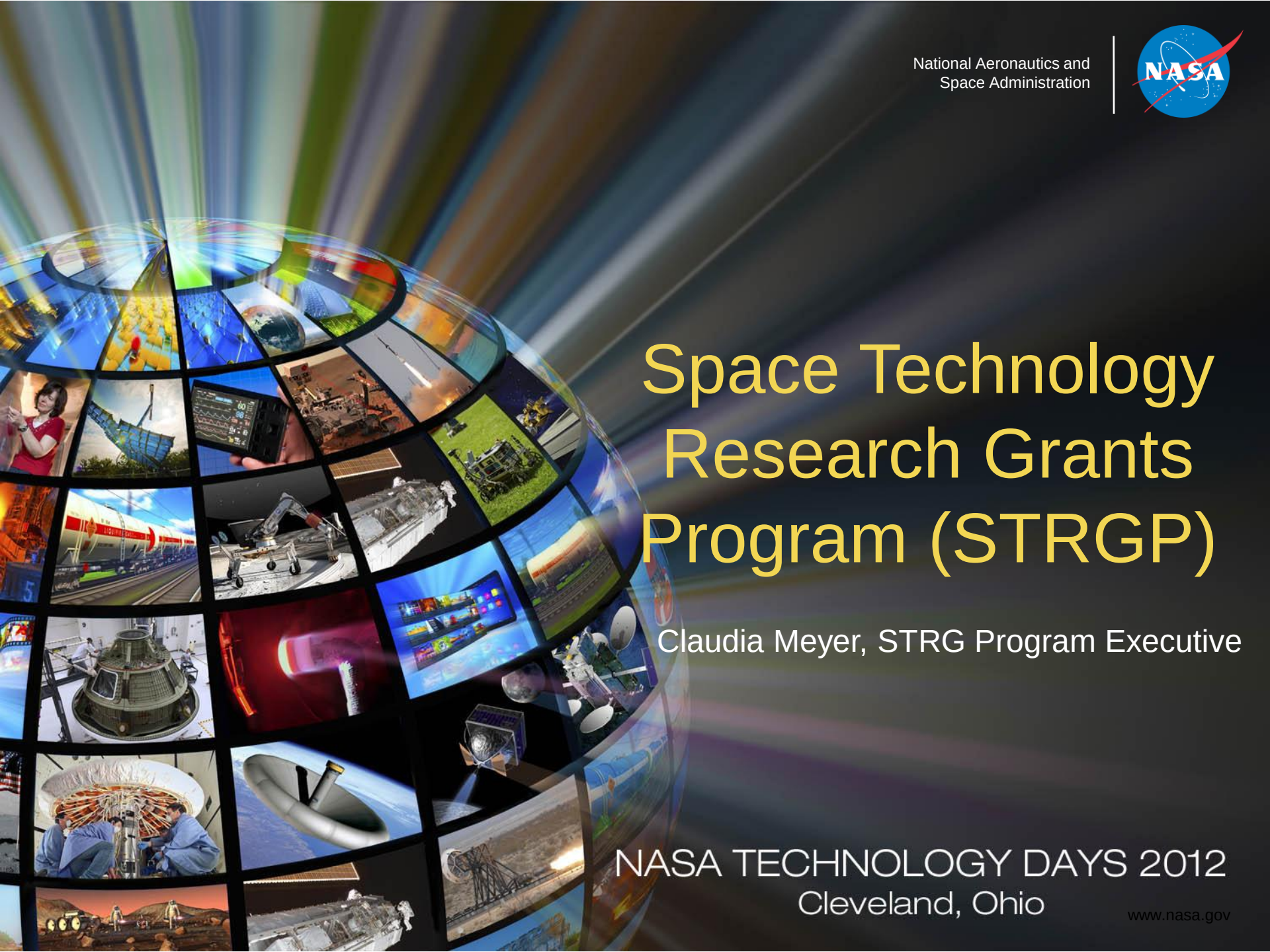


National Aeronautics and Space Administration

Space Technology Research Grants Program (STRGP)

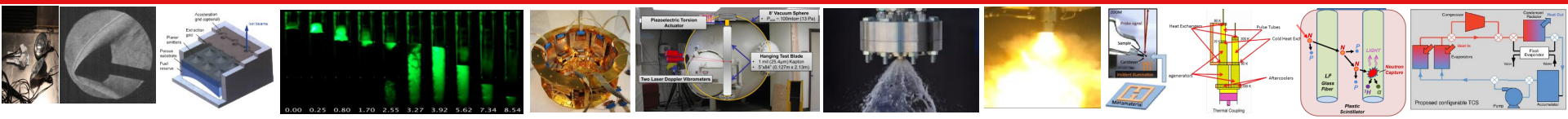
Claudia Meyer, STRG Program Executive

NASA TECHNOLOGY DAYS 2012

Cleveland, Ohio

www.nasa.gov

Space Technology Research Grants Program



- Invest in innovative, high-risk/high-payoff, low TRL groundbreaking space technology research
- Reinvigorate the pipeline of low TRL technologies and future technological leaders

NSTRF

STRO

NASA Space Technology Research Fellowships

- Competitive selection of U.S. Citizen / permanent resident graduate students
- Annual solicitation consistent with academic calendar
- Awards are training grants to U.S. universities
- Selected candidates perform graduate student research on their respective campuses and at NASA Centers and not-for-profit R&D labs
- Annual award value: ~$68K, up to four years of support possible

Space Technology Research Opportunities

- One or more NRAs expected annually. Awards are typically grants
- Two workhorse solicitations
  - *Early Career Faculty* – support for outstanding faculty early in their careers
  - *Early Stage Innovations* – university-led efforts, multiple investigators possible
- Annual award value: ~$200 - $250K, awards initially one year with 1 or 2 renewals possible (depending on solicitation)

STRGP Motivation

Improving America's Technological and Economic Competitiveness

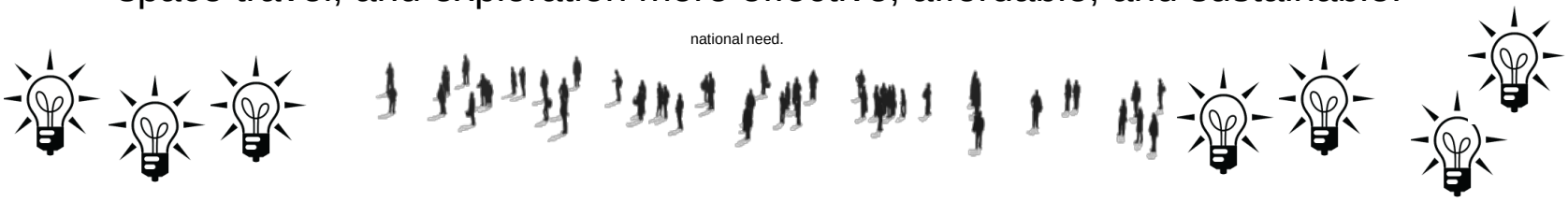
WHY? ➢ Our Nation's universities couple fundamental research with education, encouraging a culture of innovation based on the discovery of knowledge.

ALSO… ➢ Universities are ideally positioned to both conduct fundamental space technology research and diffuse newly-found knowledge into society at large.

- graduate students
- faculty
- industrial, government and other partnerships

SO… ➢ OCT investments in space technology research at U.S. academic institutions will promote the continued leadership of our universities as an international symbol of the country's scientific innovation, engineering creativity, and technological skill.

HOW? ➢ Tap into the talent base, challenging faculty and graduate students to examine the theoretical feasibility of ideas and approaches that are critical to making science, space travel, and exploration more effective, affordable, and sustainable.



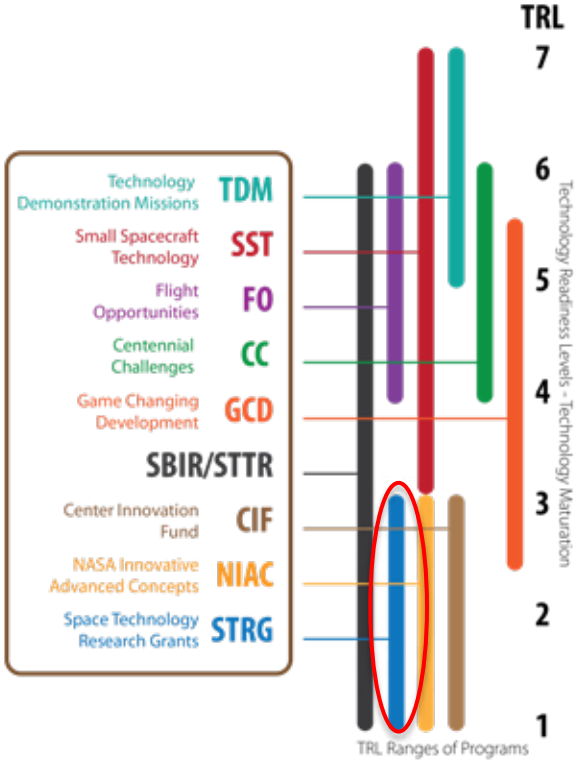
The Space Technology Research Grants Program endeavors will reinvigorate the pipeline of low TRL technologies and future technological leaders.

STRO: 2012 Solicitation Characteristics

Technical Features:

- Low TRL
- Specific topics tied to Technology Area Roadmaps
- Unique, disruptive or transformational space technologies
- Big impact at the system level: performance, weight, cost, reliability, operational simplicity or other figures of merit associated with space flight hardware or missions

http://tinyurl.com/NASAECF
http://tinyurl.com/NASAESI



Eligibility Summary:

- Proposal must be submitted by accredited U.S. university
- *Early Career Faculty*
  - PI must be recent Ph.D. (last 7 years)
  - Untenured assistant professor and on tenure track
  - U.S. citizen or permanent resident
  - No co-investigators
- *Early Stage Innovations*
  - PI must be from proposing university
  - At least 50% of the proposed budget must go to the proposing university
  - At least 70% of the proposed budget must go to universities
  - NASA Centers, other government agencies, and FFRDCs are permitted to collaborate
  - Co-investigators are permitted

NSTRF: Solicitation Characteristics

Eligibility Requirements for NSTRF13

1. Pursuing or seeking to pursue advanced STEM degrees.
2. Are U.S. citizens or permanent residents of the U.S.
3. Are or will be enrolled in a full-time master's or doctoral degree program at an accredited U.S. university in fall 2013.
4. Are early in their graduate careers.

*NSTRF**11**: http://tinyurl.com/NSTRF11-OCT.*
*NSTRF**12**: http://tinyurl.com/NSTRF12-OCT.*
*NSTRF**13**: http://tinyurl.com/NSTRF13.*

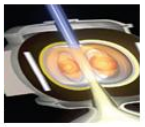
Application Components

1. Proposal Cover Page
2. Personal Statement
3. Project Narrative
4. Degree Program Schedule
5. Curriculum Vitae
6. Transcripts
7. GRE General Test Scores
8. Three Letters of Recommendation

Award Value

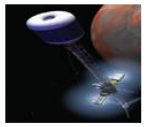
Fellowship Budget Category	Max value
Student Stipend	$36,000
Faculty Advisor Allowance	$9,000
On-site Experience Allowance	$10,000
Health Insurance Allowance	$1,000
Tuition and Fees Allowance	$12,000
TOTAL	$68,000

STRGP Portfolio



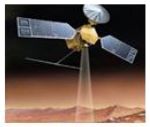
7 awards

14 awards



7 awards

19 awards



15 awards

14 awards

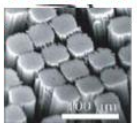
Washington
Oregon State
Stanford
UC, Santa Barbara
Caltech
Southern Cal
UC, Irvine
Arizona State
Arizona
Utah State
Brigham Young
Utah
Colorado State
Colorado
South Dakota School of Mines and Technology
Minnesota
Wisconsin
Northwestern
Michigan State
Michigan
IIT
Illinois
Purdue
Ohio State
Kentucky
Tennessee
Alabama-Huntsville
Georgia Tech
Auburn
Texas A&M
Texas
Rice
Houston
Florida
Duke
North Carolina State
Virginia
Virginia Tech
Maryland
Johns Hopkins U.
Carnegie Mellon
Penn State
Penn
Case Western Reserve
RIT
Cornell
Rochester
Yale
Brown
Columbia
Princeton
SUNY Stony Brook
Boston U.
MIT
UMass
New Hampshire
Puerto Rico

148 awards
29 states
1 U.S. Territory
57 universities

2 awards

18 awards

11 awards



9 awards

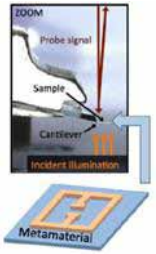
8 awards

16 awards

8 awards

STRO: Early Career Faculty Portfolio (2012)

Ultralight Nanolattices with Co-Optimized Mechanical, Thermal, and Optical Properties
Chih-Hao Chang
NC STATE UNIVERSITY

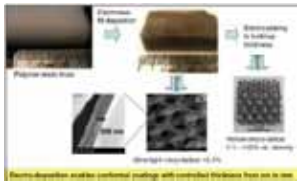


Radiation Pressure on Tunable Optical Metamaterials for Propulsion and Steering Without Moving Parts
Jeremy Munday
UNIVERSITY OF MARYLAND

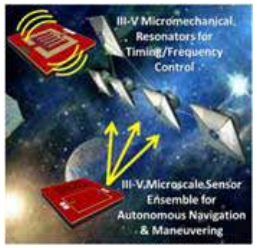
Autonomous Food Production
Nicolaus Correll
Colorado
University of Colorado Boulder

Figure 3: Stanford's space robotics facility

Algorithmic Foundations for Real-Time and Dependable Spacecraft Motion Planning
Marco Pavone
STANFORD UNIVERSITY

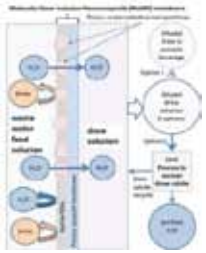


Development of Lightweight, Radiation- and Damage-Tolerant Micro-trusses
Julia R. Greer
Caltech



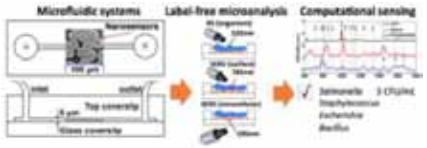
III-V Microsystems Components for Positioning, Navigation and Timing in Extreme Harsh Environments
Debbie Senesky

STANFORD UNIVERSITY



Development of Corrosion-resistant Molecular Sieve Inclusion Nanocomposite (MoSIN) Membranes to Recover Water from Urine Through Osmotic Processes
Mary Laura Lind
ASU ARIZONA STATE UNIVERSITY

Self-repair and Damage Mitigation of Metallic Structures
Michele Manuel
UF UNIVERSITY of FLORIDA

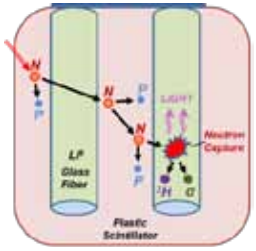


Environmental Control & Life-Support Systems
Wei-Chuan Shih

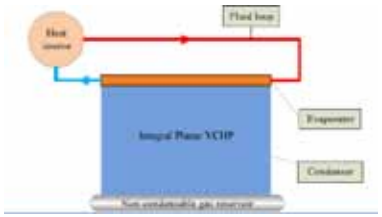
UNIVERSITY of HOUSTON

Photo of early career faculty = present at Technology Days event

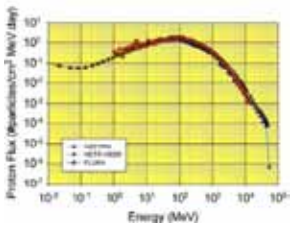
STRO: Early Stage Innovations Portfolio (2012)



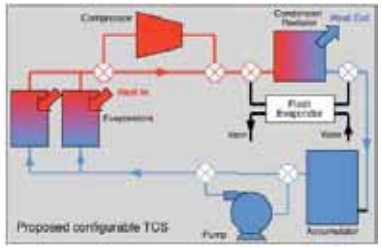
Advanced Scintillating Fiber Technology in High Energy Neutron Spectrometers for Exploration
James Adams
UAHuntsville



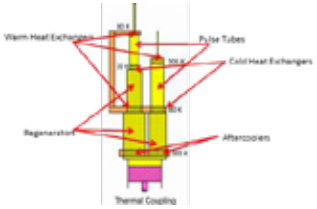
Heat Rejection System for Thermal Management in Space Utilizing a Planar Variable-Conductance Heat Pipe
Yasuhiro Kamotani
Case Western Reserve University



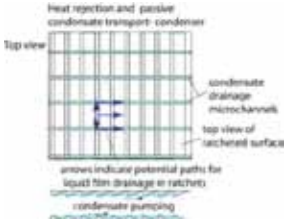
Computational Approaches for Developing Active Radiation Dosimeters for Space Applications Based on New Paradigms for Risk Assessment
Thomas Borak
Colorado State University



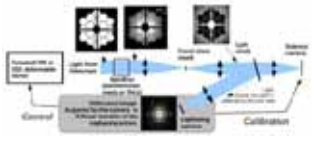
Adaptable Single Active Loop Thermal Control System (TCS) for Future Space Missions
Issam Mudawar
Purdue University



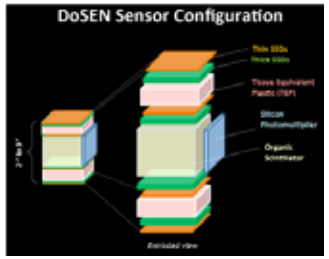
Light Weight, 20 K Pulse Tube Cryocooler for Active Thermal Control on Future Space Exploration Missions
Seyed Ghiaasiaan
Georgia Institute of Technology



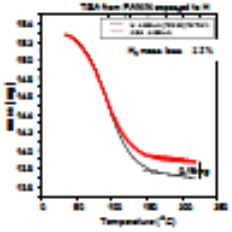
Enabling Self-Propelled Condensate Flow During Phase-Change Heat Rejection Using Surface Texturing
Vinod Narayanan
Oregon State University OSU



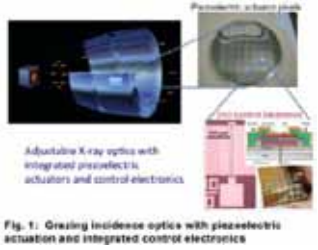
Wavefront Control for High Performance Coronagraphy on Segmented and Centrally Obscured Telescopes
Olivier Guyon
The University of Arizona



Small Active Readout Device for Dose Spectra from Energetic Particles and Neutrons (Dosen)
Nathan Schwadron
University of New Hampshire



High Hydrogen Content Nanostructured Polymer Radiation Protection System
Alex Ignatiev
University of Houston



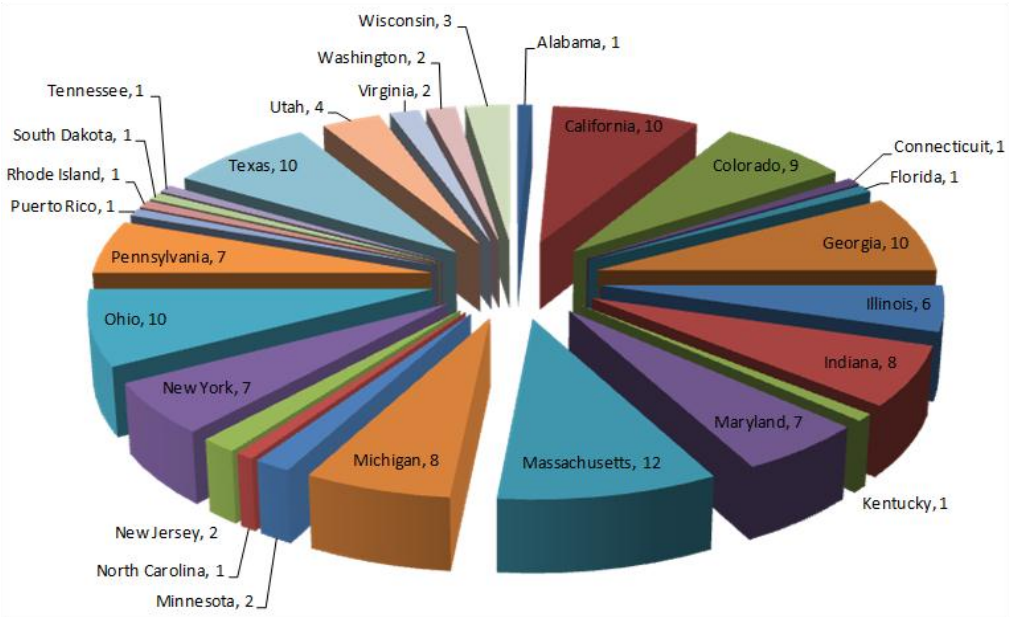
Integrated Control Electronics for Adjustable X-Ray Optics
Susan Trolier-McKinstry
Penn State

NSTRF: Current Portfolio

Covering 13 Technology Areas

26 states, 1 U.S. territory… and 50 universities

Auburn
Boston U
Brigham Young
Brown
Cal Tech
Carnegie Mellon
Case Western Reserve
Colorado State University
Columbia
Cornell
Duke
Georgia Tech
Illinois Institute of Tech
Johns Hopkins
Michigan State
MIT
Northwestern
Ohio State
Penn State
Princeton
Purdue
Rice
Rochester Institute of Tech
SD School of Mines
Stanford



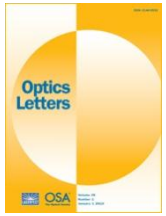
NSTRF 11 and 12
128 graduate students conducting space technology research

SUNY – Stony Brook
Texas A&M
U of Cal – Irvine
U of Cal – Santa Barbara
U of Colorado – Boulder
U of Florida
U of Illinois
U of Kentucky
U of Maryland
U of Massachusetts
U of Michigan
U of Minnesota
U of Pennsylvania
U of Puerto Rico
U of Rochester
U of Southern California
U of Tennessee - Knoxville
U of Texas – Austin
U of Utah
U of Washington
U of Wisconsin
Utah State
Virginia
Virginia Tech
Yale

NSTRF: Technical Accomplishments

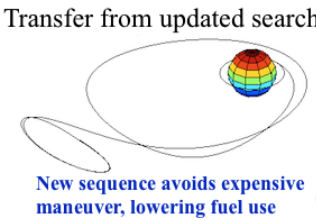
Next chart shows description for each image.

1

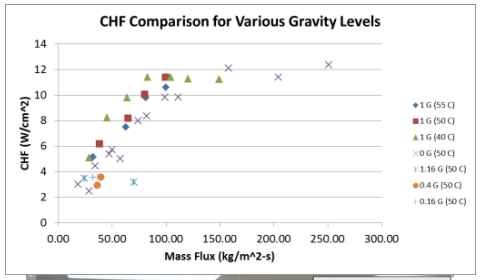


2

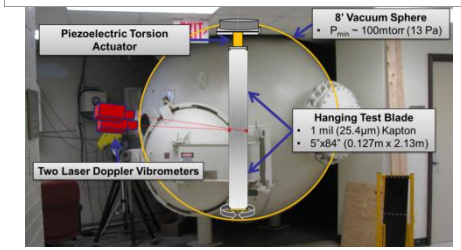
3



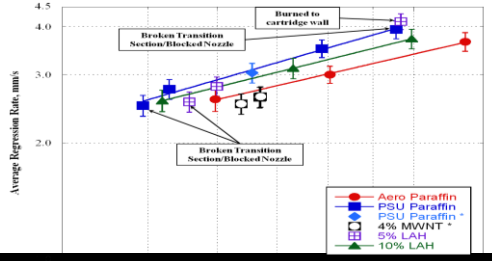
4



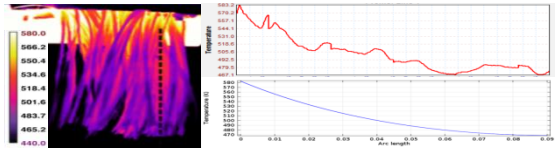
5



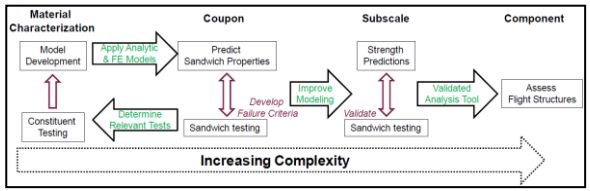
6



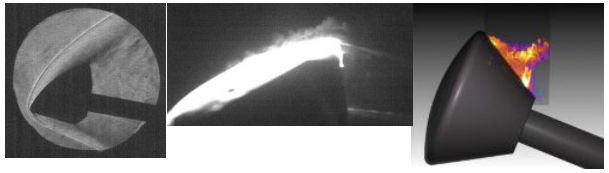
7



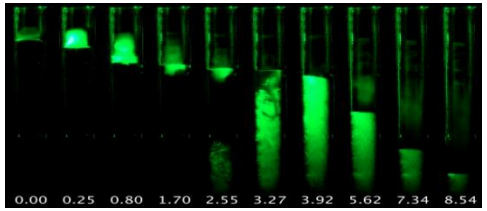
8



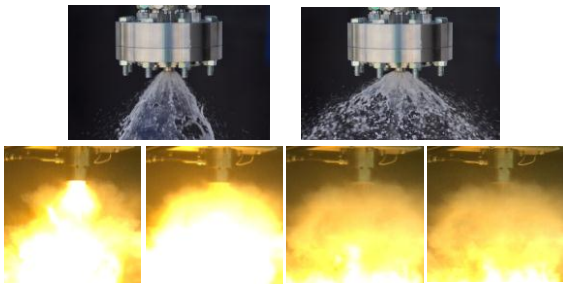
9



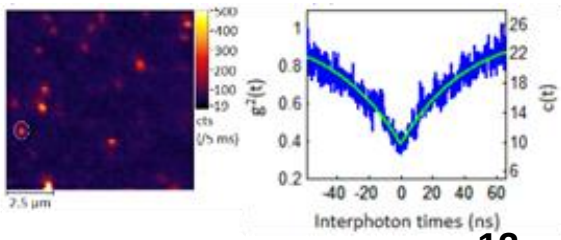
10



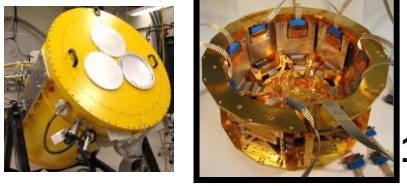
11



12

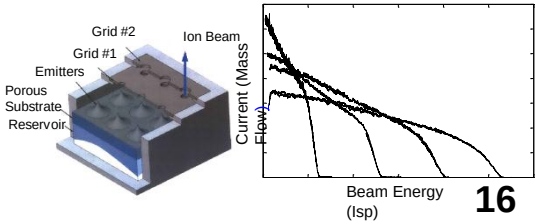


13

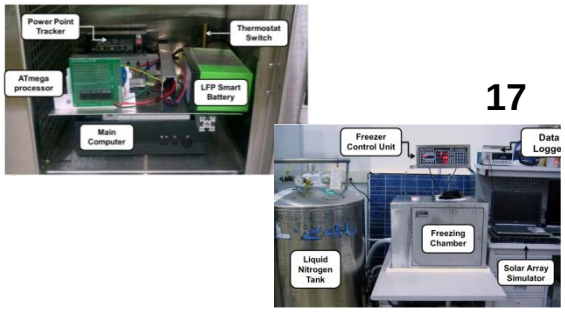


14

15



16



17

NSTRF: Technical Accomplishments

Number in lower-right of each box corresponds to image on previous chart.

"A Survey of Communication Sub-systems for Intersatellite Linked Systems," Journal of Communications, Vol. 7, No. 4, 2012. (**Paul Muri**, University of Florida) **1**

"Resonance in Quantum Dot Fluorescence in a Photonic Bandgap Liquid Crystal Host." Optics Letters, 37, N 7, p.1259, 2012. (**Justin Winkler**, University of Rochester) **2**

Completed design, construction, testing, and calibration of a position-sensitive diode sun sensor for EBEX. (**Kyle Helson**, Brown University) **3**

Completed proof-of-concept trajectory redesign tool. Demonstrated the generation of multiple transfers for example system in seconds. (**Eric Trumbauer**, University of California, Irvine) **4**

Two weeks of parabolic flights were completed in April and May 2012 during which various tube sizes and gravity levels were tested. (**Alex Scammell**, University of Maryland) **5**

Collected the frequency response of a hanging heliogyro blade in a vacuum chamber. (**Dan Guerrant**, University of Colorado, Boulder) **6**

With the Aerospace Corporation, showed that paraffin fuel grains with LiAlH4 particles have enhanced regression rates. (**Dan Larson**, Penn State University) **7**

Demonstrated temperature profile agreement between test article and finite element fin model. (**Briana Tomboulian**, UMass, Amherst) **8**

Zach Kier (University of Michigan) and his colleagues received IR&D funding from the Aerospace Corporation for material fabrication, cold temperature testing, and damage tolerance investigation. This will provide critical data for validating the models. **9**

Schlieren and PLIF images of the Orion Capsule model at Mach 5. (**Christopher Combs**, University of Texas, Austin) **10**

Novel experimental apparatus with optical measurements show that previous self-pressurizing propellant systems models' assumptions are incorrect. (**Jonah Zimmerman**, Stanford University) **11**

Measurements from cold-flow and hot-fire test series with fabricated hypergolic pintle thruster.
https://vimeo.com/47469840
(**Brandon Kan**, Purdue University) **12**

Single-photon emission (~800 nm) from CdSeTe quantum dots in photonic-bandgap glassy chiral liquid crystal host. (**Justin Winkler**, University of Rochester) **13**

Fully assembled ACTPol array and completed integration of ACTPol receiver with custom dilution refrigeration system. (**Emily Grace**, Princeton University and **Benjamin Schmitt**, University of Pennsylvania) **14**

Microgravity testing on airplane yielded what is believed to be the first 0g results where a steady state condensed fueled flame was established on a planar surface in quiescent and ambient conditions. (**Michael Bustamante**, University of Maryland) **15**

As evidenced in proof-of-concept experiments, dual grids allow for the specific impulse to be modulated independent of the engine power (very useful in power-limited applications). (**Chase Coffman**, MIT) **16**

Low cost hibernating power system built: battery survived repeated freezes to cryogenic temperature without physical damage or loss of capacity and consumer electronics survived repeated freezes to cryogenic temperature and performed subsequent burn in tests without error. (**Ethan Minogue**, Carnegie Mellon University) **17**

NSTRF: Presenting at Technical Conferences

AIAA Fluid Dynamics Conference
New Orleans, LA
June 25-28, 2012

AIAA/AAS Astrodynamics Specialists Conference
Minneapolis, MN
August 13-16, 2012

International Union of Radio Science (URSI) National Radio Science Meeting
Boulder, CO
January 4, 2012

International Planetary Probe Workshop (IPPW-9)
Toulouse, France
June 2012

Annual Meeting of the APS Division of Fluid Dynamics
San Diego, CA
November 18-20, 2012

AIAA/AMSE/SAE/ASEE Joint Propulsion Conference & Exhibit
Atlanta, GA
July 29-31, 2012

AIAA Aerospace Sciences Meeting
Nashville, TN
January 9-12, 2012

SPIE Astronomical Telescopes + Instrumentation Conference
Amsterdam
July 1-6, 2012

IEEE ICRA Conference
St. Paul, MN
May 14-18, 2012

AIAA/Utah State University Small Satellite Conference
Logan, UT
August 13-16, 2012

AIAA Space Conference and Exposition
Pasadena, CA
September 11-13, 2012

AIAA Structures, Structural Dynamics and Materials Conference
Honolulu, HI
April 23-26, 2012

IEEE Aerospace Conference
Big Sky, MT
March 2012

AIAA Guidance, Navigation, and Control Conference
Minneapolis, MN
August 13-16, 2012

Materials Research Society Spring Meeting
San Francisco, CA
April 9-13, 2012

ASME International Mechanical Engineering Congress and Exposition
Houston, TX
November 9-15, 2012

AIChE Annual Meeting
Pittsburgh, PA
October 28 - November 2, 2012

American Astronautical Society Guidance, Navigation and Control Conference
Breckenridge, CO
3-8 February 2012

Planned Year-1 Conference Attendance for NSTRF11 Fellows

National Aeronautics and Space Administration

Example of an NSTRF Task

Sensory Integration and Decision Making Based on Insect Brain Model

Brian Tietz, Case Western Reserve University
NSTRF Student Fellow – 2011 Class

Roger Quinn, faculty advisor
Vytas Sunspiral, NASA mentor

NASA TECHNOLOGY DAYS 2012
Cleveland, Ohio

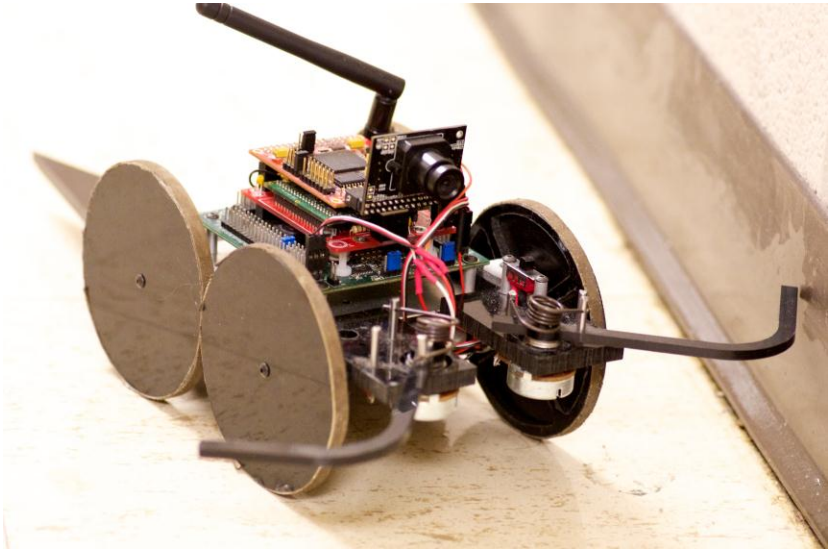
www.nasa.gov

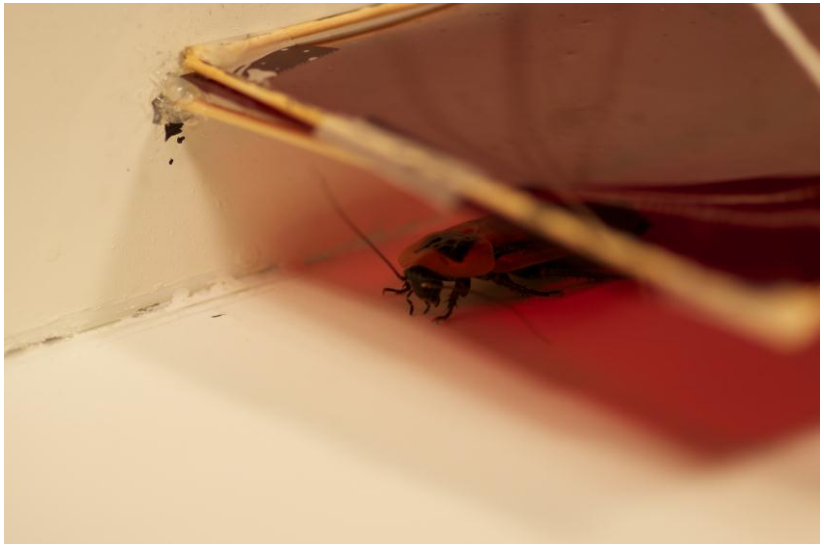
Research Plan

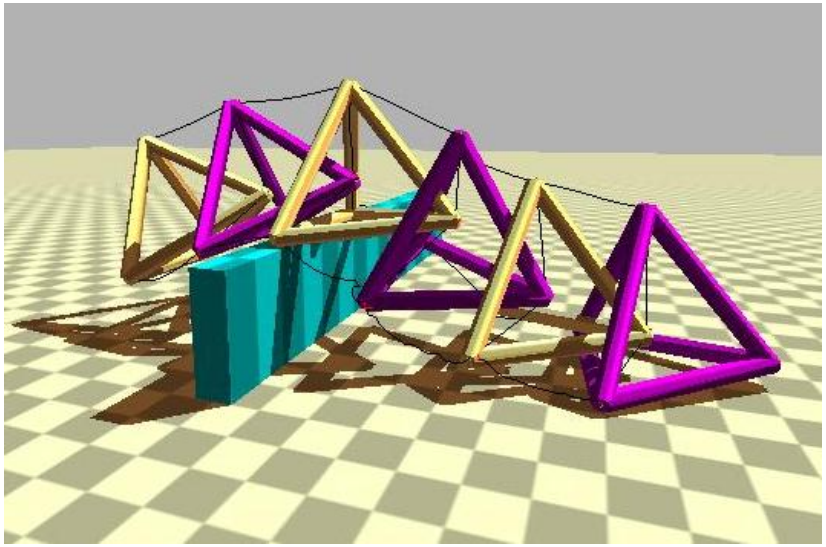
Goal: Autonomous decision making for locomotion and exploration

Relevance:

- Autonomous controller for planetary exploration
- Designed for all terrain mobility in unanticipated situations

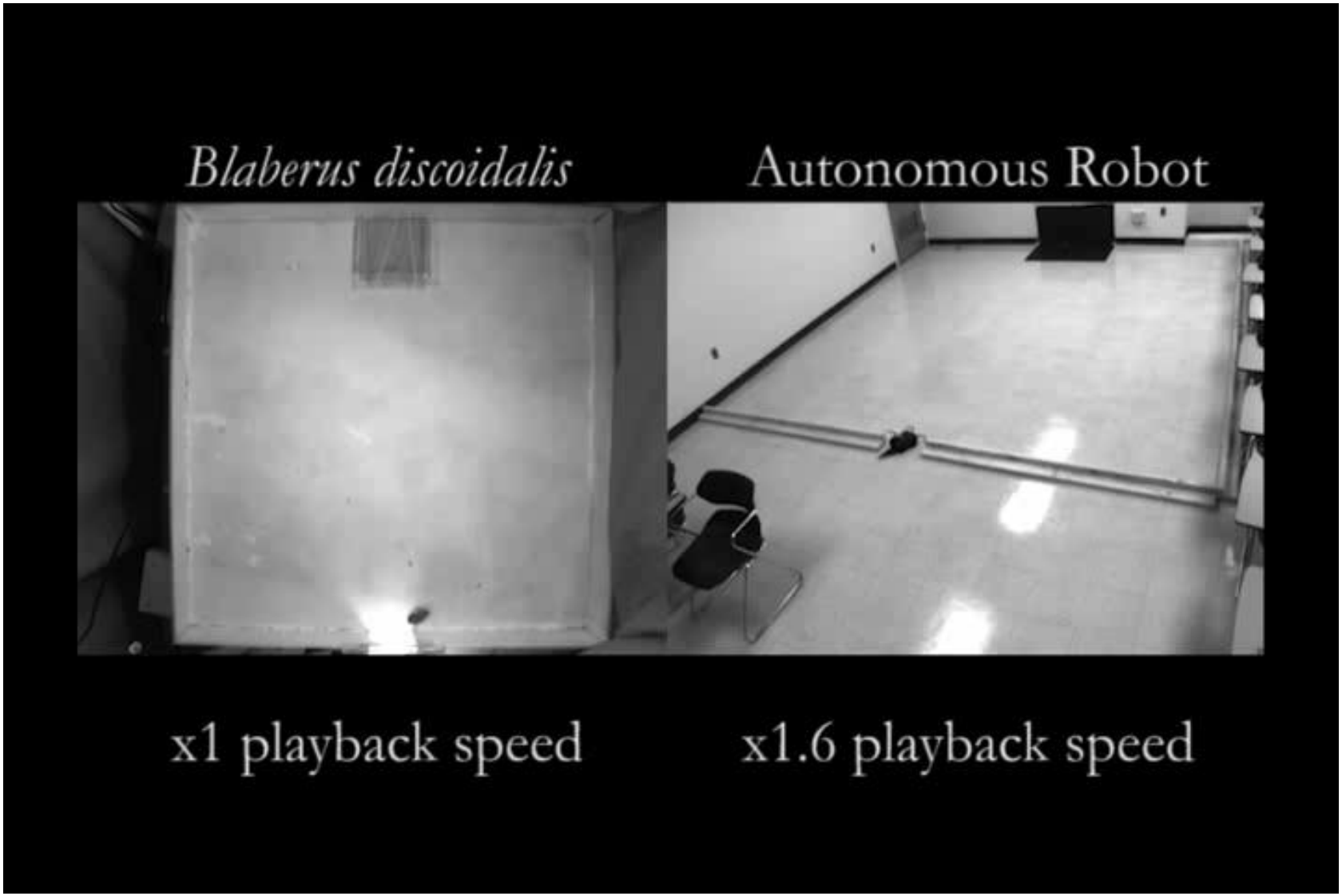






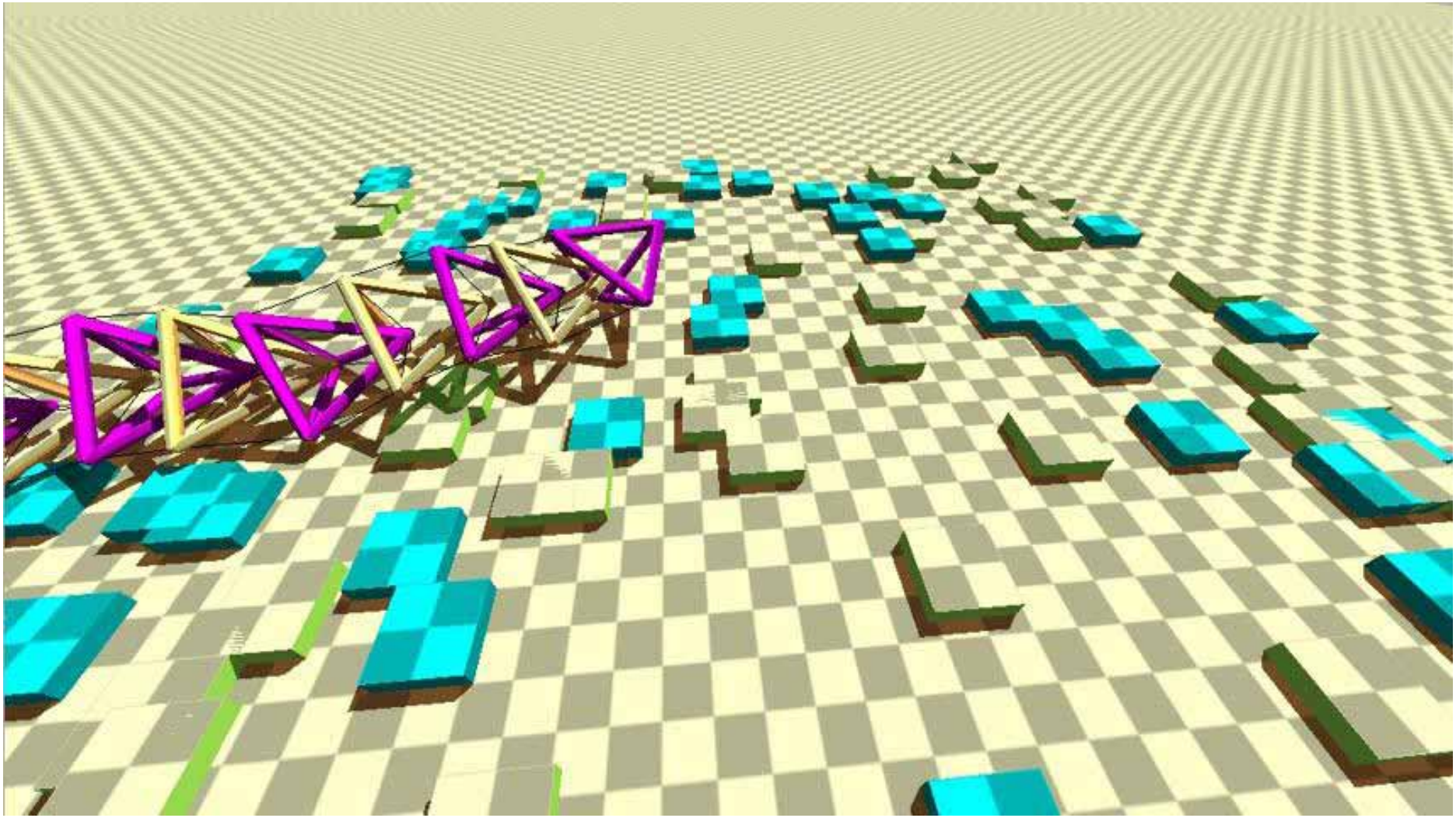
CWRU Work

- Matching robot behavior to cockroach behavior
- Next: Biological neural network, central pattern generators for decisions while moving



Ames Work

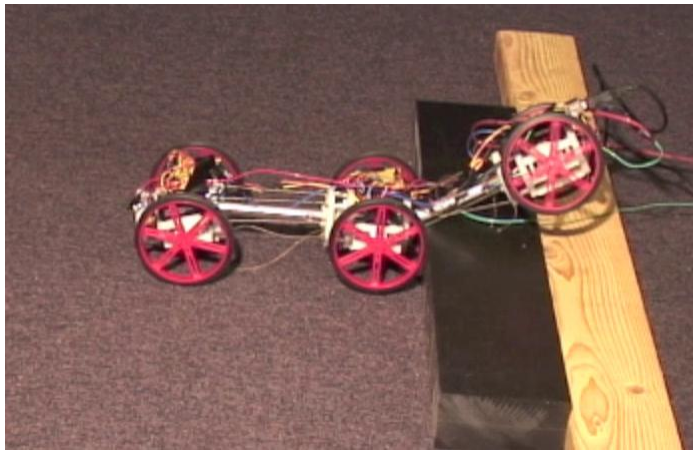
Compliance in the structure and local control, no visual or contact sensors used

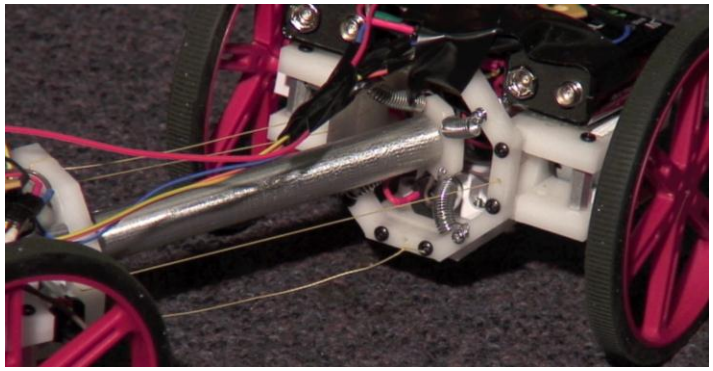


Connections

- New team of researchers for collaboration (cross pollination)
  - Paper submission for CWRU team
  - Tensegrity as course & senior project

"While I was not aware of Dr. Quinn and his students' work before this, they are doing very relevant work, and I'm already learning a lot from interacting with them. This is going to be an excellent long-term partnership."
–Vytas Sunspiral, NASA Mentor



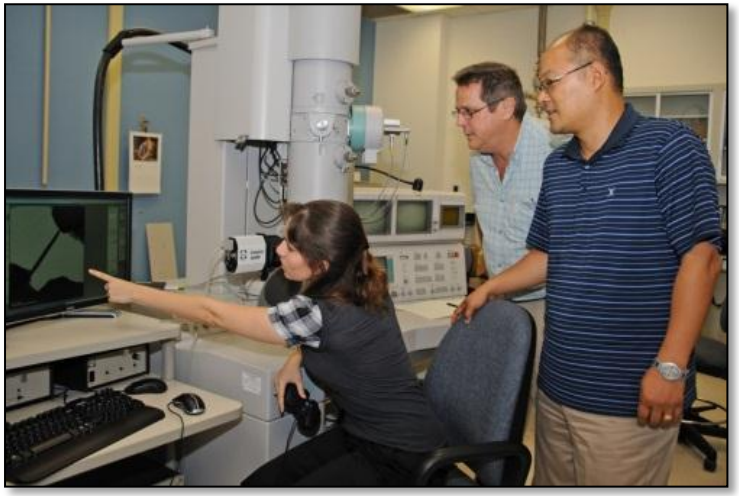


Webster, Lonsberry, Horchler, Shaw, Chiel, Quinn, ICRA 2013

STRGP: 2013 Plans and Contact Information

- The STRG Program will continue its efforts to develop future technical leaders and facilitate new collaborations while sponsoring the development of new and emerging technologies of high priority to NASA and the aerospace community.

- New solicitations will target new, high priority technology areas, which, in turn, will increase both the number of participants engaged in space technology development, and the breadth of technologies being worked.



Jennifer Carpena at LaRC, NSTRF Class of 2011

STRGP Contact Information:

- Claudia Meyer, Program Executive
- Andy Eckel, Program Manager
- NASA-STRG@mail.nasa.gov
- http://www.nasa.gov/offices/oct/stp/strg/index.html

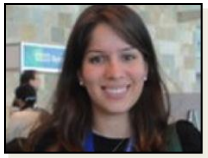
Benjamin Schmitt at NIST, NSTRF Class of 2011

Interactions while at Technology Days

Please feel free to interact with our NSTRF researchers who are here…


Adriana Popa


Michael Sekerak


Jennifer Carpena


Benjamin Schmitt


Paul Muri


Benjamin Reinke


Kyle Stewart


Daniel Morgan


Benjamin Ashman


Brian Tietz


Jaemi Herzberger


Brian Michal


Edward Chen


Daniel Lubey


David Surovik


Heather Jones


Hannah Clevenson

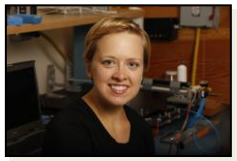

Michael Eades


Matthew LaRue


Corwin Olson


Olivia Lenz


Nicholas Szczecinski


Shannon Zirbel


Julian McMorrow


Benjamin Bunes

STRG Breakout Session (must be pre-registered)
Day 2, November 29, 2012 One-on-One Meetings 1:00-3:00, Room LL06