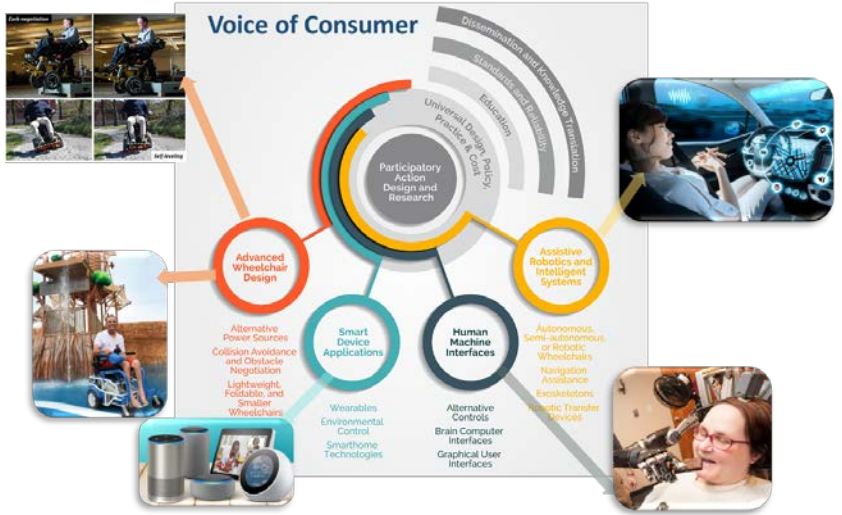
Extraordinary Engineering Impacts on Society

Outcomes and Lessons Learned from NSF ASPIRE REU and other NSF Funding Mechanisms

Rory A. Cooper, PhD

Nation Council on Disability

“The disability community knows better than any other how being involved in the planning from day one is critical to a successfully accessible product, regardless of how many years in the future it lies.“



"Never Leave a Fallen Comrade"

Rory Cooper, left, competing with Tim Davis in the Central Coast Marathon last December, hopes to raise enough money to compete in the National Wheelchair Games in Hawaii June 14-19.

ERIC BJERKEN / TELEGRAM TRIBUNE

Cooper has life back on track

By Jon Hastings
Staff Writer

Rory Cooper was born to race.

Nothing has stopped him the past 23 years — not even a semitruck in Wormis, Germany, nearly three years ago.

Cooper was paralyzed from the mid-stomach down after the bicycle he was riding collided with a city vehicle on July 23, 1980.

And while Cooper is quick to recall the exact date of the accident, he seems far removed from the incident. The past is just that — the past.

Cooper, a 1977 graduate of San Luis Obispo High School, is more concerned with the future — which he looks upon with plenty of optimism.

The junior electrical engineering major at Cal Poly is one of the nation's premier wheelchair athletes, concentrating on track and field.

He is currently trying to raise money through a drawing to subsidize his trip to Honolulu, Hawaii, for the National Wheelchair Games on the University of Hawaii-Manoa campus. The Games are slated for June 14-19, with over 300 athletes competing.

Cooper is the current Class 3 Division collegiate record holder in the 1,500 meters with a time of 3:30.44.

He also competes in the 400, 800 and marathons, displaying potential in just about every event he enters.

Cooper competed on the track team at SLO High for two years, specializing in the two-mile. "I was slow," he now says of his top prep time of 10:41.00.

He kept his running up in the army, competing on the all-Armed Forces team in Germany.

He said it didn't take long to get involved in athletics after the accident.

"Athletics for people in wheelchairs is as critical because part of what you lost — or the physical limitations — can be overcome through athletics," said Cooper. "Your physical well-being becomes more important once you have a physical disability.

"I kind of think athletics is the key to my mobility, which is my independence. By working through athletics I have more awareness and also I have greater strength and better health. Participation sports opens so many doors."

Cooper said he didn't brood about his situation, even immediately after the accident: "No, because my injury wasn't that serious."

Part of Cooper's positive thinking may be a result of what a German newspaper printed days after his accident. It may have made him realize what could have been. The publication erroneously reported he had been killed in the accident.

"Of course I didn't know about it, but my first reaction was what Mark Twain said: 'Rumors of my death are greatly exaggerated.'"

Cooper's enthusiasm for life, however, isn't exaggerated at all.

He plans to get even more involved in wheelchair athletics, both as a participant and as a organizer. In April he was responsible for organizing the Tri-City Wheelchair Track Meet at Cal Poly.

Over 25 athletes competed — a number Cooper wasn't particularly impressed with. Next year he hopes to have closer to 100.

"It seemed like we had more spectators and helpers this year than participants."

Cooper also hopes to start focusing more attention on marathons. His best time thus far has been 2:18.00. The world record is held by Jim Knaub (1:47.00).

Cooper thinks he can lower his own time by nearly an hour in the immediate future.

He currently devotes 25 hours a week to his training, which includes every two hours a day on the track. His muscular upper body is the result of rigorous weight training.

"My upper body has never been this strong before," he said.

He hopes to be in Boston next spring for the most prestigious of all marathons.

For now, however, he still needs some help getting to Hawaii.

Tickets for the benefit drawing are available at the Disabled Students Office on the Cal Poly campus and in the University Union.

Several prizes, including free dinners, albums and the grand prize of a one-month membership to a local health club will be offered.

YAKITORI

By David Lammers

It's the thought that counts

We had flown across the United States and checked into the Sheraton Hotel in downtown Seattle. My three young children all started wailing for something to eat, preferably a hamburger.

I was tired and needed a shower, but we took the kids down the street and into a Wendy's. To get the kids out of my hair, I asked my weary, pregnant wife to go find a table while I ordered food for all of us.

I carried two trays over to where my family was waiting. But the only place for me to sit was at a small table nearby. A man in a wheelchair was already sitting at one side of the table, eating a baked potato and drinking milk.

"Mind if I sit down here?" I asked.

"Go right ahead."

The guy had a beard and wore an old tee shirt with a wheelchair racer on the front. My mind started turning.

"This is downtown Seattle. This guy is probably living on a stipend, in some rooming house. A baked potato is probably all he can afford," I thought to myself.

"Nice children you have over there," he said. He spoke with a confident voice. Pretty soon I felt comfortable enough with Rory Cooper to ask what had put him in a wheelchair.

He had been living in West Germany, working as a translator—a *certified* translator, he told me. One day, while he was riding a bicycle, a bus ran over him.

After he got out of the hospital, he went to California and got interested in electronics. He got his PhD in electronics engineering last year. His dissertation was in control theory, and now he is teaching at the University of California at Sacramento and developing controls that ease the lives of people in wheelchairs.

My mind flashed back to 1972. Working at a golf course outside of Boston, I was riding a bicycle to work early one sunny Sunday morning when a German shepherd, sitting on the front porch of a mansion, spotted me. His ears stood straight up, and he tore across the lawn.

Way behind me I heard a car go into a slide. The dog grabbed my coveralls at the ankle, and my 10-speed started to topple. The sliding car closed in.

"It's over," I thought, forgetting Yogi Berra's maxim.

Later, the doctor told me how lucky I was that my rear end had jammed into the car's passenger window without damaging my spinal column.

I thought of that incident while I talked to Cooper.

He said he was in Seattle for a big wheelchair race at the University of Washington. His wife, a German, was back home for a visit. He thanked us for the dinner company before he wheeled down the street to his hotel.

I promised myself never to judge someone again, and never to feel sorry for myself again over some stupid little thing.

Promises like that are more easily made than kept.

I thought about Cooper again the other day. My wife was in a small maternity hospital, having given birth to a healthy baby girl a few days earlier. The kids started wailing for something to eat, preferably a hamburger.

After paying for the second extra cheeseburger, I commenced to worrying: "How can we take care of all of these kids? How much will it cost to send all of them to school?" And so on.

No bearded man wheeled in to ease my mind. But I remembered the man I'd met in a distant hamburger joint, and I felt a bit stronger. For a moment I thought about how lucky we are. I thought about how some people deal with adversity and strive for greatness.

With human beings, most of the time it's the thought that counts, one way or another.

NSF QuOTE

- Key contributions:
  - Created a system to collect baseline information on PWDs in STEM fields at PITT.
  - Synthesized literature on success strategies and barriers to success for PWDs in STEM.
  - Developed and administered a survey of alumni and current PWDs in STEM at PITT identifying success strategies and barriers.
    - The literature review and the survey formed the foundation for a mentor course.
  - The project developed an academic field, retention, and graduation tracking database adopted by PITT Disability Resources and Services
    - Collected baseline data on PWDs at PITT used by Trustees to make improvements; increased knowledge of and success rate with fellowships and scholarships for PWDs.

HRD-1128797

NSF ASPIRE REU

- >200 students have participated in the ASPIRE program.
  - Participants have been about 55% women, and >25% of students reported to have an impairment that limits one or more daily activity.
  - On average, over 20% of the students supported have been from racial or ethnically diverse populations.
  - Nearly 80% were majoring in engineering (biomedical, mechanical, computer, industrial, or electrical) and the other students were majoring in rehabilitation sciences, computer science, math/physics, or other science field.
- Craig H. Nielsen Foundation (CHNF) program, which provides meaningful STEM research opportunities to students with spinal cord injuries
- VA VALOR program – graduate and undergraduate student interns interested in federal research career.
- Expansive interactive experiences with mentors and course/workshop presenters.
- Elevator pitch competitions, scientific/technical posters and papers, and symposia with the opportunity to reach a large external audience.
- Research paper based on the work they have completed over the course of the program.
  - Conference review committees have accepted all papers submitted.
- The student feedback of the program has been very positive since its inception.

EEC-1262670, EEC-1560174, EEC-1852322, EEC-2149772

Technology promotes social mobility, health, and participation

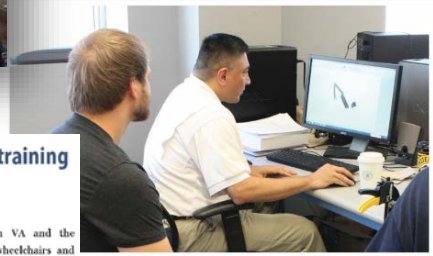
[video not included in PDF]

NSF ELeVATE

- New model intervention for Veterans with disabilities (VwD) that has been replicated at universities and supported by state and federal agencies.
- ELeVATE is a holistic college transition and success program that provides support to Veterans in engineering or technology programs.
  - The program is comprised of multiple components, including academic support, professional development, counseling, and community reintegration.
  - Each participant works on a research or development project under the guidance of a mentoring team that includes a Veteran in the community who has successfully transitioned to gainful employment and is able to link the participant to job opportunities.
  - Participants prepare a paper and the program culminates with a Symposium and Poster Session.
- Participated in I-Corps for Learning (I-Corps-L) pilot program, with the focus on scaling and replication of ELeVATE at academic institutions nationwide.
  - Created a “How to Guide” to assist with the replication process and made it available on the program website.
  - Led to several ELeVATE sites ELeVATE inspired the creation of the Research Experience for Veterans and Teachers (REV-T), as a NSF-RET, the program connected Veterans and STEM teachers, who learned to apply Participatory Action Design and Engineering principles and create devices.

IEECI-1036964, REE-1232336

Experiential Learning for Veterans in Assistive Technology and Engineering - ELeVATE



Research lab **offers job training** for wounded warriors

A joint research program between VA and the University of Pittsburgh that studies wheelchairs and related technology is now helping to train disabled Veterans for careers in machining.

The program is called Fabrication of Assistive Technology Program for Wounded Warriors. It's run by the Human Engineering Research Laboratories, a collaboration between the VA Pittsburgh Healthcare System and the University of Pittsburgh School of Health and Rehabilitation Sciences.

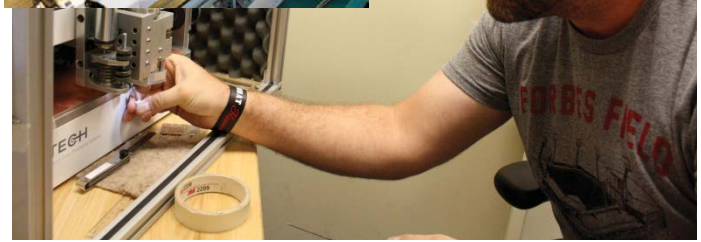
The program is being launched this fall with the help of a $100,000 donation from Highmark Blue Cross Blue Shield.

Created by director Rory Cooper , PhD, and education and outreach project director Mary Goldberg at HERL, the program will prepare participants to pass a basic machining exam. The participants will also get on-the-job training at local companies, which could lead to permanent, full-time jobs.

82% of ELeVATE participants have are currently enrolled in or have completed 2-year or 4-year STEM degree programs.

"The ELeVATE program is incredible. It not only better prepared me for pursuing a degree in engineering, but it was extremely beneficial in what it offered to me as a Veteran."

"Deciding to take part in ELeVATE was the best decision I could have made. Participating has put me back on track to go to school in the fall; it pushed me out of my comfort zone and led me to learn new things."



IEECI-1036964
REE-1232336

Facilitating Veteran Transition to STEM

Veteran transition and rehabilitation programs need to understand military and civilian culture

IEECI-1036964
REE-1232336

[video not included in PDF]

NSF AIM and ACCESS ATE

- Advancing Inclusive Manufacturing (AIM) program extended Advanced Manufacturing (AM) training and employment opportunities to PWDs.
  - Broad range of industry, academic, and advocacy experts
  - Designed, developed, and delivered didactic and experiential curricula tailored for PWDs and provided guidance to academia and industry on making accommodations for PWDs.
- Achieved the following:
  - Curricular materials that promote inclusion
  - Accommodations to maximize participation
  - Technical and job skills training to PWDs.
  - Partnership between the PITT, Hiram G. Andrews Center (HGAC), and the Commonwealth Technical Institute (CTI).
- Evaluated AM curricula, tailored curricula/facilities to accommodate PWDs and advanced knowledge base by providing guidance to educational institutions.
- AccessATE: Making Community College Technician Education More Accessible for Everyone is a multi-institutional partnership, led by University of Wisconsin-Madison, to make advanced technology education more available and accessible to a PWDs with best practice models and educational resources.
  - PITT is a core partner providing expertise focused on veterans and people with physical impairments.

DUE-1406757, DUE-1836721

Barriers exist in STEM education that reduce participation by students with disabilities.

Evaluating and Modifying an Advanced Manufacturing Curriculum for People with Disabilities.

- **Source:** Journal of Applied Rehabilitation Counseling , Winter2016, Vol. 47 Issue 4, p30-42. 7p.
- **Author(s):** Goldberg, Mary; Millerville, Maria; Donaldson, Alexis; Hill, Victoria; Marino, D. Joshua; Rivera, Victor; Grindle, Garrett; Spooner, Michelle; Relich, Debra; Cooper, Rory A.
- **Abstract:** People with disabilities (PwD) are two times as likely to be unemployed as the general population and are particularly not well represented in advanced manufacturing (AM) fields. This study, which features the Advancing Inclusive Manufacturing (AIM) program located at a large University in the Northeast, serves as one approach to empowering PwD by teaching them the skills needed to be successful in an advanced manufacturing (AM) career. The program components help participants identify strengths and build self-advocacy to progress to a subsequent career stage. Seventy-five percent of AIM graduates entered the workforce or continued their education while 25% are pursuing employment in the AM sector. These results suggest the AIM program may result in PwD' to integration to the workforce and interest in continued professional development. Despite the AM focus of the AIM program, the results are still unclear whether the program is successful in sustained employment in that particular sector.
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EBSCO INFORMATION SERVICES

NSF QoLT ERC

- PITT and CMU partnered on the QoLT ERC to create a scientific and engineering knowledge base that enables systematic development of human-centered intelligent systems that co-exist and co-work with people, particularly PWDs.
- Contributions of the QoLT ERC have influenced the growth in human-centered design in robotics and intelligent systems and establishing new fields of study such as soft-robots, virtual coaches, and human-robot collaboration.
- Influenced industry with QoLT alumni in influential positions with Amazon, Google, Microsoft, Permobil, and Sunrise Medical.
- QoLT ERC transformed advances and developed new systems for perceiving, reasoning with, and affecting people improving lives.
  - Previous attempts to use sophisticated technology to enhance function for PWDs often failed due to either a limited understanding of the human with disability, a lack of tight integration of technical and clinical expertise with users' needs, or both.
  - The QoLT ERC looked to overcome these issues by focusing on four areas - Monitoring and Modeling, Mobility and Manipulation, Human-System Interface, and Person & Society - and by working closely with user groups throughout design, development, test, and deployment phases.
- Developed or enhanced technologies that enable PWDs to perform essential activities.
- One of the most pertinent results of the QoLT ERC was the effect it had on the research community by pioneering approaches and methods to develop and apply technologies that directly impact people in everyday life.
  - QoLT-ERC demonstrated that multidisciplinary teams, including engineers, social scientists, and clinical scientists or practitioners, were required to appropriately address ways of working with PWDs in improving the lives of people.

EEC-0540865

QoLT ERC Life-Changing Research

[video not included in PDF]

NSF IGERT

- Integration of people with and without disabilities learning about technology together was a major accomplishment.
- The IGERT program has witnessed increased self-efficacy among PWDs in research environments.
  - Able-bodied students who have not worked on teams with PWDs may still witness a stigma attached with PWDs in engineering and scientific research settings.
  - PWDs bring a unique set of personal experiences to the research and design teams.
- PWDs were attracted to the fundamentals of the IGERT program.
  - Collaborative research that transcends traditional disciplinary boundaries and requires teamwork which provides students with the tools to become leaders in the science and engineering of the future.

DGE 0333420, DGE-1144584

NSF IGERT

- Diversity among the students contributed to their preparation to solve large and complex research problems of significant scientific and societal importance at the national and international level.
  - Relationships with disability organizations like Paralyzed Veterans of America, United Cerebral Palsy, Three Rivers Center for Independent Living, and Easter Seals, were critical as well as Florida Georgia-Louis Stokes Association for Minority Participation (FGLSAMP) students.
  - Disseminate information regarding our IGERT and REU program cohesively. Engage IGERT graduate students to better reach undergraduate students who were able to relate with them on a personal level.
  - Cross-disciplinary nature of the IGERT program allowed for changing the face of graduate engineering and science disciplines at CMU and PITT.
  - Exposing engineers to clinical service and exposing clinicians to engineering principles and processes allowed them to become better prepared.
  - IGERT students were involved in teams including many different types of clinicians.
    - By involving multiple disciplines in research, many aspects of a person's life were included, and the data collected gave a detailed picture of people's overall experience with technology.
    - For many students, the IGERT offered exceptional classes that they may not have taken if they had not had the IGERT requirement otherwise.
    - Several students commented on the importance and effectiveness of these courses, as well as the beneficial collaborations formed between PITT and CMU students as well as between engineering and clinical students.
    - Several new joint courses for PITT and CMU students were developed included.

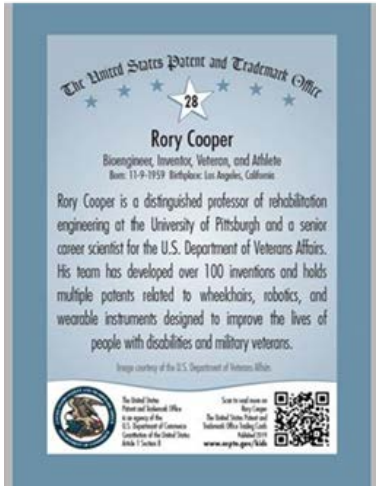
DGE 0333420, DGE-1144584

NSF IGERT – Graduate Students Innovations of Extraordinary Impact

[video not included in PDF]

DGE 0333420, DGE-1144584

Turn Adversity to Advantage and Action in Accomplishment.


The United States Patent and Trademark Office

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Rory Cooper

Bioengineer, Inventor, Veteran, and Athlete

Born: 11-9-1959 Birthplace: Los Angeles, California

Rory Cooper is a distinguished professor of rehabilitation engineering at the University of Pittsburgh and a senior career scientist for the U.S. Department of Veterans Affairs. His team has developed over 100 inventions and holds multiple patents related to wheelchairs, robotics, and wearable instruments designed to improve the lives of people with disabilities and military veterans.

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For resources see: www.herl.pitt.edu