

**Advanced Platform Technology Center (APTC)
Louis Stokes Cleveland Veterans Affairs Medical Center (LSCVAMC)**



A VA Research Center

<http://www.aptccenter.research.va.gov>

**ANNUAL REPORT
For Activities during the period: October 1, 2015 – September 30, 2016**

NARRATIVE SUMMARY

KEY IMPACTS

1. APTC Core Investigator receives the Presidential Early Career Award for Scientists and Engineers.



APTC Core Investigator Dr. Paul Marasco received the 2016 Presidential Early Career Award for Scientists and Engineers (PECASE) during a White House ceremony. The PECASE Awards recognize some of the finest

scientists and engineers who, while early in their research careers, show exceptional potential for leadership at the frontiers of scientific knowledge during the twenty-first century. The PECASE Award is the highest honor bestowed by the U.S. government on outstanding scientists and engineers beginning their independent careers. Dr. Marasco leads a number of multi-institution and international projects funded across the National Institutes of Health (NIH), the Defense Advanced Research Projects Administration (DARPA), the Department of Defense's Congressionally Directed Medical Research Program, and APTC's Innovation Incentive.

2. APTC Core Investigators demonstrate first neuroprosthesis that allows a patient with multiple sclerosis to walk again.



Walking:
(L) w/out stimulation
(R) with stimulation

APTC Core Investigators Dr. Stephen Selkirk and Mr. Rudi Kobetic released a video demonstrating a breakthrough in neural stimulation (NS) application. The video chronicles the ability of a Multiple Sclerosis (MS) patient who is now able to walk again with a temporary NS system. NS is a technique that uses electrical currents to activate nerves innervating extremities affected by paralysis resulting from spinal cord injury, head injury, stroke and other neurological disorders. NS is primarily used to restore function in people with disabilities. The video shows a 41-year old veteran with MS walking with the assistance of NS. He had not been able to walk in several years. The NS system lends itself to modification over time to accommodate progressive disability as the MS disease progresses.

3. Projects funded by DARPA enable amputees to feel the world through their prostheses and prompt a meeting with the Secretary of Defense.

Drs. Triolo and Tyler have received funding awards from the DARPA to restore sensory functions to amputees via neural stimulation. As part of the Hand Proprioception and Touch Interfaces (HAPTIX) program, Dr. Tyler's team has integrated pressure sensors into a prosthetic gripper and packaged a sensory stimulation system for 6-week trial of in-home use. Dr. Tyler and one of his research subjects also visited with the Secretary of Defense (*right*) in September in Washington D.C. to demonstrate this prosthetic and its ability to sense touch and modify pressure. Dr. Triolo's team is evoking sensations such as touch, pressure, and movement at specific locations representing the missing toes, foot and ankle of trans-tibial amputees. In their first subject, 37 out of 48 individual contacts



(77%) elicited sensations that seemed to originate in the phantom limb. After three months of sensory stimulation, the subject's perception of the phantom limb in space changed from 6 cm below the end of the residuum to the same length and orientation of the intact leg.

4. Promising APTC early career investigators receive grant and recognition awards.

APTC Core Investigator Dr. Steve Majerus received a Career Development Award (CDA) for his project "Real-Time Monitoring Device for Vascular Signals." This project investigates new techniques to rapidly screen vascular access patency in hemodialysis patients. Long-term dialysis success and cost depends on proper health of the patient's vascular access. Enabling new vascular access screening methods will enhance the quality of care for veterans on chronic dialysis and could reduce the financial impact of regular access surveillance on the VHA. APTC Core Investigator Dr. Aasef Shaikh received a CDA from the Dystonia Coalition to address current controversies in the clinical classification of head tremors in cervical dystonia using quantitative analysis to predict their pathogenesis. This research will lead to future studies into therapeutic strategies for head tremor. Dr. Shaikh was also chosen to receive the prestigious Grass Foundation – American Neurological Association (ANA) Award in Neuroscience. This award recognizes one outstanding physician-scientist in North America per year in the first five years of post-graduate/fellowship training who is conducting research in basic or clinical neuroscience.

5. APTC Investigators secure and license multiple medical inventions important to Veteran's health.

APTC continues to be highly productive in the intellectual property arena. Associate Investigator Dr. Huang secured a license this year for his wireless pressure sensing insole. Core Investigators Drs. Bogie, Capadona, Triolo and Tyler were awarded a total of five patents this fiscal year for: 1) surface stimulation for wound therapy, 2) polymer nanocomposites, 3) high density peripheral nerve electrodes, 4) vertical lift walker (*left*), and 5) stimulus waveforms for natural sensation. APTC's collaborative partners (Cleveland Clinic and CWRU) submitted five patent applications for Investigators Drs. Damaser, Majerus, Mohseni and Zorman. APTC Investigators Drs. Capadona, Damaser, Majerus and Stavrou continue the productivity with four invention disclosures.



6. APTC establishes an Innovation Site for the LSCVAMC in the national VA Innovator's Network.



U.S. DEPARTMENT OF VETERANS AFFAIRS
CENTER FOR INNOVATION

The APTC was responsible for the LSCVAMC being designated as one of eight new Innovation Sites in the national VA Center for Innovation (VACI). The VACI was established in 2010 by Secretary of Veterans Affairs to enable VA employees, patients and their families to generate and test new and creative ideas for improving veterans' current and future needs. The Innovation Site at the LSCVAMC created by APTC Director Triolo focuses on creating, prototyping, and pilot testing new technologies for the health and independence of disabled Veterans, and harnessing the creative energy, expert knowledge, and willingness to try novel approaches inherent in the VA to overcome challenges to translating

innovations into practice. The VACI will enable LSCVAMC staff to more effectively work across organizational boundaries to implement and disseminate new devices and ways of working that best serve Veterans' needs.

KEY SERVICES

1. Modifications to APTC's standing and transfer technology for competitive "trike" riding brings worldwide attention to LSCVAMC.



Pilot: Michael McClellan

Team Cleveland, led by APTC Executive Director Dr. Ronald Triolo, was formed from investigators and staff in the APTC and is one of 12 international stimulation-driven biking teams to compete in the first ever Cybathlon, or "Cyborg Olympics" in October, 2016. The Cybathlon is an international competition featuring events in six disciplines with physically disabled athletes using assistive technology, including arm and leg prosthetics, brain-computer interfaces, bike races using neural stimulation, power wheelchairs, and exoskeletons. Dr. Triolo's team pioneered applications of this technology to help individuals with leg paralysis to exercise, stand and take steps, and even maintain their

balance while standing or sitting. On July 26, 2016, five of Dr. Triolo's current research subjects competed in qualifying trials for the top two spots to represent Team Cleveland with local academic, medical, industrial and community leaders in attendance. This event, and the remarkable functional additions to the research device, brought local and national attention to the APTC and LSCVAMC, while the upcoming participation in the Cybathlon itself caught the attention of the international press. Team Cleveland was interviewed prior to the event by media representatives all over the world and was able to capitalize on the opportunity to bring awareness to the VA and spinal cord injury research being conducted in Cleveland, OH.

2. APTC Core Investigator exhibits at Congressional Manufacturing Briefing in Washington D.C. regarding progress in 3-D printing for biomedical applications.

Dr. Kath Bogie exhibited at a briefing for congress members, scientists, entrepreneurs and technologists regarding applications for additive manufacturing in medicine. The briefing was hosted by Carnegie Mellon University and America Makes in conjunction with the House Manufacturing Caucus and the House Maker Caucus. Dr. Bogie presented prototypes her team produced using 3-D printing for healthcare applications. These included small flexible implantable sensors, a personalized heel tissue health testing device and aero-balls with variable softness for use in a low cost modular wheelchair cushion.

3. APTC participates in outreach programs and family education through CWRU's Mean Green STEM Machine and LSCVAMC's bring your child to work day.

The Mean Green STEM Machine Program is an ongoing after-school program for students aged 7-12. The program is a collaboration between the Salvation Army Learning Zone, Cleveland Public Library, and CWRU's Leonard Gelfand STEM Center. Volunteers, including APTC students, prepare hands-on activities that introduce young students to various STEM disciplines and careers. APTC students created a two hour neuroscience workshop that included using an EMG-powered robotic claw to manipulate objects, identifying structures in pre-dissected sheep brains, and using a "spikerbox" to listen to the neural signals generated by touching a dissected

cockroach leg. Dr. Ronald Triolo donated a game called Mindflex that involves wearing a headset that reads brain waves to levitate a small ball and steer it through an obstacle course.

On April 28, 2016, APTC participated in LSCVAMC's Take Our Daughters and Sons to Work Day. The program was designed to allow parents, guardians, and mentors to share their work lives; and introduce our nation's daughters and sons to the power and possibilities associated with a balanced work and family life. Researchers at APTC hosted 7th to 12th grade students throughout the day and spoke with those interesting in becoming engineers about why they decided on that career path, what classes they take in school, and other information about their education journey. The researchers also showed the students demos of their research.

4. APTC empanels 13 commercial organizations for inaugural external Industrial Advisory Board meeting.

The Industrial Advisory Board (IAB) was created to solicit input from developers and manufacturers of commercial medical devices regarding APTC's overall program, and incorporate their advice into our thinking as we help investigators move their projects through the translational process. The ultimate success of later stage translational efforts moving technologies toward human use and potential commercialization is highly dependent on decisions made during early conceptualization, design and proof-of-principle stages. We empaneled 13 members from segments of the medical device industry involved with neurotechnology, prosthetics and orthotics, cardiopulmonary or genitourinary health, skin health and wound care to serve on the IAB, and will convene the first meeting the fall 2016 with 12 out of 13 members participating. We intend to hold follow-up sessions every year.

5. APTC Core Investigator establishes Society of Pelvic Research as Founding Board member and Membership Chair.



Founded in early 2016, The Society for Pelvic Research (SPR) is a new interdisciplinary scientific society founded by and for the careers and interests of basic and translational scientists interested in normal function and benign disease states of the pelvic viscera and pelvic floor. Dr. Margot Damaser is a Founding Board Member and Membership Committee Chair. Such a society is needed for promoting multidisciplinary interaction, intellectual cross-fertilization, networking for collaboration and career development through the regular dissemination of information via online resources, annual meetings and workshops, and published guidelines and standards for basic and translational science research.

6. APTC Core Investigator co-edits milestone book in the new field of female pelvic floor biomechanics.

Biomechanics of the Female Pelvic Floor, Academic Press, Elsevier, Inc., Cambridge, MA USA, 2016, was co-edited by APTC's Dr. Margot Damaser and Dr. Lennox Hoyte from USF College of Medicine and Tampa General Hospital in Tampa, FL. Publication of Biomechanics of the Female Pelvic Floor is a milestone in the development of this new field, signaling the transition from a historically observation-based approach to science where the development of novel tests measuring competing hypotheses can be tested. This is the first book to specifically focus on this key part of women's health, combining engineering and clinical expertise.

7. APTC Core and Affiliate Investigators serve on the Editorial Boards of 12 journals and 174 panel review boards.

Drs. Bogie, Capadona, Damaser, Lewandowski, Shaikh, and Triolo continue to serve on Editorial Boards. Drs. Bogie, Damaser, Henzel, Tyler and others served as reviewers for the Journal of Rehabilitation Research & Development and numerous other journals.

8. APTC Investigators contribute to multiple VA Grant and Career Award Review Panels.

Drs. Bogie, Capadona, Marasco, Potkay, Shire, Triolo, and Tyler contribute their time and expertise to review applications for VA RR&D Merit Reviews, SPIRE and other VA funding mechanisms. Ten APTC Core & Affiliate Investigators served as grant reviewers for NIH, NSF, DoD and other international and local organizations.

9. APTC's Executive Director Dr. Ronald Triolo serves on the National Professional Standards Board for Biomedical Engineering.

Dr. Triolo is a member of the Professional Standards Board and acts as an agent for the Under Secretary for Health for benchmarking Hybrid Title 38 Occupations (Biomedical Engineering) within the VA system. The Board determines eligibility and recommends the appropriate grade level for appointment as well as for special advancements for achievement and promotions to grades above the full performance level.

Summary

The APTC continues to advance the state of rehabilitation technology, fulfill our mission and improve the lives of veterans and the general population as demonstrated by international information dissemination, new awards and numerous IDEs in place for human studies research. APTC investigators continue to make important discoveries, contribute to community outreach and generate intellectual property leading to active industry conversations, licensing opportunities, and information dissemination. This past year, the APTC has received international recognition through research projects used in competition and high profile DoD programs, which verifies that core research programs of the APTC are impactful and vital to veterans, other federal agencies and the general public. Of great pride to the APTC is the success and development of our young investigators who further our mission in new areas. As we enter FY17, APTC will continue to pursue innovative and translational work in Prosthetics/Orthotics, Health Monitoring & Maintenance, Neural Interfacing and Emerging/Enabling Technologies. Our investigators, engineering, quality and regulatory staff continue to extend the capabilities of VA researchers and health care professionals at the local, regional, and national levels.