6th Annual

2017 Coulter Program Awards

Coulter Translational Partnership
University of Missouri
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CHANCELLOR’S WELCOME

The University of Missouri is proud to celebrate the sixth edition of the Coulter Program Awards. These awards highlight the ideas that emerge when clinicians and engineers join forces to attack problems and advance biomedical innovation.

Wallace Coulter, the namesake of the Coulter Foundation Programs, was a biomedical engineer and one of the most influential inventors of the 20th century. He compiled 85 patents, including one for the Coulter Principle, a means for counting and sizing microscopic particles suspended in a fluid.

At MU, we have an environment conducive to translational research, where the next Wallace Coulter could thrive. We are one of only six public universities in the nation that have a medical school, veterinary medicine college and law school on the same campus. We are one of just 34 public universities in the United States with membership in the Association of American Universities, which includes only the nation’s leading research institutions.

Scientists are among our university’s most valuable resources. The Coulter Program Awards give them the recognition they richly deserve.

Alexander Cartwright, PhD
Chancellor, University of Missouri
The Coulter Translational Partnership Program capitalizes on the best of academia and industry to accelerate the translation of biomedical innovations into products that improve patient care. Engineer-clinician teams with proprietary technologies that represent solutions to unmet clinical needs receive funding needed to perform research experiments that validate their technology. The teams also receive customized business counseling and access to marketing, regulatory and reimbursement experts to confirm that their solution represents a viable business opportunity. Lastly, the project teams are actively managed by the Coulter Program Office to ensure progress toward milestones. As a result, projects de-risked by the Coulter Program are able to attract investors and industry partners that can provide the funding needed to continue commercialization of the technology. We are excited the program has awarded its sixth round of funding to scientists at the University of Missouri.

Five new projects will receive funding to advance the translation of these discoveries into products and services. From a low-cost, easy-to-use software solution that enables earlier and more accurate detection and treatment of tongue dysfunction caused by neurological disorders such as stroke, Parkinson’s disease, ALS and multiple sclerosis to a device designed to safely and effectively improve knee range of motion as part of a non-operative or pre/post-operative rehabilitation program, each of the five research projects addresses an important unmet medical need and has the potential to improve the lives of patients. The projects selected in 2017 involve a total of 9 co-investigators from the MU School of Medicine and the MU College of Engineering and one co-investigator from Missouri University of Science and Technology.

The Coulter Program is delivering practical solutions to real medical problems to advance the health of Missourians, the nation and the world by generating of new knowledge, intellectual capital and economic development strategies. In direct alignment with the university’s vision for excellence, the program is nurturing and building on Mizzou’s rich ecosystem of qualified scientists, internationally recognized research and unique infrastructure. The $3.3 million invested in Coulter research projects to date has already led to five “Coulter Wins,” $13.6 million in new government grants and $2 million in investment funding raised by start-up companies that have licensed technologies de-risked by the Coulter Program. These numbers will continue to increase as the program continues.

I would like to congratulate our 2017 Coulter-funded investigators and thank our Coulter leadership team, which includes experts from industry and academia, for their remarkable support. Their contributions will advance translational research at MU for years to come.

Jinglu Tan, PhD, Principal Investigator, MU Coulter Translational Partnership Program
James C. Dowell Professor and Chair of the Department of Bioengineering
The goal of translational research at the University of Missouri School of Medicine is to improve the health of patients. The Coulter Translational Partnership Program provides a perfect opportunity to build upon partnerships to achieve this goal. By engaging medical leaders to identify unmet health care needs and engineers to create novel technologies to meet those needs, we can create innovations, which lead to better health outcomes for the people of Missouri and beyond.

Commercialization of health-related products and services also requires active engagement. The Office of Technology Management and Industry Relations provides the expertise to evaluate new technologies, protect intellectual property and facilitate the commercialization of new technologies. These capabilities help bridge the gap from early stage research to commercial products that can improve health.

The emphasis on translational research at MU continues to result in extraordinary partnerships and scientific progress, and few universities share MU’s potential for enhancing health through research. With more than 1,000 biomedical scientists and engineers — all on one campus — efforts such as the Coulter program position MU to transform ideas and discoveries into products, services and solutions.
The Coulter Program Office is responsible for implementing the “Coulter Process,” which is internationally recognized as the recipe for successful translation of biomedical research projects. The Coulter Process is based on the Stage-Gate™ product development process commonly used by industry to move new products from idea to market launch. In the case of the Coulter Program, the goal is to take ideas for solutions to unmet clinical needs developed by engineer-clinician teams to the point that a commercial entity or professional investor (e.g., venture capitalist, angel investor) sees enough value to provide the funding needed to continue the commercialization process.

The Coulter Program Office ensures that the best projects are funded by creating campus-wide awareness of the Program and by educating potential applicants about the differences between a Coulter Award and a government grant. While both provide non-dilutive funding, Coulter Awards require regular reporting of progress toward pre-determined milestones and make continued funding of the project contingent on achievement of these milestones. Coulter Awards also come with individualized counseling, connections to industry experts, marketing, regulatory and reimbursement consulting support, and introduction to potential customers, partners and investors.

To assist project teams seeking a Coulter Award, the Program Office offers a 12-session Boot Camp. During Coulter Boot Camp, the project teams, mentored by instructors, business advisers and experts, are guided through a series of lectures and interactive exercises to pressure-test the commercial viability of their ideas using universal business criteria as well as the unique requirements of biomedical product commercialization. Boot Camp provides teams with an opportunity to learn how to pitch their project to potential investors and partners as they prepare their pitch for a Coulter Award. Students enrolled in MGMT 8200 offered by the MU Robert J. Trulaske, Sr. College of Business work with the teams going through Coulter Boot Camp to learn what it takes to commercialize life science innovations by working on real world problems and potential solutions.

The active engagement of the Coulter Program Office in every funded project is what ultimately makes the Coulter Program successful in accelerating the movement of biomedical technologies out of the University and into companies that can continue translation of the technology.
BioJoint Flex: A Simple Solution for Stiff Knees

More than 1 million knee surgeries are done in the United States each year, and an even larger number of patients with knee problems are managed non-operatively. While improved range of motion is strongly linked to improved outcomes, a common limitation for all these patients is loss of knee motion. Existing methods for improving knee range of motion can be painful, costly or ineffective if not done in a controlled and measured manner. The BioJoint Flex is a non-invasive device that assists in controlled, supported and measured knee flexion exercises. This device is specifically designed to safely and effectively improve knee flexion and overall knee range of motion as part of a non-operative or pre/post-operative rehabilitation program in physical therapy clinics, facilities and homes. With the BioJoint Flex, patients can reduce the need for repeat surgery, treat refractory loss of motion (arthrofibrosis) and improve their functional outcomes.
Knee injuries are common, with more than 750,000 ligament injuries and 500,000 anterior cruciate ligament ruptures occurring each year in the United States. When a ligament is torn, knee stability and function become abnormal. Precisely determining the direction and magnitude of the instability (laxity) is vitally important for making a complete and accurate injury diagnosis, determining optimal treatment options and monitoring recovery to determine when it is safe to return to daily activities. While devices that measure knee laxity have been commercially available for decades, the Mizzou Knee Arthrometer Testing System (MKATS) can potentially address limitations of existing devices by delivering cost-effective quantitative measurement of knee laxity. That would be valuable to orthopaedic surgeons, physical therapists and athletic trainers. Additionally, knee laxity is a known risk factor for ACL injury. Assessing this risk with the MKATS would help millions of amateur, collegiate and professional athletes by providing critical decision-making information to physical therapy clinics and athletic training facilities.
More than 300,000 total hip replacement surgeries are done annually in the United States, with greater worldwide demand causing the incidence of this operation to increase. In the most commonly performed hip replacement procedure, the arthritic ball-and-socket joint is replaced with a metal-plastic prosthesis. If the prosthetic ball jumps out of the socket (dislocation), repeat surgery is usually required at considerable expense and morbidity. Dislocation complicates both primary (first-time) and revision (repeat THR) surgeries, and risk is highest during the first three months after surgery, when surgical trauma and muscle weakness reduce hip joint stability. Existing technologies that address hip dislocation rely on large-diameter femoral heads (balls), minimally invasive surgical techniques and, in high-risk patients, constrained sockets that add locking rings to secure the ball inside the socket. Unfortunately, none of the existing surgical technologies is universally successful. The proposed Natur-o-Lock system potentially provides an innovative and simple hip socket that gives intrinsic stability to the ball-and-socket joint, thus preventing the problem of dislocation. The Natur-o-Lock solution is applicable to all sockets (dual-mobility design or otherwise) and does not increase the length of the surgical procedure.
Each year, approximately 2 million women in the United States are referred for colposcopy after positive Pap smear/HRV screening results, and over a half-million women worldwide are diagnosed with cervical cancer. Fortunately, when correctly identified using colposcopy, precancerous lesions (cervical intraepithelial neoplasia or “CIN”) are fully treatable. However, current video-based colposcopy is subjective and requires tissue destruction. Because tissue samples must be sent to the pathology lab for analysis, it has a long lead time for diagnosis. The proposed OPT-Enhanced Colposcopy is a new imaging system based on optical polarization tractography (OPT) technology that makes it possible to accurately and objectively identify and stage CIN, as well as invasive cancerous lesions, during the colposcopy procedure. OPT enables precise 3D imaging of subsurface cellular morphological changes in a living organism. These changes are histology-comparable markers of precancerous lesions and invasive cancer. OPT-Enhanced Colposcopy could potentially allow clinicians to precisely detect lesions, perform image-guided therapy and verify treatment outcomes all in a single colposcopy session.
The tongue is one of the strongest muscles in the body and is essential for normal speech and swallowing function. Therefore, tongue dysfunction caused by neurological disorders such as stroke, Parkinson’s disease, ALS and multiple sclerosis can result in devastating speech and swallowing impairments. In the United States, approximately 15 million people are living with speech and swallowing impairments that profoundly impede quality of life and cost over $30 billion annually in medical care and lost work productivity. Current diagnostic methods to detect and monitor tongue dysfunction are subjective and therefore prone to inaccuracy, which risks misdiagnosis and inappropriate treatment. Tongue Twister provides a low-cost, easy-to-use software solution that transforms widely used tongue performance tasks into real-time objective data, thus enabling earlier and more accurate detection and treatment of tongue dysfunction and monitoring of treatment outcomes. This is especially important for progressive neurological disorders, for which earlier intervention is associated with improved quality of life and survival. Scalability beyond clinical settings includes detection of sports concussions during athletic events and detection of fatigue and substance abuse by law enforcement and safety regulatory agencies.
**CelluloGel: Injectable Osteomodulatory Hydrogels for Vertebral Compression Fracture Repair**

**PRINCIPAL INVESTIGATORS**

BRET ULEY, PhD  
Department of Chemical Engineering

ELLEN WAN, PhD  
Department of Bioengineering

CHRISTINA GOLDSTEIN, MD  
Department of Orthopaedic Surgery

2016

**Corneal Cryopreservation and Storage System**

**PRINCIPAL INVESTIGATORS**

XU HAN, PhD  
Department of Mechanical & Aerospace Engineering

FREDERICK FRAUNFELDER, MD, MBA  
Department of Ophthalmology

2016

**Near Infrared Navigation System (NAVI) for Image-guided Surgery in Coronary Artery Bypass Grafting**

**PRINCIPAL INVESTIGATORS**

RAGHURAMAN KANNAN, PhD  
Department of Bioengineering  
Department of Radiology

AJIT THARAKAN, MD  
Department of Surgery

2016
ENSUR: A Novel Diagnostic Prenatal Genetic Test

PRINCIPAL INVESTIGATORS
RAGHURAMAN KANNAN, PhD
Department of Bioengineering
Department of Radiology

DANNY SCHUST, MD
Department of Obstetrics, Gynecology and Women’s Health

2016

Down the Hatch Solutions

PRINCIPAL INVESTIGATORS
FILIZ BUNYAK ERSOY, PhD
Department of Computer Science

ZHIHAI (HENRY) HE, PhD
Department of Electrical & Computer Engineering

TERESA LEVER, PhD
Department of Otolaryngology

2016

Intelligent Oxygen Control for NICU Patients

PRINCIPAL INVESTIGATORS
ROGER FALES, PhD
Department of Mechanical and Aerospace Engineering

JOHN PARDALOS, MD
Department of Child Health

RAMAK AMJAD, MD
Department of Child Health

2015
Panacea’s Cloud: Augmented Reality System for Mass Casualty Disaster Triage and Coordination

PRINCIPAL INVESTIGATORS

PRASAD CALYAM, PhD
Department of Computer Science

SALMAN AHMAD, MD
Department of Surgery

Germ Sensor System for Rapid Detection of Salmonella and Other Pathogens

PRINCIPAL INVESTIGATORS

MAHMOUD ALMASRI, PhD
Department of Electrical and Computer Engineering

SHUPING ZHANG, PhD, DACVM
Department of Veterinary Pathobiology

DR Sensor for Early Detection of Diabetic Retinopathy

PRINCIPAL INVESTIGATORS

RAGHURAMAN KANNAN, PhD
Department of Bioengineering
Department of Radiology

DEAN HAINSWORTH, MD
Department of Ophthalmology
Safer Laser Handpiece for Dermatology Treatments

**PRINCIPAL INVESTIGATORS**

RANDY CURRY, PhD
Department of Electrical and Computer Engineering

NICHOLAS GOLDA, MD
Department of Dermatology

2015

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Implantable Antennas for Biomedical Telemetry

**PRINCIPAL INVESTIGATORS**

RANDY CURRY, PhD
Department of Electrical and Computer Engineering

RENEE SULLIVAN, MD
Department of Medicine

2014

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Plasmonic Grating Point-of-Care System for Detection of TB

**PRINCIPAL INVESTIGATORS**

SHUBHRA GANGOPADHYAY, PhD
Department of Electrical and Computer Engineering

CAROLE MCARTHUR, MD, PhD
Department of Oral and Craniofacial Sciences
University of Missouri-Kansas City

2014
RTN-Scan: A Novel Molecular Probe for Early Detection of Recurrent and Metastatic Breast Cancer

PRINCIPAL INVESTIGATORS

RAGHURAMAN KANNAN, PhD
Department of Bioengineering
Department of Radiology

AMOLAK SINGH, MD
Department of Radiology

2014

Engineered Osteochondral Allograft for Knee Cartilage

PRINCIPAL INVESTIGATORS

CLARK HUNG, PhD
Professor, Biomedical Engineering, Columbia University

JAMES COOK, DVM, PhD
Department of Orthopaedic Surgery

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A Tapered and an Anatomically Shaped Osteochondral Allograft System

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FERRIS PFEIFFER, PhD
Department of Orthopaedic Surgery
Department of Bioengineering

JAMES STANNARD, MD
Department of Orthopaedic Surgery

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Department of Radiology

GERALD ARTHUR, MD
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Department of Mechanical and Aerospace Engineering

RAJA GOPALDAS, MD
Department of Surgery

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Department of Orthopaedic Surgery, Department of Bioengineering

MATTHEW SMITH, MD
Department of Orthopaedic Surgery

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**Principal Investigators**

LI-QUN GU, PhD
Department of Bioengineering

MICHAEL WANG, MD, PhD
Department of Pathology and Anatomical Sciences

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Technology for Producing Superior ACL Grafts by Conjugating Nanomaterials with Acellular Biologically Derived Tissue

**Principal Investigators**

SHEILA GRANT, PhD
Department of Bioengineering

RICHARD WHITE, MD
Department of Orthopaedic Surgery

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Department of Bioengineering

STEPHEN BARNES, MD
Department of Surgery

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PRINCIPAL INVESTIGATORS

GANG YAO, PhD
Department of Bioengineering

JUDITH MILES, MD, PhD
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