UCF — a Prominent World Leader in Implantable Devices for Prosthetic Interfaces

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Based on the input from the review committee, Dr. Stephen Lambert from *COM* replaced Dr. Yoav Peles from *CECS* to head this initiative together with Dr. Sudipta Seal and Dr. Alain Kassab. This will insure a more balanced faculty lead effort between *COM* and *CECS*.

Prologue

This proposal begins with part of the narrative used for the pre-proposal. Some of the original pre-proposal's discussions were expanded while others were moved to address the five specific components requested by the *RFP* in the full proposal. Our hiring plans, startup plans, and space plans are detailed (Sections 6-8). Subsequently, we attempted to address a few of the reviews' feedback and comments (Sections 9-10); other comments are discussed in the remaining sections. The five components explicitly requested for the full proposal as stated in the cluster *RFP* are given in Sections 11-15.

You will also find in this full proposal a concise background about the cluster main focus — implantable devices for future generation of prosthetic interfaces. Major knowledge and technology gaps are identified and current *UCF*'s strength pertinent to this focus are delineated. The cluster hires will build on current capabilities and help establish *UCF* hallmark in the prosthetic domain. An effort to capture the extensive collaborative effort between multiple joint *CECS*/*COM* research groups is also presented.

1. Participating *UCF* faculty

Faculty members from four colleges/centers including *CECS*, *COM*, *AMPAC*, and *NSTC* were committed to this cluster initiative. A list of core faculty and affiliated faculty is given in Appendix *A*. Note that some changes were made in respect to the pre-proposal.

2. Vision

Imagine a world where deaf begin to hear, blind begin to see, weak hearts begin to strongly pump blood, people with spinal cord injuries make full recovery, and artificial limbs become an integrated part of our nervous and musculoskeletal systems. We've entered a time when deploying engineering and circuitry inside the human body can help erase disabilities and more controversially, enhance human capacities beyond their evolutionary limits. Some projections estimate that by 2050, bionic exoskeletons, artificial blood cells, and lab-grown organs will be possible.

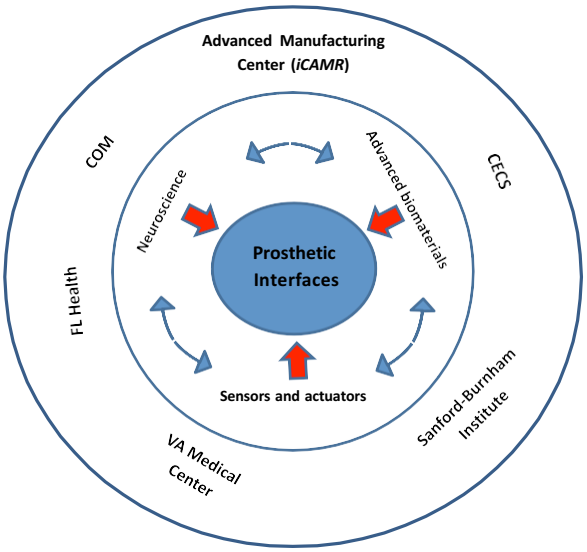

Fig. 1. A schematic depicting the proposed cluster with supporting organizations.

Intelligent prosthetics is starting to take center stage in the future of medicine and engineering. Now, imagine *UCF* at the forefront of this technological revolution. It isn't hard to do — just consider the excitement our student-led

"Limbitless Solutions" team created when a new arm was given to six year-old Alex. It is even easier if you consider our dedicated bright researchers and key infrastructure poised to take this challenge. We just lack the critical background and specialized knowledge necessary to lead such effort; this cluster will fill this void.

Over the next decade, we envision a growing demand by government agencies (e.g., Army, *NSF*, *DARPA*, *NIH*) and private/commercial organizations (e.g., Google) to develop ever-increasing sophisticated prosthetic systems. To position *UCF* as a major contributor to these initiatives, we seek to build a nucleus of core competence — **Prosthetic Interfaces** with a core strength in implantable devices (see details in Section 9 below). Contributing expertise, such as biomechanics and biomaterials, cellular and tissue engineering, bio-nano-technology, control systems, human computer interaction, and intelligent user interfaces/controls already exists at *UCF* and will provide the essential support to make this cluster successful and exceptionally attractive to key hires. In the long-term, we imagine a larger effort where *UCF* is a world leader in the entire intelligent prosthetic domain.

3. Objectives

The effort brings together for the *Prosthetic Interface Cluster* several existing strengths and strategic efforts under a single umbrella. These include advanced sensors and actuators, neuroscience, and advanced biomaterials (Fig. 1). They will be supported by several colleges, medical centers (*COM* and *VAMC*), and a manufacturing center.

3.1 The short-term objectives are threefold:

1) Establish a critical mass of dedicated faculty to enable a viable interdisciplinary bio-medical engineering (*BME*) program at *UCF* with core competency in ***prosthetic interfaces*** for implantable devices & systems — a sub-set of the intelligent prosthetic domain;
2) Identify and form a focal point for world-class research and educational endeavors for *UCF*'s scholars working on technology pertinent to medical applications, devices, and systems; and
3) Enhance interdisciplinary research capabilities and infrastructure of other *UCF*-affiliated initiatives.

3.2 The long-term objectives are:

1) Establish an internationally prominent *BME* research program at *UCF* with core competency encompassing the entire ***intelligent prosthetic*** domain;
2) Establish a graduate (*G*) and an Undergraduate (*UG*) program in *BME*;
3) Enhance *UCF* research ranking;
4) Enhance *UCF* cross-fertilizing interdisciplinary collaboration between departments, colleges, and centers; and
5) Foster biomedical economic development in Orlando and Florida.

4. Alignment between cluster's objectives and strategic priorities

Intelligent prosthetics will dominate the future of *BME*, and it is in *UCF*'s strategic interest to lead this important domain. Besides, the creation of the College of Medicine, the new Advanced Manufacturing Center (*iCAMR*), the Orlando VA Medical Center in Lake Nona, Florida Health, Sanford-Burnham Medical Research Institute, and the growing interest by departments, colleges, and centers in technology for medicine creates a unique opportunity to establish a world class program in *BME* that will cater to local and national organizations. The

proposed cluster will integrate all these elements into a single focal theme that will form *UCF*'s *BME* hallmark. This cluster also aligns well with our *G* and *UG* education mission and will interact with the "Limbitless Solutions" team to enhance outreach efforts and provide more sophisticated prosthetics worldwide to those in need.

The three pillars (see Fig. 1) supporting the *Prosthetic Interface Cluste*r are well aligned with *UCF*'s strategic priorities. Research and development in advanced sensors and actuators are inline with the *iCAMR*. Advanced biomaterials and neuroscience are major thrusts within the College of Medicine, in collaboration with other colleges, centers, and institutes. Furthermore, research in prosthetics falls within the mission of the newly-established VA Medical Center in Lake Nona and with cross-disciplinary research in robotics, mechatronics, and controls in MAE and EECS, the two major departments in the CECS.

The synergetic activities between the pillars — neuroscience, advanced biomaterials, and sensors/actuators — are important elements that will help make this cluster an eminent success. For instance, advanced prosthetics require comprehensive integration between the mind and peripheral nervous system (neuroscience) and compatible bio-materials through an array of innovative sensors and mechanical, electrical and microfluidic actuators.

The great success of *MAE* "Limbitless Solutions" team indicates strong student interest in *BME* and specifically in prosthetics that can be cultivated to significantly grow the *UG* and *G* programs. Besides, an effort is currently underway to create an *MS* graduate degree in *BME*. With a strong body of dedicated faculty formed by this cluster hiring, *UCF* will be in a position to support such an initiative and expand the graduate program offering to the doctoral level. With a strong graduate program, *UCF* will be able to establish an accredited *UG BME* program. For additional information, please see Section 15 below.

5. A graduate and an undergraduate curriculum statement

Academic programs and curriculums will be launched. Initially, an interdisciplinary master degree in *BME* will be developed and offered. With additional hires and the maturation of the graduate program and the creation of a *PhD* degree in *BME*, an undergraduate program will be created with the intention of securing *ABET* accreditation. The development of the curriculum will address the needs of and input from all pertinent parties. National recognition will require a strong *PhD* program supported by significant federal, state, and industrial funds. Endowments for student scholarships will also be explored.

There are several existing dedicated *BME* graduate courses offered in *CECS* (e.g., Biofluids, Biomechanics, and Biomedical Instrumentation), and several in Biomedical Sciences (e.g., Tissue Engineering). The cluster hires will consolidate the development of a viable Bio-medical engineering curriculum at the graduate and undergraduate level and will add a new concentration in prosthetics. Courses, such as Bio-mechatronics, Mechatronics, Bioinstrumentation, Biosignal Processing, Biomaterials, Implant materials, Biomechanics, Biomedical Systems Design and Analysis, Embedded Systems, and Robotics Surgery, will support the Prosthetic's curriculum. Several of these courses can be taught by current faculty, but many require dedicated *BME* experts in prosthetics.

6. Proposed hiring plan

Seven hires are proposed in four key *BME* disciplines — Bio-mechatronics, Bionics, Neural Engineering, and Brain-Computer Interaction; these areas are currently lacking at *UCF*, but are central to prosthetics engineering. A senior endowed director will oversee the Prosthetic

Interface initiative within the *BME* program, encompassing thrust leaders, and junior faculty members. The Cluster's director will have extensive experience and a broad knowledge of intelligent prosthetics with special experience in implantable devices and an intimate familiarity with prosthetics interfaces and the corresponding scientific community. She/he will be a prominent leader who is currently tenured and will be recruited from one of the Nation's top *BME* department; exceptional candidates from other departments will also be considered. Leaders for Bio-mechatronics, Bionics, and Neural Engineering will be subsequently/concurrently hired. The cluster leaders will form search committees for the junior hires. All cluster's faculty will have strong affiliations with *CECS* and *COM*. The search committee will be comprised of three faculty from *CECS* (one from *MAE*, one from *MSE*, and one from *IEMS*), three from *COM* (one from Burnett School Biomedical Sciences, one from *IM*, and one from *ME*), one from VA hospital, and one from *iCAMR*.

7. Startup plans

The COM, CECS, and UCF administration will continue to work out the details following approval of the cluster. Start-up commitment per faculty is anticipated including for shared usage (e.g., equipment, post-docs, etc.) at the discretion of the cluster members. The funds will include support for common equipment that will be used by all cluster faculty members (to be jointly determined by cluster leaders, college and school leadership and senior cluster director).

8. Space plans

To enhance the collaborative effort between the cluster members, the entire team will be co-located. A typical space that will be allocated to assistant professors is 450 ft^2 and 900-1000 ft^2 to associate/full professors. Laboratory space at *UCF* is scarce and *CECS* and *COM* will continue their discussion to identify a proper co-location facility. This dialogue will be facilitated by the expectations that new space will become available in the near future (e.g., Interdisciplinary Building, relocation of several colleges and units to the downtown campus).

9. Implantable devices — *UCF* competitive advantage

A guiding principle of prosthetic design is increased integration between the device and the user. As a result of this focus, the last two decades have been marked by significant developments in the field of so-called implantable devices, the central elements of a prosthetic interface crucial to an intelligent prosthetic. Recently, new generations of warfighter amputees whose lives have been saved by new developments in body armor, demand greater control of their limb prosthetics leading to new machine/brain interfaces that allow for enhanced neuromuscular control and all-important sensory feedback. Similarly, an aging population with an escalating frequency of cardiovascular and neurological conditions find their treatments increasingly carried out by 'implantable devices'; stimulating and recording electrodes interfaced with nervous tissue to treat Parkinsons disease or interfaced with muscle to control both cardiac and gastric function. It is estimated that currently 25 million US citizens are dependent upon an implantable device to maintain life. Implantable devices also allow prosthetic applications to areas previously thought incurable, such as implants in the retina of the eye for blindness, and in the cochlea of the ear and auditory brainstem for deafness. Finally, it is anticipated with the increasing obesity and diabetes problem worldwide that there will be an increased demand for

implantable devices, such as glucose sensors that provide instant real-time feedback to the user and connected to a responsive drug delivery system.

Despite tremendous advances in the design of implantable devices, with regards to miniaturization and power utilization, significant intrinsic issues exist that impede their functionality arising from their maladaptive interface with the natural tissue environment. These issues include: 1) damage to the environment surrounding the implant resulting from mechanical stress, aberrant electrical stimulation/heat generation or localized stimulation of the body's immune system; 2) implant's encapsulation by the body's immune or pro-inflammatory (fibrotic) systems; and 3) the implant as a platform/nidus for infection. All of these issues shorten the life-span of the implant requiring its surgical removal and replacement after only a few years. These functional longevity issues sit at the interface between biology and the mechanical/materials world and hence mirror the expertise and training of the faculty assembled in this cluster. We propose to take a two pronged approach to these issues: 1) To develop better biomaterials and surfaces with improved interaction and integration with the body; and 2) to develop real-time sensors that will monitor the 'health' of the implantable device. Such sensors could be designed to detect local inflammation, mechanical stresses, irregular flow characteristics or early stages of infection. They could act as an early warning system for device failure. Given the faculty's strength in the Neurosciences we anticipate a central push in the area of neural interfaces.

The goal of this proposal is not to directly compete in the field of prosthetic design, where there is already a plethora of groups with varying degrees of success that specialize in select areas, such as eye or ear prosthetics. Instead we intend to utilize the combined strengths of the cluster faculty in biomaterials and sensor design to solve universal problems of implantable devices and to optimize their interaction with living tissue, thereby improving their functionality and longevity. For example, *UCF* already has a world-class materials design program that will be accompanied by the *iCAMR*. The recruitment of faculty within the area of bio-materials, for example, in the newly developing field of resorbable materials, could result in the development of *UCF* as a world leader in materials fundamental to implantable devices. Crucial to this initiative are faculty within *COM* that can develop the biological and translational aspects of this initiative. Similarly, the development of chemical microsensors with their roots in nanoscience is still in the basic discovery phase, e.g., carbon nanotubes modified to detect nitric oxide associated with inflammation. It is envisaged that the faculty associated with this cluster initiative will have the ability to develop these sensors and integrate them with prosthetic materials to produce truly intelligent prosthetics.

We expect that many of the developments arising from this cluster will be universal and could be applied to multiple devices. For example, encapsulation sensors that could be used for all devices with a nervous system interface. Some devices to be implanted in specialized niches, such as the eye or ear may require the recruitment of faculty with expertise in these areas. Also with the ongoing development of the *BME* program we will be recruiting faculty easily capable of crossing between biology and materials. We anticipate that the developments and discoveries arising from this cluster initiative will be incorporated into newly-arising generations of implantable devices, thereby facilitating collaborations with other institutions and industry, thereby enhancing *UCF*'s mission as a partnership University. We also anticipate numerous potential spin-offs from this technology, for example, nanosensors that can detect bacterial bio-film build-up could be incorporated into a wide variety of hospital devices, such as catheter and hemodialysis tubing, to help reduce or limit the soaring rates of hospital infections. New bio-compatible or resorbable materials could be incorporated into other surgical implants, such as

surgical meshes and implantable drainage tubes as used to treat hydrocephalus. We believe that the combination of faculty brought together by this cluster initiative could place *UCF* as an International leader in biomaterials and biosensors.

10. *CECS*/*COM* — an established collaborative effort

The synergetic activities between the College of Medicine and the College of Engineering and Computer Science have been steadily growing over the last several years with multiple joint research projects, committees, mini-sabbatical, and meetings. Several junior engineering faculty members have labs at *COM* and are co-mentored by senior *CECS*/*COM* faculty (see Appendix C for a memorandum of understanding for Dr. Robert Steward, a new faculty member in the Mechanical and Aerospace Department). The current arrangements and understandings between *CECS* and *COM* will be leveraged to consolidate cluster arrangement.

UCF provides established pathways for cross-collaboration among the Colleges of Engineering and Computer Science and Colleges of Medicine. Indeed, the *CECS* and the *MAE* department have longstanding collaboration with the *COM*. For example, Prof. Kassab (*MAE*) served on the *COM* Curriculum Committee (2006-2008) and currently serves on the *COM* Research Council. The 2015 *MAE* search committee for two Biomedical Engineering (*BME*) faculty positions has critical participation by Dr. Sampath Parthasarathy the *COM* Associate Dean for Research and *COM* faculty member Dr. William DeCampli. Further concrete evidence of collaboration is laboratory space provided by the *COM* for Dr. Robert Steward who was recently hired in *MAE* (Spring 2015) and whose research focus is in *BME*. The *COM* will also provide laboratory space and access to shared facilities to the two additional *BME* faculty members being recruited under the current 2015 *BME* search carried out by *MAE*.

Dr. Juan Cendan, the *COM* Chair for Medical Education and the *COM* Associate Dean for Medical Simulation, and *COM* Professor Dr. William DeCampli also played key and enabling roles as members of a *BME* planning committee that additionally included faculty members from *CREOL*, *COS*, and *CON* and that was chaired by *CECS* Prof. Kassab. The *BME* planning committee completed and submitted a Masters in *BME* pre-proposal that was signed by both the Deans of *CECS* and *COM* and that is currently under review by the Florida *SUS* Council of Academic Vice-Presidents. It is envisaged that faculty and research scientists from these colleges will collaboratively teach the curriculum and that the program will tap the large pool of practicing physicians with *COM*-affiliated faculty positions, to teach clinical topics, as they do in *COM*. The Chairman of the *COM* Department of Medical Education has agreed to a combined *MSBME*/*MD* degree program utilizing the existing *FIRE* research module in *COM*'s curriculum.

In mid-2014 the Deans of *CECS* and *COM* co-sponsored two faculty symposia to encourage cross-college research efforts. Dr. Kassab (*MAE*) and Dr. DeCampli (*COM*) are co-chairing and co-organizing the 5th International Conference on Engineering Frontiers in Pediatric and Congenital Heart Disease that will be held 9th and 10th of June 2016 at the *UCF*-*COM*.

A successful cross-college/disciplinary research program in multi-scale computational fluid dynamics in treatment planning for cardiovascular disease has been established between Dr. Kassab (*CECS*-*MAE*) and Dr. William DeCampli (*COM*). This research endeavour has been supported by two multi-year grants from the American Heart Association, the *NIH*, and Arnold Palmer Hospital, and has been ongoing for over eight years. As part of this program, Dr. Decampli and Dr. Kassab have mentored three *COM FIRE* projects that have led to conference and journal publications in the medical literature.

Another example of a longstanding research collaboration undertaken by Dr. Kassab (*MAE*) and Dr. Price (*COM*) is the study of the biomechanics of closed hip reduction for neonatal developmental dysplasia of the hip and harness/brace strategies for low to severe grades. This project, begun in 2009, has been supported by Arnold Palmer Hospital, the Florida High Tech Corridor, the International Hip Dysplasia Institute, and the NSF.

These research collaborations have run smoothly for both faculty and students and have led to numerous conference and poster presentations at engineering and medical forums as well as manuscript publications in bioengineering and medical journals. Over the past eight years, these two research projects have produced several *HIM* (5) and *MS* theses (7) and PhD. dissertations (2) with three more *PhD* dissertations currently in progress.

The co-head of this proposal, Dr. Stephen Lambert, has a long history of collaboration with the Nanoscience center under Dr. Sudipta Seal. Dr. Lambert maintains office space within the center and collaborates with the hybrid systems laboratory of Dr. James Hickman, studying the interface of cellular systems with synthetic biomaterials. This collaboration has resulted in numerous publications and several grants funded by *NIH* and *DOD*, with both individuals as PI and Co-PI. Although he is a member of the Department of Medical Education, responsible for the training of medical students, Dr. Lambert maintains laboratory space within the BSBS building at Lake Nona, where in addition to his own research he has collaborated with Dr. Cristina Fernandez-Valle (Co-I on a funded *NIH R*01 award) in basic neuroscience and is currently collaborating with Dr. Willenberg in the area of biomaterials for a peripheral nerve shunt. Finally, Dr. Lambert has collaborations in the neuroprosthetic field outside of *UCF*, including collaborations with neuroprosthetic researchers at Worcester Polytechnic Institute that was funded by the Telemedicine and Advanced Technology Research Center (*TATRC*) office of the *US* Army. Other *COM* faculty also have a history of collaboration across colleges. Dr. Fernandez-Valle has co-published with Dr. Hickman and been a Co-I on one of his successfully funded NIH proposals. Currently, Dr. Willenberg is co-mentoring a Masters student in the Biomolecular Science Program in a biomaterial drug delivery project with Dr. Fernandez-Valle.

Dr. Seal has a long history of nano-medical research collaboration with Drs. Self and Zhao at *BSBS*. Dr. Seal and Self had *NIH* R21, *NIH R*O1, *NSF NIRT*, *NSF GOALIE*, and other *NSF* grants in the use of nanomaterials in Reactive Oxygen Species (*ROS*) mediated cell dysfunctions. Between the two, they have graduated more than ten graduate students and undergraduates (including honours students) in biomedical research and published in high impact journals and received key patents. Dr. Seal's nano-biomedical research has led to NanoCe *LLC* start up from *UCF* Incubator and some of his technology is being licensed to companies. Under Dr. Seal's guidance *NSTC* has created the Professional MS program in Nanotechnology (1st one in the State), where several courses are dedicated to nano-biomedical technology.

COM faculty interact closely with CECS faculty and students, attend joint research meetings, and serve on dissertation committees. COM and CECS faculty successfully formulated and submitted joint proposals and high quality publications in the bioengineering and medical literature.

11. National and international prominence

This cluster will define *UCF*'s hallmark in the prosthetic domain. The University has many successful faculty members working in isolation on topics that are very amenable to implantable devices, such as biomechanics, biomaterials, cellular and tissue engineering, bio-nano-technology, controls, human computer interaction, and intelligent user interfaces. Formally

bringing all of these expertize together through the cluster initiative will enhance the depth and breadth of the individual's research endeavor and will establish a much needed focal point to work on significant and challenging scientific and societal problems. Moreover, the complexity of future implantable devices introduces an array of rich fundamental scientific problems. Identifying and securing funding to study these issues introduces ample opportunities to enhance fundamental research at *UCF*. Extending fundamental knowledge will enable publications in elite scientific journals, and thus, enhance our prominence.

We will hire nationally and internationally-recognized leaders who will leverage existing capabilities to form a large cohesive research center. Specifically we will hire experts in mechatronics, medical robotics, bio-micro-fluidics, biomaterial development, surface chemistry and surface engineering, nanoscience sensor, cellular electrophysiology, as well as physicians and basic biologists/biomedical engineers to facilitate the translational aspects of the initiative. Beside their scholarly stature, they will help current faculty at *UCF* become world leaders in this important prosthetics area. They will publish in top journals in the field, such as *Nature, Science, Technology/Medicine*, the *ASME*/*IEEE Journal of Microelectromechanical Systems* (*JMEMS*), the *ASME Journal of Biomechanical Engineering*, *ASME Journal of Medical Devices*, *Annals of Biomedical Engineering*, the *Journal of Biomechanics*, *Biomaterials*, *Tissue Engineering*, and the *Journal of Rehabilitation Research and Development*.

12. Increase scholarly and creative work that can help address challenging scientific and societal problems facing us in the coming century

Implantable devices for prosthetic interfaces is a growing field that is far from perfected. Much research and development will be needed in many years to come to meticulously address practical and scientific challenges presented by this important field. With a prominent implantable devices competency under the prosthetic interface program, *UCF* will establish itself as a top-tier *BME* program. It will bring together faculty from many departments, colleges, centers, and institutes to work on exciting multidisciplinary research topics, funded by government and state agencies, industry, and nonprofit organizations. With a strong graduate program in *BME*, *UCF* will graduate more *PhD* students, improving our research ranking. Importantly, the inventions created will impact the health and well-being of our aging population, the veteran population, as well as serve the needs of the local community and will have the potential to impact global health. As research evolves into products, there will be increases in patent activity, spin-off companies and business partnerships that will impact economic development in Central Florida and the Medical City.

Although, *UCF* has no dedicated research endeavor in prosthetics, the inexpensive 3D printed arm, designed and built by the "Limbitless Solutions" team, has received much attention in the media. Implantable devices — an area at the intersection of external devices (e.g., artificial limb) and internal organs (e.g., nervous system and tissue) with significant research and development needs — align well with our current capabilities. A large number of faculty members are working in pertinent areas, such as sensors, actuators, control, systems, tissue engineering, soft materials, bioprinting, human computer interaction, intelligent user interfaces and visualization, and neuroscience. Many of these researchers desire to see a major thrust in *BME* where they can provide research and teaching support, but they lack the critical background and knowledge necessary to lead such effort.

To participate in the future of this important field, we need to hire devoted experts in prosthetics research and education. They will be able to connect all the current patchy silos into a single coherent effort that will make *UCF* a world leader in intelligent prosthetics.

13. Enhance research capacity to develop a robust, diverse, and recurring funding base

The potential impact of a world with advanced prosthetics is unequivocal. While request for proposals (RFP) are numerous (see for example RFPs from NIH, DARPA, and NSF), it is very likely that in the next decade or so research and development (and funding) pertinent to intelligent prosthetics will grow exponentially. Just ask Ray Kurzweil, Google's director of engineering, who believes he can live forever. To bring this to fruition, Google has gone on an unprecedented shopping spree and is aggressively assembling what looks like the greatest artificial intelligence laboratory on Earth. Google has bought almost every machine-learning and robotics company it can find. Several months ago it bought Boston Dynamics, a firm that produces lifelike military robots, for a massive sum. It spent 3.2 billion dollars on Nest Labs, a smart thermostat maker. It also recently bought the British artificial intelligence start-up DeepMind for 369 million dollars.

Also UCF is in a unique position to collaborate with VA in Lake Nona, where prosthetics will play an important role as war veterans are returning home. This cluster will play an important role in attracting VA funding and already VA CEO at Orlando has shown keep interest in participating in this cluster. Besides Orlando Health and Florida Hospital, two vast healthcare networks are interested in prosthetics related research and this cluster will interact with MDs and other medical professionals to attract Foundation and/or large donation type research funding. Besides many of the interface electronics and sensors in the prosthetics system will involve UCF and iCAMR interaction and will bid for large Federal consortium proposals (one such in the making, DOE's call for Smart sensors for Advanced Manufacturing, which can involve a variety of biomedical sensors and interfaces, which will tie into prosthetics functionality). This unique cluster can certainly aid the possibility of submitting Engineering Research Center or Science and Technology Center type proposal to National Science Foundation.

Is this a sign of things to come? No one can be certain; but if it is, UCF should aspire to take a leading role, in this emerging new world.

14. Ensure an increase in interdisciplinary publications reaching multiple disciplines

The design, development and refinement of implantable devices, sits on the intersection between biology and engineering and therefore requires an interdisciplinary approach as reflected in the faculty on this cluster. To insure a successful initiative, the cluster will be led by a diverse team of experts from several different disciplines including mechanical engineering, material science, industrial engineering, bio-medical sciences, internal medicine, and biomolecular sciences. It is therefore expected that publications arising from this research will be interdisciplinary in nature. We anticipate that faculty within this cluster will publish quality articles in interdisciplinary high impact journals such as *Biomaterials and Nature Translational Medicine*, *Nature, Science, Technology/Medicine*, The *ASME/IEEE Journal of Microelectromechanical Systems* (*JMEMS*), the *ASME Journal of Biomechanical Engineering*, *Biomaterials*, *Tissue Engineering*, and The *Journal of Rehabilitation Research and Development*. Typically, articles in these journals are read by scientists in a number of different

disciplines, and publication in such journals will be one of the measures used for evaluating the success of the initiative.

15. Strengthen the undergraduate and/or graduate education mission at UCF

The hiring of key faculty members under the intelligent prosthetics cluster hire enables significant enhancement of the existing engineering curriculum and enrichment of the biomedical engineering curriculum at the undergraduate and graduate levels by integrating the cluster research portfolio within the CECS engineering pedagogical mission. At the undergraduate level courses in subject areas that play key roles in intelligent prosthetics include solid mechanics, controls, mechatronics, instrumentation and measurements, biomechanics, robotics, and the capstone senior design sequence will significantly benefit by incorporation of topics in prosthetics design and development and enriched by cross-disciplinary subjects from neuroscience and medicine. The gait lab in MAE will be an invaluable asset to the testing and validation of prosthetics designs. Moreover, it is envisaged that a 3D Printing curriculum will be developed and expanded to include bio-printing of interfaces in collaboration with COM faculty members such as Dininder Singla, leveraging and expanding the 3D printing facilities developed in the CECS Ideas lab and CECS machine shop. Enthusiasm on the part of undergraduates in prosthetics design is evidenced by the student-led nonprofit Limbitless Solutions and the newly formed Center for Applied Biomedical Additive Manufacturing (CABAM).

At the graduate level, the intelligent prosthetics cluster enables enriching our graduate curriculum by incorporating the growing fields of bio-interfaces, microfluidics, micro and nano-piezoelectrics, micro- and nano-micro devices device development. The initiative also enables cross-disciplinary curricular development in neuroscience (COM) and engineering (CECS). Indeed, the MAE department is strategically building on a strong foundation in controls a complementary faculty expertise in medical robotics and micro-nano-mechanical systems and bio-interfaces. Curricular development at the graduate level will be incorporated in the creation of a graduate Biomedical Engineering (BME) program in CECS in close collaboration with COM.

An important curricular development will be a new course on ethical issues, FDA approval, and pathway for commercialization for medical device development. This BME course will be offered at the 5000 level to reach both undergraduates and graduate students. Contemporary and future issues in prosthetics design will be incorporated in the BME seminar series.

Summer Institutes (SI) on intelligent prosthetics and bioengineering will be held at UCF for middle and high school students in collaboration with the UCF Initiatives in STEM (iSTEM) program director Dr. Melissa Dagley. Hands-on experiences will be provided to students who will be actively recruited from Metropolitan Orlando schools. iSTEM uses Qualtrics, a data management tool licensed to the UCF, to create the pre/post-tests as well as formative surveys for SI. Ongoing, in-class assessment to test basic understanding of concepts as a classroom "feedback loop" is performed using iClickers.

The immediate impact of the cluster initiative is in the training and immersion of graduate and undergraduate students into a highly interdisciplinary working environment at the crossroads of engineering and medicine. The very nature of intelligent prosthetics requires students to synthesize knowledge acquired in engineering courses, such as controls, mechatronics, robotics and physical sciences classes such as chemistry, biology, and neuroscience.

Appendix A — Core faculty

CECS

- Waldemar Karwowski, Industrial Engineering and Management Systems
- Alain Kassab, Mechanical and Aerospace Engineering
- Sudipta Seal, Material Science and Engineering
- Robert Steward, Mechanical and Aerospace Engineering

COM

- Cristina Fernandez-Valle, Burnett School Biomedical Sciences
- Kiminobu Sugaya, Burnett School of Biomedical Sciences
- Bradley Wallenberg, Internal Medicine
- Stephen Lambert, Medical Education
- Alvaro Estevez, Burnett School of Biomedical Science

Appendix B — Grants related to the proposed cluster

PI name		Title	Area
William DeCampli (PI) and Alain Kassab (Co-PI)	MAE/ CECS	American Heart Association: Conceptual and Laboratory Development of a Self-Powered FONTAN for Treatment of Congenital Heart Disease	Multi-scale computational fluid dynamics for hemodynamics. Biofluids.
Alain Kassab (PI)	MAE/ CECS	NIH National Heart, Lung and Blood Institute (NHLBI), NIH Graduate Fellowship: A Multi-Scale CFD-FSI Model of the Hybrid Norwood Palliative Treatment for Hypoplastic Left Heart Syndrome	Multi-scale computational fluid dynamics for hemodynamics. Biofluids.
Alain Kassab (PI), Charles T. Price (Co-PI), Eduardo Divo (Co-PI) and Faissal Moslehy(Co-PI)	MAE/ CECS	United States National Science Foundation, REU: Analysis and Optimization of the Palvlik Harness Treatment of Neonated with Hip Dysplasia	Biomechanics
Alain Kassab (PI), Charles T. Price, Eduardo Divo, and Faissal Moslehy	MAE/ CECS	NSF, REU: Analysis and Optimization of the Palvlik Harness Treatment of Neonated with Hip Dysplasia	Biomechanics
Hansen Mansy	MAE/ CECS	The Audible Human Project	Sensor/digital signal processing/Computer modeling
Hansen Mansy	MAE/ CECS	Acoustic sensors for patient monitoring	Sensors/data acquisition and processing
Chanda Debashis		Printed Cavity-Coupled Nanoplasmonic	Plasmonic bio-sensors,

		Crystals for Non-Invasive In Vivo Diagnosis (UCF Office of Research)	Tissue Eng. inside 3D Nanostructured Scaffolds.
Fang Jiyu	MSE and AMPAC	Tailoring the surface of liquid crystal droplets by the self-assembly of supramolecular surfactants for biosensor applications (NSF)	Biosensors, drug delivery and artificial tissue engineering
Fang Jiyu	MSE and AMPAC	Integration of stimuli-responsive soft materials into prototype tissue for medical training (Army)	
Gesquiere Andre	NSTC/ Chemistry/ CECS	Engineering and study of a new multifunctional sensing nanoprobe for direct and rapid delivery of cargo to cytosol (NSF)	Quantum dot biosensors, drug delivery, Photodynamic therapy
Hickman, James	NSTC/Chemistry/CECS/COM	An In Vitro Model of Stem Cell Innervation of Myotubes (NIH)	Organ-on-a-chip, In vitro animal replacements, ALS, Alzheimer's disease, Diabetes, Ischemia, Biomaterial interfaces
Hickman, James	NSTC/Chemistry/CECS/COM	Microphysiological systems and low cost microfluidic platform with analytics (NIH)	
Hickman, James	NSTC/Chemistry/CECS/COM	Establishment of a Human-based In Vitro Functional NMJ System for ALS Screening (US Army Medical Research Acquisition Activity – ALS)	
Lambert, Stephen	COM/NSTC	Functional in vitro CNS and PNS myelination model (NIH)	
Hickman, James	NSTC/Chemistry/CECS/COM	Investigation of a functional 4-organ body-on-a-chip system with common serum free medium (L'Oreal)	
Hickman, James	NSTC/Chemistry/CECS/COM	Validation of an in vitro co-culture assay system using pharmacological references and potential active compounds (L'Oreal USA Product, Inc)	
Perez, J. Manuel		A novel polymeric nanotechnology platform with imaging capabilities for targeted delivery (NIH R01)	Nanotherapeutic, Imaging, Cancer Research.
Santra, Swadeshmukul	NSTC/Chemistry, MSE	Engineering and study of a new multifunctional sensing nanoprobe for direct and rapid delivery of cargo to cytosol, reporting on the delivery event, and quantification of delivered (NSF)	Nanotechnology in Biomedical Applications and Nanotoxicology. bioimaging, biosensing and drug delivery
Vaidyanathan, Raj	MSE and AMPAC	Improving the MRI Compatibility of Alloys and Devices (Lumen Medical)	Shape memory and superelastic alloys, MRI compatibility of alloys
Seal, Sudipta	MSE, AMPAC & NSTC	Unraveling the mechanism and the role of anti- inflammatory nanoparticles in multiple sclerosis model (NSF)	Nanoplatform, novel coatings on implant for bio-compatibility
Seal, Sudipta	MSE, AMPAC &	Radioprotective effect of nanoceria on neutron and photon induced lung damage	

	NSTC	(NASA, Co-PI)	
Seal, Sudipta	MSE, AMPAC & NSTC	Protection by engineered cerium oxide nanoparticles by particle radiation (NASA, PI)	
Seal, Sudipta	MSE, AMPAC & NSTC	Prolonged Inhibition of Pathologic Neovascularization by Catalytic Antioxidants (NIH RO1, Co-PI)	
Seal, Sudipta	MSE, AMPAC & NSTC	Regenerative nanosensors for quantative assessment of oxidative stress in neurodegeneration (NSF, Co-PI, EECS)	
Seal, Sudipta	MSE, AMPAC & NSTC	Pro-angiogenic and inorganic nano antioxidants for wound healing application in diabetic mouse model (Nemours Children Hospital, PI)	

Appendix C — an example of memorandum of understanding between CECS and COM

Memorandum of Understanding for the Hire of Dr. Robert Steward between the College of Engineering and Computer Science (CECS) and College of Medicine (COM)

July 12, 2014

Terms and conditions for an offer of Assistant Professor in Mechanical and Aerospace Engineering (MAE) in the area of Biomedical Engineering

MOU is valid for 5 years (from 2014-2015 to 2019-2020)

Salary (9 months: ~$85,000 + 28% benefits) Covered 100% by CECS

Start-up
Up to $200,000 cash, graduate students, summer support (provided by CECS):

Years 1-3: Equipment and lab expenses as required up to $200,000.
Years 1-2 2 graduate students per year.
Years 1-2: 2 months of summer salary support

Laboratory Space
Years 1-5: Share of cell culture lab, share of office space and personal lab space (500 sq. ft) provided by COM.

Overhead Return
70% to CECS; 30% to COM on all external proposals which may or may not include COM faculty

Teaching
One course each per year in MAE and one course per year in COM from the 2014-2015 academic year to the 2019-2020 academic year. Team-taught courses at COM will be considered one course by MAE. In the semesters when no course is given to Dr. Steward in COM, he will teach a course in MAE.

Research
Expectations are that several joint research proposals and research articles will be written by Dr. Steward with COM faculty; co-advise MS and PhD students; attend seminars and faculty meetings in CECS and COM, and in general be a good citizen of both colleges.

Mentoring Committee
A mentoring committee will be formed for Dr. Steward consisting of at least two faculty members from CECS and at least one faculty member from COM. The committee members will be chosen by Dr. Steward with the help of the MAE chair and the Associate dean of Research at COM. The committee will meet at least once a month with Dr. Steward to discuss his teaching, research and service activities and advise him as appropriate. The committee chair will report these discussions to the MAE chair and the Associate dean of Research at COM.

Reports and Evaluations

Dr. Steward will submit his Faculty Annual Report (FAR) to CECS with a copy to COM. Cumulative Progress Evaluations (CPE) will be done by CECS accompanied by an evaluation letter from COM, completed by the dean of COM. Tenure evaluation and tenure votes will be conducted only at CECS with letter of evaluation from COM, completed by the dean of COM.

Moving Expenses
Up to $5,000 (charged to CECS).

SIGNED

Dean of CECS: Michael Georgiopoulos

Dean of COM: Deb German

BIOGRAPHICAL SKETCH

Provide the following information for all the core cluster personnel. Follow this format for each person.

DO NOT EXCEED TWO PAGES PER INVESTIGATOR.

NAME: Sudipta Seal Cluster Lead: (Yes)

POSITION TITLE, DEPT, & UNIT and or COLLEGE: Professor, Director, Interim Chair, MSE, AMPAC, NSTC

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, include postdoctoral training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date YEAR	FIELD OF STUDY
IIT – KGP, India	BTech (Hons)	1990	Metallurgy Eng
U Sheffield, UK	MMet	1992	Eng. Materials
U Wisconsin (UWM)	PhD	1996	Mat. Sci. Eng
LBNL, UC-Berkeley	Postdoc	1997	Mat Sci

NOTE: The Biographical Sketch may not *exceed two pages*. Follow the formats and instructions below.

A. Personal Statement- your value to the cluster

(Briefly describe your unique value to the cluster and describe any previous interdisciplinary activities related to this cluster.)

My current role as an administrator will greatly help leading the cluster. I have also done interdisciplinary biomedical and nanotechnology research with COM and CECS faculty and had joint grants from NSF, NIH and Industry. Besides I have extensive collaboration with national (Virginia Tech, Mayo Clinic, Dean McGee Eye Center, Sanford Burnham, John Hopkins, NIH, Henry Ford Hospital, Nemours, etc) and international institution (Germany, Italy, UK, Spain, India) and will bring an international flavor to this cluster

B. Contribution to Scholarship and Creative Activities

(Briefly describe your most significant contributions to scholarship and creative activities. Include appropriate indicators for your area of scholarship and external recognition)

My most significant discovery is the engineering of rare earth oxide nanostructures as antioxidants and have found applications from neuroscience, tissue engineering to implant research in a team collaboration with scientists across the disciplines inside and outside of UCF). These nanostructures are further utilized as biomedical sensor to monitor cell dysfunctions when challenged with reactive oxygen species. I have been awarded more than 44 patents (many pending) and many of them are licensed through UCF. NanoCe LLC is a spinout from UCF as a result to commercialize some these technologies. I am a fellow of AIMBE (American Institute of Medical and Biological Engineers.

Select awards: United Engineering Foundation Fellowship, New York, (2001), Office of Naval Research YOUNG INVESTIGATOR AWARD- ONR YIP 2002 Award, ASM – IIM Visiting Lecturer Award, ASM International (2003), Japan Science and Promotion Award (JSPS) Fellow @ NIMS (2004), GOLD Award – UWM (2004), Alexander Von Humboldt Fellowship, RWTH, Germany (2006), Marquis WHO's WHO (2006), Distinguished Visiting Professorship Fellowship, Royal Academy of Engineering-UK, Imperial College of Science and Technology and Medicine (2007), Invited & Selected to the Frontiers of Eng. Sym, National Academy of Engineering (2009), UWM CECS Materials Eng. Distinguished Alumnus award (2011), Science Spectrum Trailblazer award, BEYA STEM Global Comp. DC (2013),

Central Florida Engineers Week: Technical Excellence in Engineers Academia (2013), Tech-Connect Innovation Award: Tech Connect World Expo, DC (2014), Schwartz Tech Award – Researcher of the Year (Orlando, 2014), Issac Ellizier Memorial Lecture (2015), UCF Research Incentive Award and UCF Teaching Incentive Program Award (multiple times, for Excellent Research and Teaching)

Professional registration: Fellows of American Society of Materials (FASM), Electrochemical Society (FECS), Institute of Nanotechnology (FloN-UK), American Vacuum Society (FAVS), American Advancement of Association of Science (FAAAS), National Academy of Inventors (FNAI), American Institute of Medical and Biological Eng (FAIMBE), Advisor of Tau Beta PI

C. Evidence of Impact & Support

(Briefly describe evidence of impact and support related to the proposed cluster)

External Funding: (Total Involvement reported, Related grants to biomedical only):
NASA (PI, 1 Co-PI): (NNX 13AN 18G) $210,000
NSF (PI) (CBET-1261956): $190,000
NASA (Co-PI): (NNX12AJ72G): $200,000
NIH RO1 (Co-PI) 1R01EY022111: $226,000 (sub from Oklahoma)
DOD (Co-PI) W81XWH-11-1-0407: $65,068 (sub from Henry Ford)
NSF (PI) (CBET-1201951): $46,329: NSF (PI) (CBET 1007495): $59,998
NSF, SBIR Ph1 (sub from NovaBone, Alachua): $53,000
NSF (Co-PI, 2 PIs+BU) (EECS – 0901503): $600,000
NSF (PI+1Co-PI) (CBET – 0930170): $418,085
NIH RO1 (Multi-PIs) (1R01EY018724-01): $81,840 (Total: $740,000)
NSF NIRT (PI+3 CoPIs) (CBET-0708172): $1,034,000 (+ International, and REU/RET)
NIH (Co-I): (R01: AG031529-01): $1,269,724
NIH, Co-PI (with OU as PI) (R21: 1R21EY018306): $558,989 (Total)
NIH, Co-PI (R21: GM079600-01): $562,000 (after 1 yr, we send back this since we won RO1)
NSF, (PI): (CBET: 0711239): $130,000: NSF (PI): (BES: 0541516): $112,000
NSF (2 PIs, UCF, U Conn) (DMII: 0500268): $150,000
NIH, (Co-PI,1 PI) (NIH: R01AG022617): $1,440,000 (Total)
Nemours (+Florida High Tech) (PI): $240,000: Sanofi Pasteur (+Florida High Tech): $150,000
Orlando Health (+Florida High Tech) (PI): $67,000: Bionucleonics (PI): $24,000

Partnership/Collaboration: UCF BSBS, COM, CECS, Sanford Burnham, Vax-Design (Sanofi Pasteur), U Florida, FIT, Out of State – Dean McGee Eye Center, MD Andersen, Mayo Clinic, Henry Ford Hospital, Virginia Tech, NIH/Johns Hopkins, Imperial College-UK, Germany, Spain, Italy
Keynote/Invited Lectures: More than 50 talks at ASM, AVS ACERS, MRS (all Materials meetings), Nanotech, Radiation Society, WHS (Wound society), ARVO (Eye), Biomaterial meetings, and GORDON Conference in Radiation/Biology

Out of 30 papers: (With Self, Zhao, Bossell, et al., from COM) *Environmental Science: Nano,* **2014**, *MRS BULLETIN*, Nov, Vol 39 (11), 976-983, 2014. Env. *Sci.: Nano*, 2014,1, 516-532. J Cell Death and Differentiation, (2014) **21**, 1622–1632, *Future Medicine*, 8(9), 1483-1508, 2013. *Environmental Toxicology*, 27, 107-118, 2013. *ACS Nano*, *7*, 4855-4868, 2013. *PloS One*, 8(5): e62816, 2013. *Journal of Drug Delivery and Translational Research*, 3(4):375-379, 2013. *Nanomedicine: Nanotechnology, Biology and Medicine,* 9(4), 558-569, 2013. *Biomaterials,* 33, 7746-7755, 2012. *Chem Commun*, 48(40):4896-8, 2012. *Nanoscale*, 4 (8), 2597 – 2605, 2012. *J of Luminescence*, 132, 743–749, 2012. *Biomaterials*, 32(28):6745-6753, 2011. *Chemical Society Reviews*, 39,11, 4422-4432, 2010. *Molecular Biosystems*, 6(10), 1813-1820, 2010, *Nanomedicine:Nanotechnology,BiologyandMedicine*,6(6),738-744, 2010. *Nanomedicine: Nanotechnology, Biology and Medicine*, 6(5), 698-705, 2010. *Chemical Communications*, 46(16), 2736-2738, 2010. *Langmuir*, 26(10), 7188-7198, 2010. *Journal of the American Chemical Society*, *131* (40), 14144–14145, 2009. *ACS NANO*, 3(9), 2523-32, 2009. *ACS NANO*, 3(5), 1203-11, 2009. *Nanomedicine: Nanotechnology, Biology and Medicine*, *5*(2), 225-231, 2009. *Biomaterials*, 29(18), 2705-2709, 2008. *JOM*, 60(3), 33-37, 2008. *Biomaterials*, 28(31), 4600-4607, 2007. *Chemical Communications*, 10, 1056-1058, 2007. DOI: 10.1039/b615134e

BIOGRAPHICAL SKETCH

Provide the following information for all the core cluster personnel. Follow this format for each person.

DO NOT EXCEED TWO PAGES PER INVESTIGATOR.

NAME: ***Alain Kassab*** Cluster Lead: ***Yes***

POSITION TITLE, DEPT, & UNIT and or COLLEGE***: Professor, Mechanical and Aerospace Engineering Department, CECS***

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE	Completion Date YEAR	FIELD OF STUDY
University of Florida, Gainesville Florida	B.S.E.S.	1982	Engineering Sciences
University of Florida, Gainesville Florida	M.S.M.E.	1985	Mechanical Engineering
University of Florida, Gainesville Florida	PhD	1989	Mechanical Engineering

A. Personal Statement- your value to the cluster

I have over 25 years of experience in research and development in bioengineering, computational fluid dynamics (CFD), inverse problems, boundary elements, and meshless methods resulting in over 300 scientific publications, including 89 journal papers, 190 refereed international/national archival conference papers, 3 books authored/edited, 9 invited chapters in monographs, and I am Co-editor of 9 Proceedings of international conferences. I am Fellow of ASME and WIT, associate editor of 2 journals, and member of 5 journal editorial boards. I have mentored to graduation 13 PhD and 26 MS students. Over the past 8 years, I have been ***collaborating closely with COM faculty member Dr. William DeCampli*** in a research program funded by Arnold Palmer Hospital, the American Heart Association, and the NIH in multi-scale CFD for cardiovascular modeling aimed at treatment planning with applications to thrombus transport in LVADs and palliative treatment of hypo-plastic left heart syndrome. Since 2010, I have also been closely ***collaborating with COM faculty Dr. Charles Price*** on a multi-year project funded by the NSF and the International Hip Dysplasia Institute investigating the biomechanics of hip reduction for neonatal developmental dysplasia of the hip (DDH) for low to severe grades of DDH using the Pavlik Harness and alternative braces. I also have related experience in bioengineering computational modeling having been engaged in a research project with MD Anderson modeling the lung tumor motion in patients undergoing radiation therapy. I have authored and direct the CECS Bioengineering Minor. I have recently been appointed director of bioengineering in the MAE department and lead of group of 5 (soon to be 7) MAE faculty carrying out BME research and teaching. I chaired the 2015 MAE bioengineering search committee (committee included ***COM faculty member Dr. Sampath Parthasarathy***). I chaired as well a university-wide committee (included ***COM faculty members Dr. Juan Cendan and Dr. William DeCampli***) that submitted a MS in Biomedical Engineering (MSBME) pre-proposal that was approved by the SUS Council of Academic Vice Presidents and this same committee is preparing the full-proposal for a MSBME degree program. I bring experience in translational bioengineering research to the cluster initiative along with a track-record of successful projects at the interface of engineering and medicine.

B. Contribution to Scholarship and Creative Activities (selected publications since 2013 - - cluster member and COM collaborators names are bolded)

Huayamave, V., Rose, C., Serra, S., Jones, B., Divo, E., Moslehy, F., **Kassab, A.J.**, and **Price, C.T.**, "A Patient-Specific Model of the Biomechanics of Hip Reduction for Neonatal Developmental Dysplasia of the Hip: investigation of strategies for low to severe grades of DDH," *Journal of Biomechanics*, (online 2/4/2015 DOI:10.1016/j.jbiomech.2015.03.031).

Jia, Y., Argueta-Morales, I-R, Liu, M., Bai, Y., Divo, E., **Kassab, A.J.**, and **DeCampli, W.M**., "Experimental Study of Anisotropic Stress/Strain Relationships of the Piglet Great Vessels and Relevance to Pediatric Congenital Heart Disease," *Annals of Thoracic Surgery*, 2015 Apr;99(4):1399-407. doi: 10.1016/j.athoracsur.2014.11.032.PMID: 25681872 [PubMed].

DeCampli, W.M., **Secasanu, V.**, I. Ricardo Argueta-Morales, Cox, K., Ionan, C., and **Kassab, A.J.**, "External counterpulsation of a systemic-to-pulmonary artery shunt increases coronary blood flow in neonatal piglets, " *World Journal for Pediatric and Congenital Heart Surgery*, 2015, Vol. 6, No. 1, pp. 75-82.

Argueta-Morales, I.R., Tran, R., Ceballos, A., Osorio, R., Clark, W., Divo, E., **Kassab, A.**, **DeCampli, W.M.**, Mathematical modeling of patient-specific ventricular assist device implantation to reduce particulate embolization rate to cerebral vessels, *ASME Journal of Biomechanical Engineering*, 2014, Vol. 136, No. 7, pp. 071008-1-8. PMID: 24441718.

Osorio, A.F., Osorio, R., Ceballos, A., Tran, R., Clark, W., Divo, E.A., Argueta-Morales., I.R., **Kassab, A.J.,** and **DeCampli, W.M.**, "Computational Fluid Dynamics Analysis of Surgical Adjustment of Left Ventricular Assist Device Implantation to Minimize Stroke Risk," *Computer Methods in Biomechanics and Biomedical Engineering*, 2013, vol. 16, no. 4-6, pp. 622-638.

Ardila, O., Divo, E.A., Moslehy, F., Rab, G.T., **Kassab, A.J.**, and **Price, C.T.,** "Mechanics of Hip Dysplasia Reduction in Infants Using the Pavlik Harness: A Physics-Based Computational Model," *Journal of Biomechanics*, 2013, Vol. 46.

DeCampli,W.M., I. Ricardo Argueta-Morales, Eduardo Divo, and **Kassab, A.J., "**Computational Fluid Dynamics in Congenital Heart Disease," *Cardiology in the Young*, 2012, Vo. 22, pp. 800–808. (doi:10.1017/S1047951112002028).

Ceballos, A., Argueta-Morales, I.R., Divo, E., Osorio, R., Caldarone, C., **Kassab, A.J.**, and **DeCampli, W.M.**, "Computational Analysis of Hybrid Norwood Circulation with Distal Aortic Arch Obstruction and Reverse Blalock-Taussig Shunt," *Annals of Thoracic Surgery*, 2012, Vol. 94, No. 5, pp. 1540-1546. (http://dx.doi.org/10.1016/j.athoracsur.2012.06.043).

Secasanu V., Argueta-Morales I.R., Cox K., Ionan C., **Kassab A.J.**, **DeCampli W.M**. Systemic-to-pulmonary artery shunt counter-pulsation prevents diastolic coronary blood flow runoff. *J. Am. Coll. Surg.* 2013;217(3S):36. Presented at the Surgical Forum of the American College of Surgeons 99th Annual Clinical Congress on Oct, 2013. Washington, DC.

C. Evidence of Impact & Support (selected recent grant awards - cluster member and COM collaborators names are bolded)

American Heart Association, (January 1, 2015- December 31, 2016). Project title: Conceptual and Laboratory Development of a Self-Powered FONTAN for Treatment of Congenital Heart Disease. PI: **DeCampli, W.M.** and **Kassab, A.J. (**AHA Award Number 5IRG22470015).

US Army Research Laboratory (March 11, 2015- March 10, 2016). Project Title: Evaluation and Transition of Emerging Medical Simulation Technologies. PI: Goldiez, B, **Kassab, A.J.**, and Bai, Y., (UCF ORC account 16-26-6134).

NIH National Heart, Lung and Blood Institute (NHLBI), (Septemebr 1, 2014 - August 31, 2015) NIH Graduate Fellowship, Ceballos, A., "A Multi-Scale CFD-FSI Model of the Hybrid Norwood Palliative Treatment for Hypoplastic Left Heart Syndrome," PI: **Kassab, A.J.**, (NIH GRant Number 1F31HL123280-01).

United States National Science Foundation, (September 1, 2012- August, 31, 2015), Project Title: "Analysis and Optimization of the Pavlik Harness Treatment of Neonates with Hip Dysplasia," PI: **Alain Kassab**, **Charles T. Price**, Eduardo Divo and Faissal Moslehy. (NSF Grant Number CBET-1160179).

American Heart Association, (September 1, 2011- August 31, 2013). Project title: "Multiscale Modeling of the Neonate Circulation After Hybrid Norwood Palliation," P.I.: **Kassab, A.J.**, **DeCampli, W.M.** and Divo, E. (AHA Grant number 11GRNT7940011).

SUS of Florida Board of Governors, Jan. 1, 2011-Dec. 31, 2011, Project Title: "New Florida Clustering Program - Florida Biomedical Engineering Partnership," PI: **Alain Kassab.**

BIOGRAPHICAL SKETCH

Provide the following information for all the core cluster personnel. Follow this format for each person.

DO NOT EXCEED TWO PAGES PER INVESTIGATOR.

NAME: **Stephen Lambert, Ph.D.** Cluster Lead: Yes

POSITION TITLE, DEPT, & UNIT and or COLLEGE: Associate Professor of Medical Education, Department of Medical Education, College of Medicine.

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, include postdoctoral training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date YEAR	FIELD OF STUDY
University of the Witwatersrand, South Africa	Ph.D	1992	Medical Biochemistry
The University of Hertfordshire, United Kingdom	BSc. (Hons)	1982	Biochemistry

NOTE: The Biographical Sketch may not *exceed two pages*. Follow the formats and instructions below.

A. Personal Statement- your value to the cluster

I am the co-lead in this cluster initiative and a member of the Department of Medical Education at the College of Medicine. I have over 20 years of research experience in the Neurosciences and in the last 8 years since joining UCF have included studies on the interface between cellular systems (largely neuronal) and artificial materials in the development of prosthetics and microphysiological platforms for drug discovery. These studies result from collaborations with cluster member **Dr. James Hickman (NTSC)**. I also maintain a basic neuroscience lab in the BSBS building at Lake Nona and collaborate with cluster members **Dr. Fernandez-Valle (BSBS)** and **Dr. Bradley Willenberg** (Internal Medicine) in the areas of peripheral nerve biology and biomaterials for peripheral nerve repair respectively. I have served on numerous NIH and DOD review panels including the Neurotechnology and glial biology NIH panels, as well as time spent as the Chairman of the Neuroscience fellowships review panel. Current areas of focus in my lab include studies of myelin repair mechanisms, the mechanisms underlying neuropathic pain perception and the development of biomaterials for shunts associated with peripheral nerve repair.

B. Contribution to Scholarship and Creative Activities (selected publications in the area of the cluster since 2012 with collaborations with cluster individuals bolded).

Davis H, Gonzalez, M Stancescu M, **Hickman JJ** and **Lambert S**. A phenotypic culture system for the molecular analysis of CNS myelination in the spinal cord. Biomaterials. 35: 8840-8845, 2014.

Huang F, Bladon J, Lagoy R, Shorrock P, Hronik-Tupaj M, Zoto CA, Connors RE, McGimpsey WG, Molnar P, **Lambert S**, Rittenhouse AR, and Lambert CR. A photosensitive surface capable of inducing electrophysiological changes in NG108-15 Neurons. Acta Biomater. 12:42-50, 2015.

Guo X, Greene K, Akanda N, Smith A, Stancescu M, **Lambert S**, Vandenburgh H, **Hickman J.** In vitro Differentiation of Functional Human Skeletal Myotubes in a Defined System. Biomater Sci. 2(1):131-138, 2014.

Rumsey JW, McAleer C, Das M, Bhalkikar A, Wilson K, Stanescu M, **Lambert S**, **Hickman JJ**. Myelination and node of Ranvier formation on sensory neurons in a defined in vitro system. In vitro Cell Dev Biol Anim., 49(8):608-18, 2013.

Guo X, Spradling S, Stancescu M, **Lambert S** and **Hickman JJ**. Derivation of sensory neurons and neural crest stem cells from human neural progenitor hNP1. Biomaterials, 34(18): 4418-4427, 2013.

Guo X, Ayala JE, Gonzalez M, Stancescu M, **Lambert S** and **Hickman JJ**. Tissue engineering the monosynaptic circuit of the stretch reflex arc with co-culture of embryonic motoneurons and proprioceptive sensory neurons. ***Biomaterials.*** 23:5723-5731, 2012.

Davis H, Gonzalez M*,* Bhargava N, Stancescu M, **Hickman JJ** and **Lambert S**. Rat Cortical Oligodendrocyte–Embryonic Motoneuron Co-culture:An *in vitro* Axon-Oligodendrocyte Interaction Model. ***J Biomat. and Tissue Engineering,*** 2:206-214, 2012.

Davis H, Guo X, **Lambert S**, Stancescu M, and **Hickman JJ**. Small Molecule Induction of Human Umbilical Stem Cells into MBP-positive Oligodendrocytes in a Defined Three-Dimensional Environment. ***ACS Chem. Neurosci.***, 3, 31−39, 2012.

C. Evidence of Impact & Support (Selected Past and Present grant support with cluster members emboldened).

R01EB009429-01A1 (**Lambert PI and Dr. James Hickman as Co-I**)
NIH (NIBIB) "*Functional Invitro CNS and PNS myelination model"* 1/4/10-12/31/14 (on NCE)

1R01DC010189-01, (**Co-I** with **Dr. Cristina Fernandez-Valle, UCF**).
NIH (NIDCD) *"Identification of novel Drug Targets For Use in Preventing Deafness Caused by NF2".* 7/1/09-6/30/14.

5R01NS050452-05 (**Co-I** with **Dr. James Hickman, UCF**).
NIH (NINDS) "An In Vitro Model of Stem Cell Innervation of Myotubes". 2/1/11-1/31/16.

NIH (**Co-I** with Dr. Michael Schuler, Cornell University).
Microphysiological Systems and Low Cost Microfluidic Platform with analytics. 7/1/12-6/30/14

1R01NS062825-01A1, (**Co-I** with **Dr. Cristina Fernandez-Valle, UCF**).
NIH (NINDS) *"Mechanisms Modulating Cytoskeletal Dynamics During Schwann Cell Myelination"*7/1/09-6/31/11.

Subsystem 2, Biomedical Engineering Institute (WPI) Center for Neuroprosthetics (**Lambert PI**)
Development of a sensory feedback module for prosthetic control. 06/06/08-08/05/11.

<u>Keynote Addresses in the area of the Cluster:</u>

Neuronal Hybrid System Interfaces. **S.Lambert.** International Meeting on Neuroprosthetics 2010, WPI,Worcester, MA.

BIOGRAPHICAL SKETCH

Provide the following information for all the core cluster personnel. Follow this format for each person.

DO NOT EXCEED TWO PAGES PER INVESTIGATOR.

NAME: Cristina Fernandez-Valle, PhD Cluster Lead: No

POSITION TITLE, DEPT, & UNIT and or COLLEGE: Professor, Burnett School of Biomedical Science, College of Medicine

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date YEAR	FIELD OF STUDY
Florida International University, Miami, FL	B.S.	1981	Biological Sciences
University of Miami School of Medicine	Ph.D.	1989	Cell & Molecular Biology
University of Miami School of Medicine	Postdoctoral	1989–1993	Neuroscience

A. Personal Statement- your value to the cluster

I have twenty years of research experience in neuroscience at UCF in peripheral nerve development and myelination and in Neurofibromatosis Type 2, a genetic tumor disorder of the nervous systems that causes loss of hearing, vision and nerve function associated with sensation and movement. I instruct 700+ undergraduates each year in Introduction to Neurobiology and have trained over 100 high school/undergraduate/graduate and post-doctoral fellows;the majority have been women and minorities. **My expertise related to the "Intelligent Prosthetics"** cluster is in cell culture particularly of neurons and glial cells. I have collaborated with Dr. **Hickman** (Nanoscience) on an NIH RO1 grant and have published together. More recently I have been collaborating with Dr. **Chanda** (Nanoscience) on 3D-scaffolds and cell culture related to implants for peripheral nerve regeneration. I also have significant expertise in cell imaging and have collaborated with Dr. **Dogariu** in CREOL which has led to RIBOP funding (COM-CREOL-ORC internal grant) and publications/presentations.

B. Contribution to Scholarship and Creative Activities

EXTERNAL RECOGNITION-GRANT REVIEW PANELS

2000 Department of Defense, Neurofibromatosis Study Section
2001-2005 NIN/NINDS, Regular Member NSD-B Scientific Review Panel
2002-2005 Department of Defense, Neurofibromatosis Study Section
2004 NIH/NINDS Training Grant & Career Development Review Panel
2005 NIH/NINDS NZS1 SRB-E Special Emphasis Panel, Neurofibromatosis
2005-2011 BoD/VP, Florida Chapter of National Children's Tumor Foundation
2007-2008 Department of Defense/CDMRP TSC Concept Panel
2008-pres Research Advisory Committee, Children's Tumor Foundation
2008-2011 Children's Tumor Foundation, Review panel, Drug Discovery Initiative
2010-2015 Standing Member, CMBG Panel, Center for Scientific Review, NIH.

REFERRED JOURNAL ARTICLES (selected)

Fernandez-Valle C, Tang Y, Ricard J, Ruano-Rodenas A*, Hackler E*, Taylor A*, Biggerstaff J. Iacovell J*. (2002) The Neurofibromatosis Type 2 Tumor Suppressor Binds Paxillin: Evidence for a Role in Membrane Localization and Density Dependent ß1 Integrin and ErbB2 Interactions. Nature Genetics. 31(4):354-62.

Thaxton C*, Lopera J*, Bott M, and **Fernandez-Valle C**. (2008) Neuregulin and Laminin

Stimulate Schwannomin Phosphorylation in Schwann Cells. Oncogene. 27(19):2705-15.
Rumsey JW*, Das M*, Stancescu M, Bott M, **Fernandez-Valle C**, **Hickman** J. (2009) Node of Ranvier formation on motoneurons in vitro. Biomaterials. 30(21):3567-72.
Thaxton C*, Bott M, Walker B, Sparrow NA*, Lambert S, and **Fernandez-Valle C**. 2011. Schwannomin Promotes Process Extension and Determines Internodal Myelin Length. Mol Cell Neuroscience. 47:1-9.
Sparrow N*, Manetti M, Bott M, Bates, M, Bunge MB, Lambert, S, **Fernandez-Valle C**. (2012) The Actin Severing Protein Cofilin is Downstream of Neuregulin Signaling and is Essential For Schwann Cell Myelination. J Neuroscience. 32:5284-97.
Douglass, Sparrow, Bott, **Fernandez-Valle** , Dogariu (2013)Measuring Anisotropic Cell Motility on Curved Substrates. J Biophotonics May;6(5):387-92.
Petrilli*, Copik, Posadas, Chang, Welling, Giovannini and **Fernández-Valle**. (2013) LIM domain kinases as potential therapeutic targets for neurofibromatosis type 2. Oncogene Jul3;33(27):3571-8
Petrilli A*, Bott M, **Fernández-Valle C**. (2013) Inhibition of SIRT2 in merlin/NF2-mutant Schwann cells triggers necrosis. Oncotarget Dec;4(12):2354-65
Petrilli AM*, Fuse MA*, Donnan MS*, Bott M, Sparrow NA*, Tondera D, Huffziger J, Frenzel C, Malany CS, Echeverri CJ, Smith L, **Fernández-Valle C**. A chemical biology approach identified PI3K as a potential therapeutic target for neurofibromatosis type 2. Am J Transl Res. 2014 Oct 11;6(5):471-93.
Lee MW, Bassiouni R, Sparrow NA*, Iketani A, Boohaker RJ*, Moskowitz C, Vishnubhotla P, Khaled AS, Oyer J, Copik A, **Fernandez-Valle C**, Perez JM, Khaled AR. The CT20 peptide causes detachment and death of metastatic breast cancer cells by promoting mitochondrial aggregation and cytoskeletal disruption. (2014). Cell Death Dis May 22;5:e1249
Petrilli A., **Fernandez-Valle C.** Role of Merlin/NF2 Inactivation in Tumor Biology. (2015) Oncogene. Invited review (in press).

C. Evidence of Impact & Support

CURENT FUNDING
1) DOD/CDMRP-NFRP: Investigator Initiated Research Award. "*In Vivo* Validation of High-throughput Drug Screening Results for NF2 Therapy Development". Principal Investigator 07/01/015-06/30/18 $777,059
2) DOD/CDMRP-NFRP: Investigator Initiated Research Award; "Identification of Novel Targets for the Treatment of Schwannomatosis Pain". Co-I (Sherman-OHSU) 07/01/015-06/30/18 $204,269 to CFV
3) State of Florida/Florida Translational Research Program; Chemical Modification of Molecular Probes for NF2 Scaffolds. Principal Investigator 3/14-6/15 $500,000 to SBMRI
4) Children's Tumor Foundation: Synodos-Experimental Therapeutic Targeting the NF2 Kinome: NF2 from Basic to Translational to Clinical. Co-Investigator with Co-I's from 7 other universities 6/01/14-5/31/17 $3M; $233,003 to CFV
5) NIH/NIDCD: RO1 Identification of Novel Drug Targets for Use in Preventing Deafness Caused by NF2 Principal Investigator 07/01/2009-06/30/2015 $1,785,040

PENDING FUNDING
6) NIH/NINDS Translational R21 "Pre-Clinical In Vivo Testing of Candidate NF2 Drugs" Principal Investigator 07/01/015-06/30/18 Amount: $720,093 (Pending Council Review)

7) NIH/NIDCD RO1 Identification of Novel Drug Targets for Use in Preventing Deafness Caused by NF2Principal Investigator 02/01/2015-01/31/2020 $1,785,040

BIOGRAPHICAL SKETCH

Provide the following information for all the core cluster personnel. Follow this format for each person.

DO NOT EXCEED TWO PAGES PER INVESTIGATOR.

NAME: Waldemar KARWOWSKI Cluster Lead: no(yes or no)

POSITION TITLE, DEPT, & UNIT and or COLLEGE: Professor and Chair, Department of Industrial Engineering and Management Systems, CECS

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, include postdoctoral training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date YEAR	FIELD OF STUDY
Wroclaw University of Technology, Wroclaw, Poland	M.S. (five year program that integrates BS.)	1978	Production Engineering
Texas Tech University	PhD	1982	Industrial Engineering
State Institute for Organization and Management in Industry, Warsaw, Poland	DSc	2004	Management Science

NOTE: The Biographical Sketch may not *exceed two pages*. Follow the formats and instructions below.

A. Personal Statement- your value to the cluster

My research and teaching focus on two interdisciplinary fields of study, namely human factors and systems engineering, which includes human-centered design, human-systems integration, cognitive engineering, computational ergonomics, and neuroergonomics. I also have a very strong background in mathematical modeling and computer simulation of human physical and cognitive performance. Throughout my academic career, I have had the opportunity to collaborate with many colleagues from medicine, neuroscience, nursing; health sciences, psychology, sociology, computer science, computer engineering, design, and mathematics.

In close cooperation with other team members at UCF, I will contribute to this cluster by investigating the human-computer interaction aspects of prosthesis, including biomechanical and physiological considerations, as well as neural aspects of brain-muscle interfaces, from the perspective human-centered design of neuroadaptive systems.

As Chair of the IEMS Department, I will also provide the logistical and institutional support of the planned cluster activities, cluster leader(s), as well as the faculty members involved across UCF departments and colleges in order to assure this cluster's success.

B. Contribution to Scholarship and Creative Activities

Karwowski, W., Gaweda, A., Marras, W. S., Davis, K., Zurada, J., and Rodrick, D., 2006, A fuzzy relational rule network modeling of electromyographical activity of trunk muscles in manual lifting based on trunk angels, moments, pelvic tilt and rotation angles. *International Journal of Industrial Ergonomics,* 36 (10), 847-859.

Rodrick, D. and Karwowski, W., 2006, Nonlinear dynamical behavior of surface electromyographical signals of biceps muscle under two simulated static work postures, *Nonlinear Dynamics, Psychology, and Life Sciences*, 10 (1), 21-35.

Hou, Y., Zurada, J.M., Karwowski, W., Marras, W.S., and Davis, K., 2007, Estimation of the dynamic spinal forces using a recurrent fuzzy neural network. *IEEE Transactions on Systems, Man and Cybernetics, Part B: Cybernetics*, 37 (1), 100-109.

Hou, Y., Zurada, J.M., Karwowski, W., Marras, W.S. and Davis, K., 2007, Identification of key fuzzy variables using fuzzy average with fuzzy cluster distribution. *IEEE Transactions on Fuzzy Systems*, 15(4), 673-685.

Marek, T., Karwowski, W., and Rice, V., (Editors), 2011, *Advances in Understanding Human Performance: Neuroergonomics, Human Factors Design, and Special Populations*, CRC Press, Taylor & Francis: London.

Fafrowicz, M., Marek, T., Karwowski, W. and Schmorrow, D. (Editors), 2012, *Neuroadaptive Systems: Theory and Applications*, CRC Press, Taylor & Francis: London.

Garg, A., Waters, T., Kapellusch, J., & Karwowski, W., 2014, Psychophysical basis for maximum pushing and pulling forces: A review and recommendations. *International Journal of Industrial Ergonomics,* 44(2), 281-291.

Khalaf, T., Karwowski, W., & Sapkota, N., 2014, A nonlinear dynamics of trunk kinematics during manual lifting tasks. *Work: A Journal of Prevention, Assessment and Rehabilitation.* DOI 10.3233/ WORK, 141880.

Member, *Board on Human Systems Integration*, National Research Council: National Academy of Sciences, USA (2010-2011).

Member, *Committee on Human Factors*, National Research Council: National Academy of Sciences, USA (2007-2009).

C. Evidence of Impact & Support

Karwowski, W. (PI) and Zurada, J. M, *Development of a Neuro-Fuzzy System to Predict Spinal Loading as a Function of Multiple Dimensions of Risk*, DHHS-NIOSH / Ohio State University; 2002-2007.

Karwowski, W. (PI), *Modeling Variability of Human Performance in STAMPS*. Office of Naval Research, Award No.00014-14-1-0777, 2014- 2018.

Invited Keynote Speaker, *The Challenges Of Human-Systems Integration In A Complex World: Understanding Emergent Properties Of Human-Systems Interactions*, *IEA 2012 18th World Congress of the International Ergonomics Association*, Recife, Brazil February 2012.

BIOGRAPHICAL SKETCH

Provide the following information for all the core cluster personnel. Follow this format for each person.

DO NOT EXCEED TWO PAGES PER INVESTIGATOR.

NAME: Kiminobu Sugaya Cluster Lead: Yes

POSITION TITLE, DEPT, & UNIT and or COLLEGE: Professor, Burnett School of Biomedical Sciences, College of Medicine

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date YEAR	FIELD OF STUDY
Science University of Tokyo, JAPAN	BS	1983	Pharmacology
Science University of Tokyo, JAPAN	MS	1985	Pharmacology
Science University of Tokyo, JAPAN	PhD	1988	Pharmacology
Southern Illinois Univ., Springfield, IL		1989	Neurochemistry
Mayo Clinic, Jacksonville, FL		1994	Molecular Biology

A. Personal Statement- your value to the cluster

Dr. Kiminobu Sugaya has been doing research in neuroscience area more than 30 years, resulting in 110 publications, 46 patents, 168 proceedings and 81 invited presentations. He trained more than 20 graduate students, 10 postdocs and 70 undergraduate students. He received a postdoctoral training at the Southern University of Illinois, where he showed nicotinic receptors are reduced in Alzheimer's disease. After the postdoctoral training he worked 3 years as a lecturer in Science University of Tokyo. Then he moved to the Mayo Clinic in 1992, where he expanded his research with molecular biological techniques. There, he finished his postdoctoral training and became an Assistant Professor of Pharmacology and the Associate Consultant. He moved to the University of Illinois at Chicago in 1997, where he became an Associate Professor of Physiology and Biophysics, Ophthalmology and Bioengineering. He has further expanded his research area to the biology of stem cell and bioengineering. He became a tenured professor of the University of Central Florida in 2004. He is the Chair of Neuroscience Consortium for Central Florida and the Chair of Central Florida Chapter of the Society for Neuroscience. He is serving as the Council of the Florida State organization, the Center for Universal Research to Eradicate Disease. Currently he is conducting stem cell researches to treat neurodegenerative diseases. One is to produce of brain cells from the patient own adult stem cells, which is patented before the development of Novel prize winning iPS cell technology developed by Japanese group. Another is to increase endogenous stem cell by systemic administration of a drug. Dr. Sugaya is collaborating with internally and internationally including NIH and Karolinska Institute (Sweden), and investigating treatments for the diseases associate with aging with stem cells. He recently awarded National Honor Plaque of Panama for exceptional contribution to neuroscience from the President of Panama.

He will be contributing to this cluster with his expertise in neuroscience and stem cells technologies. For example, he awarded patents, TISSUE SUBSTITUTE COMPOSING STEM CELLS AND REDUCED CERIA and METHODS AND MATERIALS FOR STIMULATING PROLIFERATION OF STEM CELLS with Dr. Sudipta Seal.

B. Contribution to Scholarship and Creative Activities

Recent

B. Hendrix and K. Sugaya, The Future of Neuroregenerative Therapy for Parkinson's Disease, Current Tissue Engineering, 2014, 3(1), Pp. 25 - 33

Valerio LSAand Sugaya K, Potential Therapeutic Approaches for Stroke Using Induced Pluripotent Stem Cells, Austin Journal of Biomedical Engineering, 2014 ;1(4): 10-16

Jacob Kimmel and Kiminobu Sugaya, Nanog Overexpression Increases Neural Marker Expression in Adipose Derived Stem Cells, Recent Patent on Regenerative Medicine, 2014, 4(1) 69-74.

Y-D Kwak; B. Hendrix and K Sugaya, Secreted type of amyloid precursor protein induces glial differentiation by stimulating the BMP/Smad signaling pathway, BBRC 2014, 447 (3) 394- 9

Collaborative publications with other UCF units

C S, Venkataraman R, Barrera D, Naganathan A, Madan M, Paul L, Pattisapu, JV, Kyriazis GA, Sugaya K, Bushnev S, Lathia JD, Rich JN, and Chan SL: "Receptor channel TRPC6 is a key mediator of Notch-driven glioblastoma growth and invasiveness." 2010 Cancer Research; 70(1): 418-427.

M Field, A Alvarez, S Bushnev, and K Sugaya, Embryonic Stem Cell Markers Distinguishing Cancer Stem Cells From Normal Human Neuronal Stem Cell Populations in Malignant Glioma Patients Clinical Neurosurgery, 2010 57, 151-159

Biener G, Vrotsos E, Sugaya K, Dogariu A. Optical torques guiding cell motilityOpt Express. 2009;17(12):9724-9732

LD, Hua KA, Sugaya K., A generic framework for internet-based interactive applications of high-resolution 3-D medical image data. IEEE Trans Inf Technol Biomed. 2008 Sep;12(5):618-626.

C. Evidence of Impact & Support

Grant reviewer

Alzheimer Association, NIH study sections Medical Research Council Research Career Awards (London, England), Guy's & St Thomas' Charitable Foundation research grant (London, England), The Welcome Trust (London, England), Austrian Science Fund, California Institute for Regenerative Medicine, European Union Commission FP7-Health 2013 Innovation 1 Stage 2 CORE program, Fonds National de la Recherche, Luxembourg, Individual research grant, the Israel Science Foundation, Israel, NATIONAL SCIENCE CENTRE, Poland

Editorial board

Current Tissue Engineering, Journal of Psychology and Psychotherapy Research, American Journal of Stem Cells, Dataset Papers in Neuroscience, Stem Cell International, Austin Journal of Biomedical Engineering

Funding

2012-2016 Optical regulation of stem cell mobility, Principal Investigator, NSF

2014-2016 The Wrenn Trust, Cure for Alzheimer's disease, Principal Investigator

2005-2010 An In Vitro Model of Stem Cell Innervation of Myotubes (R01NS050452), Co-investigator, NIH

2007-2009 Small Molecule Drug Therapy for Stroke (R43 NS060471), Principal Investigator, NIH

2008-2011 Small Molecule Drug Therapy for Parkinson's Disease (R41NS062531) Principal Investigator, NIH

2011 Kryostop Eyedrop Study, Principal Investigator, Principal Investigator, Advanced International Medicine

2012-2013 Florida Hospital Medical Center, Sugaya Research Support, Principal Investigator

BIOGRAPHICAL SKETCH

Provide the following information for all the core cluster personnel. Follow this format for each person.

DO NOT EXCEED TWO PAGES PER INVESTIGATOR.

NAME: ***Alvaro G. Estevez, Ph.D.*** Cluster Lead: ***No***

POSITION TITLE, DEPT, & UNIT and or COLLEGE***: Associate Professor, Burnett School of Biomedical Sciences, College of Medicine***

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date YEAR	FIELD OF STUDY
Universidad de Buenos Aires	B.S./M.S	1990	Biology
University of Buenos Aires	Ph.D.	1995	Biology/Cell Biology
University of Alabama at Birmingham		1999	Biochemistry/Neuroscience

A. Personal Statement- your value to the cluster

I have investigated the role of reactive oxygen and nitrogen species in the pathogenesis of motor neuron disease including amyotrophic lateral sclerosis, spinal cord injury, and ventral root avulsion. Our contributions showed for the first time the role of endogenous production of the strong oxidant peroxynitrite in the stimulation of motor neuron apoptosis. We also described the intracellular pathways activated by peroxynitrite and identified tyrosine nitration as the key oxidative modification responsible for peroxynitrite toxicity. Using state of the art non-natural amino acid incorporation we demonstrated that nitration of one of two residues in the amino terminal domain of the heat shock protein 90 is necessary and sufficient to explain the induction of apoptosis by peroxynitrite. Our research demonstrated by the first time that tyrosine nitration is an oxidative posttranslational modification used for cell signaling. We have also investigate the mechanism by which riluzole, the only FDA approved drug for the treatment of ALS provide protection. During the development of our research we developed a number of original assays and co-culture models that are use now by a number of investigators to study interactions between neurons and glia. We also pioneer the development and use of quantitative methods to measure oxidative protein modifications. We have standing collaborations with researches at UCF (Dr. Fernandez-Valle and Dr. Khaled). We hve collaborations with Dr. Joseph S. Beckman and Ryan Mehl (Oregon State University), M. Flint Beal (Weill Cornell Medical College), Rafael Radi (Universidad de la Republica, Uruguay. Recently named External Fellow of the NAS), Stephen Barnes, Victor Darley-Usmar, Karina Ricart, Amee Landar (University of Alabama at Birmingham) and Carol Milligan (Wake Forest University) among others.

B. Contribution to Scholarship and Creative Activities (selected publications since 2010 - - cluster member and COM collaborators names are bolded)

1. Sahawneh, M.A., Ricart, K.C., Roberts, B.R., Bomben, V.C., Basso, M., Sahawneh, J., Ye, Y.-Z., Beckman, J.S., and **Estévez, A.G.** (2010) Stabilization of mutant and Zn-deficient SOD dimers by Cu,Zn SOD enhances Fas-mediated motor neuron death. J Biol Chem, 285:33885-97
2. Shi, Q., Xu, H., Yu, H., Zhang, N., Ye, Y.Z., **Estévez, A.G.**, Deng, H., and Gibson, G.E. (2011) Inactivation and reactivation of the mitochondria α-ketoglutarate dehydrogenase complex. J Biol Chem, 286:17640-17648
3. Magrané, J., Sahawneh, M.A., Przedborski, S., **Estévez, A.G.**, and Manfredi, G. (2011) Mitochondrial dynamics and bioenergetic dysfunction is associated with synaptic alterations in mutant SOD1 motor neurons. J Neurosci 32:229-242

4. Viera, L., Radmilovich, M., Vargas, M.R., Dennys, C.N., Wilson, L., Barnes, S., Franco, M.C., Beckman, J.S., and **Estévez, A.G**. (2013) Temporal patterns of tyrosine nitration in embryo heart development. Free Rad. Biol Med. 55:101-108
5. Franco, M.C., Ye, Y.-Z., Refakis, C.A., Feldman, J., Stockes, A.L., Basso, M., Melero Fernandez de Mera, R.M., Calingasan, N.Y., Kiaei, M., Rhoads, T.W., Ma, T.C., Grumet, M., Barnes, S., Beal, M.F., Joseph S. Beckman, Mehl, R., **Estévez, A.G**. (2013). Nitration of Hsp90 induces cell death. PNAS Plus, www.pnas.org/cgi/doi/10.1073.1215177110
6. Franco, F.C, and **Estévez, A.G.** (2012) Reactive nitrogen species in motor neuron apoptosis. In "Amyotrophic Lateral Sclerosis." M. H. Maurer Ed. InTech, Rijeka, Croatia, pp 314-334
7. Drechesel, D.A., **Estévez, A.G.,** Barbeito, L., and Beckman, J.S. (2012) Nitric oxide-mediated oxidative damage and progressive demise of motor neurons in ALS. Neurotox Res. 4: 229-242
8. Rossi, F. H., M. C. Franco and **A. G. Estevez** (2013). Pathophysiology of Amyotrophic Lateral Sclerosis. In "Current Advances in Amyotrophic Lateral Sclerosis." A.G. Estevez, Ed. InThech, Rijeka, Croatia, pp 1-33
9. Franco, M. C., C. N. Dennys, F. H. Rossi and **A. G. Estévez** (2013). Superoxide Dismutase and Oxidative Stress. In "Current Advances in Amyotrophic Lateral Sclerosis." A.G. Estevez, Ed. InThech, Rijeka, Croatia, pp 142-158
10. Franco, M.C. and Estevez, A.G. (2014) Tyrosine Nitration as a mediator of Cell death (2014) Cell Mol Life Sci 71:3939-3950
11. Dennys, C.N., Franco, M.C. and Estevez, A.G. (2014) Trophic factor production by glial cells in the treatment of amyotrophic lateral sclerosis. Austin J Biomed Eng

C. Evidence of Impact & Support (selected recent grant awards - cluster member and COM collaborators names are bolded)

R01 NS3671-15 Estévez(PI) 04/01/1998-04/30/2016
Peroxynitrite, nitrotyrosine and HSP90 in neuronal death
NIH/NINDS
Investigates the hypothesis that nitration of HSP90 is sufficient for the induction of apoptosis by peroxynitrite.

Pending Research Support

R21NS091952-01 Estevez (PI)
New transgenic model for testing nitrated Hsp90 role in neurodegeneration
NIH/NINDS
Develops an inducible conditional knock in for Hsp90 beta in which residues 33 and 56 are replaced by phenylalanine
Florida Biomedical Engineering Partnership," PI: **Alain Kassab.**

BIOGRAPHICAL SKETCH

Provide the following information for all the core cluster personnel. Follow this format for each person.

DO NOT EXCEED TWO PAGES PER INVESTIGATOR.

NAME: Robert Steward Jr. Cluster Lead: no

POSITION TITLE, DEPT, & UNIT and or COLLEGE: Assistant Professor, Department of Mechanical and Aerospace Engineering, College of Engineering and Computer Science

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date YEAR	FIELD OF STUDY
Clark Atlanta University, Atlanta, GA	BS	2007	Mech. Engineering
Carnegie Mellon University, Pittsburgh, PA	PhD	2011	Mech. Engineering
Harvard T.H. Chan School of Public Health, Boston, MA	Postdoc	2014	Cellular Biophysics

NOTE: The Biographical Sketch may not *exceed two pages*. Follow the formats and instructions below.

A. Personal Statement- your value to the cluster

The central theme of my research is in the field of cellular biomechanics. Broadly defined this involves investigating the effects of mechanical forces on cell behavior. Cell behaviors investigated include collective cellular migration and proliferation, for example, while physical forces investigated include cell-substrate adhesion forces, cell-cell adhesion forces, and external mechanical forces such as stretch and compression. In addition I have also spent time investigating how the cell's microenvironment dictates its behavior as well. To this end, I have developed and utilized novel cellular biophysics technologies with the intent to unravel underlying physical mechanisms that drive the behaviors mentioned above. Therefore the unique value I add to this cluster include my expertise in the field of cellular biomechanics and ability to design and implement novel cellular biophysical techniques.

B. Contribution to Scholarship and Creative Activities

My most significant contribution to scholarship include publications in many diverse and interdisciplinary journals including PNAS, Cell Biochemistry and Biophysics, Scientific Reports (Nature Publishing Group), and American Journal of Physiology-Cell Physiology. Furthermore as a postdoc at Harvard I mentored and tutored high school students in AP Biology at the Edward M. Kennedy Academy for Health Careers and a creative activity I did also occurred as a postdoc as I participated in annual workshops designed specifically to encourage inner city students pursue research and a career in research in the biomedical field. Relevant publications are listed below.

R. Steward, D. Tambe, C. C. Hardin, R. Krishnan, J. J. Fredberg, "Fluid Shear, intercellular stress, and endothelial cell alignment", *American Journal of Physiology-Cell Physiology*, 2015 (in press).

R. Steward, C.M. Cheng, J. D. Ye, R. M. Bellin, and P. R. LeDuc, "Mechanical Stretch and Shear Flow Induced Reorganization and Recruitment of Fibronectin in Fibroblasts," *Scientific Reports (Nature Publishing Group)*, 1(147), 1-12, 2012.

Steward, R.L., Cheng, C.M., Wang, D.L., & LeDuc, P.R. Probing Cell Structure Responses Through a Shear and Stretching Mechanical Stimulation Technique *Cell Biochem Biophys*, 56(2-3):115-24, 2010.

Bellin, R.M., Kubicek, J.D., Frigault, M.J., Kamien, A.J., **Steward, R.**, Barnes, H.M., DiGiacomo, M.B., Duncan, L.J., Edgerly, C.K., Morse, E.M., Park, C.Y., Fredberg, J.J., Cheng, C.M., & LeDuc, P.R. Defining the Role of Syndecan-4 in Mechanotransduction using Surface-Modification Approaches *Proceedings of the National Academy of Sciences*, 106(52), 22102-22107, 2009.

C. Evidence of Impact & Support

I am a very driven and highly motivated person. This resulted in me becoming the first joint hire between the College of Engineering and Computer Science (CECS) and College of Medicine (COM) at UCF. As such I have actively participated in almost every active bioengineering initiative within the university to promote and increase collaborations between CECS and COM.

BIOGRAPHICAL SKETCH

Provide the following information for all the core cluster personnel. Follow this format for each person.

DO NOT EXCEED TWO PAGES PER INVESTIGATOR.

NAME: Willenberg, Bradley J. Cluster Lead: No

POSITION TITLE, DEPT, & UNIT and or COLLEGE: Assistant Scientist, Department of Internal Medicine, University of Central Florida College of Medicine

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, include postdoctoral training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date YEAR	FIELD OF STUDY
University of Florida	BS	1993-1998	Interdisciplinary Studies, Concentrations: Biochemistry & Molecular Biology
University of Florida	PhD	1999-2005	Biomedical Engineering
University of Florida	Postdoctoral Training	2005-2010	Stem Cell Biology, Biomaterials, Tissue Engineering and Materials Science

NOTE: The Biographical Sketch may not *exceed two pages*. Follow the formats and instructions below.

A. Personal Statement- your value to the cluster

This cluster initiative is focused on building and supporting a core group of interdisciplinary UCF faculty to address the complex problems associated with advanced prosthetics and prosthetic interfaces. Over the past decade, I have acquired extensive experience and expertise in materials science and engineering with specializations in both biomaterials and tissue engineering. I have enhanced my biomaterials and tissue engineering expertise with postdoctoral stints in the stem-cell biology laboratories of Drs. Naohiro Terada and Dennis Steindler. My position as lead on characterization of chlorine diffusion in cement and concrete materials at the UF Major Analytical Instrumentation Center (MAIC) has honed my materials characterization skills as well as my expertise in scanning electron microscopy.

B. Contribution to Scholarship and Creative Activities

I have invented a new family of biomaterials based on copper-capillary alginate gel (Capgel); these materials have been the subject of peer-reviewed publications focused on biomaterial tissue scaffolds and a granted US patent (#7,601,525). I have been deeply involved in mentoring four (4) master's students, two (2) PhD students, a medical (MD) fellow and over a dozen undergraduate students, both academically and in research. Three of the master's students have developed very successful careers in industry and government. The other master's student continued on to get his PhD and currently holds a postdoctoral position. The PhD students have passed their candidacy exams and the MD fellow is halfway done with his fellowship; the fellow and I have already published together. Several of the undergraduates have gone on to work in industry while others have pursued advanced graduate degrees. Currently, I am heavily involved in mentoring a PhD and master's student in the Ross lab at UCF. I have also taught graduate lecture and undergraduate laboratory courses at the University of Florida in the Department of Materials Science and Engineering (MSE) and was specifically recognized by the MSE department chair for my highly-evaluated graduate teaching.

C. Evidence of Impact & Support

Currently, Capgel materials are at the center of four (4) independent collaborations with other UCF researchers and another with Sanford-Burnham and the University of Florida. These materials are also key in an ongoing commercial research collaboration, and I have recently developed partnership with Base Pair Biotech, Inc., for a different research program using aptamer technology. In conjunction with my direct research efforts, I have setup and maintained both industrial and academic laboratories, trained and managed technicians, and have expanded the functionality and utility of capital equipment. I have extensive grant writing experience and have been a primary reviewer of submissions to the leading journals *Tissue Engineering* and *Journal of Biomedical Materials Research: Part B - Applied Biomaterials*. I also have experience establishing and maintaining academic collaborations across departments within the university environment as well as external commercial collaborations with local and national companies and have founded my own company, Saisijin Biotech, LLC (www.saisijin.com).