##### CURRICULUM VITAE

Richard Fergus *ƒƒ*rench Weir, Ph.D.

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RESEARCH INTERESTS

My research is focused on the development an artificial hand replacement capable of true dexterous manipulation for use by persons with upper-limb loss. Our research covers all aspects of the problem ranging from neural control and sensing, mechatronic design and development, novel actuator technologies, and clinical deployment of these systems. While we are able to build highly complex mechatronic recreations of the human hand, as evidenced by our development of an 18 degree-of-freedom hand for the DARPA Revolutionizing Prosthetics (RP2007 & RP2009) initiatives, intuitive control of these hands still eludes us. The interface between the user and the device is lacking. To enable advanced control of the next generation of prosthetic devices we are developing, as part of the NIH SPARC initiative, a highly novel compact optogenetic based optical probe capable of optically neuromodulating individual afferent and/or efferent axons. My goal is to achieve non-invasive read-in or read-out from these nerves with the goal of modulating the organs, brain circuits, or muscles innervated by them. We are also developing robust mechatronic artificial finger replacements using our expertise in 3D metal printing to fabricate high strength small parts and we are exploring the use of implantable fuel cells which can extract electricity from blood sugar as well as 3D printed osseointegration abutments for prosthetic finger replacement.

I have been in the field of Prosthesis design and Rehabilitation Research for over 25 years and have maintained extramural funding both at the University and VA over that time. Over that time, I completed the training required to become clinical prosthetist and was Director of Research for Advanced Arm Dynamics (AAD) for 2 years, AAD is a national provider of upper-limb prosthetics care. We are working with commercial partners to translate novel control algorithms for todays 6 DoF hands I am a founding partner of Point Designs a company we started to sell a novel mechanical finger for persons with partial hand amputations. Most recently I am participating in the ACUE certificate course to become a better teacher more learned in how to apply the techniques of active learning.

In the past, I led the development of the Implantable Myoelectric Sensor (IMES) devices that can be chronically implanted into the residual muscles of an amputee’s arm using minimally invasive surgical techniques. We are working with Alfred Mann Foundation (AMF) (Valencia, CA), Illinois Institute of Technology (IIT), (Chicago, IL), and Sigenics Inc. (Chicago, IL) to move our IMES through FDA and to get them into people. In other work, we developed the drive train for a 3 DOF Hand for the University of New Brunswick, Canada. I was the lead architect of the hand for the final limb system of the DARPA Revolutionizing Prosthetics 2009 initiative. As part of the RP2009 initiative we developed, in collaboration with Otto Bock, Vienna, and Applied Physics Laboratory, an 18 DOF multifunction hand system called the “Intrinsic Hand” for “Prototype 2”, as well as a 7 DOF arm/hand system called “Prototype 1”. As part of the DARPA RP2007 initiative I consulted for DEKA on the development of their Luke arm. I have also explored work in the area of series elastic, or compliant, motors/drives/actuators for use in prosthetic components in particular a compliant elbow and wrist. We are about designing and building and translating physical prosthesis systems.

**RESEARCH AND PROFESSIONAL EXPERIENCE**

2018-Present Research Career Scientist, Denver VAMC, Denver, Colorado.

2017-Present Founder and President, Point Designs, llc, Louisville, CO.

2011-Present Director, VA Biomechatronics Development Laboratory, Jewell Center, Aurora, Colorado

2011-Present Associate Research Professor, Department of Bioengineering, College of Engineering and Applied Science, University of Colorado Denver ∙ Anschutz Medical Campus, Aurora, CO

2011-Present Associate Research Professor, Department of Rehabilitation Medicine, Anschutz Medical Center, Colorado University at Denver, Denver, CO

2011-Present Adjunct Professor, Department of Integrative Physiology, University of Colorado – Boulder, Boulder, CO

2011-2018 Research Healthcare Scientist, VA Eastern Colorado Healthcare System - Denver VAMC, Denver, Colorado.

2011-2013 National Director for Research and Development, Advanced Arm Dynamics, Redondo Beach, CA

2006-2013 Adjunct Professor, Department of Physical Medicine & Rehabilitation, Northwestern University Feinberg School of Medicine, Chicago, IL, September, 2006.

2006-2013 Associate Clinical Professor, Biomedical Engineering Department, Northwestern University McCormick School of Engineering and Applied Science, Evanston, IL, September, 2006.

2006-2011 Director, Biomechatronics Development Laboratory, Rehabilitation Institute of Chicago, Illinois, September 2006.

2006-2011 Senior Research Scientist, Rehabilitation Institute of Chicago, Chicago, Illinois, September 2006.

2006-2011 Research Associate Professor, Department of Physical Medicine & Rehabilitation, Northwestern University Feinberg School of Medicine, Chicago, IL, September, 2006.

1999-2010 Research Healthcare Scientist, Veterans Administration, Jesse Brown VA Medical Center – Lakeside CBOC, Chicago, IL, August, 1999.

1996-2011 Adjunct Faculty, Northwestern University Prosthetics & Orthotics Center (NUPOC), Chicago, IL, September 1996

2003-2006 Research Assistant Professor, Biomedical Engineering Department, Northwestern University McCormick School of Engineering and Applied Science, Evanston, IL, October, 2003.

1999-2006 Research Assistant Professor, Department of Physical Medicine & Rehabilitation, Northwestern University Feinberg School of Medicine, Chicago, IL, June, 1999.

1995-2006 Biomedical Engineer, Northwestern University Rehabilitation Engineering Research Center and Prosthetics Research Laboratory, Chicago, IL, May, 1995.

1997-1999 Research Associate, Department of Physical Medicine & Rehabilitation, Northwestern University Medical School, Chicago, IL, September, 1997.

1996-1997 Research Associate, Department of Orthopaedic Surgery, Northwestern University Medical School, Chicago, IL, May, 1996.

1995-1996 Post-Doctoral Research Fellow, Department of Orthopaedic Surgery, Northwestern University Medical School, Chicago, IL, May 1995.

1990-1995 Graduate Student Ph.D. Studies, Department of Biomedical Engineering, Northwestern University, Evanston, IL.

1986-1989 Graduate Student Masters Studies, Department of Biomedical Engineering, Northwestern University, Evanston, IL.

1984-1986 Control Engineer, APV Automation, Crawley, England.

1981 Research Assistant, Chem Systems, Chemical Engineering Consultants, London, England, Summer.

**EDUCATION**

1. Ph.D. Biomedical Engineering, Northwestern University, Evanston, IL.

*Dissertation: Direct Muscle Attachment as a Control Input for a Position Servo Prosthesis Controller.*

1. M.Sc. Biomedical Engineering, Northwestern University, Evanston, IL.

*Thesis: An Externally-Powered, Myo-electrically Controlled Synergetic Prosthetic Hand for the Partial Hand Amputee.*

1983 BAI(Hons.) Microelectronics & Electrical Engineering, Trinity College, Dublin, Ireland (Major).

1983 BA Mathematics, Trinity College, Dublin, Ireland (Minor).

**WORK EXPERIENCE**

2011-2013 National Director for Research and Development, Advanced Arm Dynamics, Redondo Beach, CA

* 1. Control Engineer, APV Automation, Crawley, England.

*Designed and commissioned computer control panels for hygienic applications, principally in the biotech, food, and beverage industries.*

Summer 1981 Internship, Chem Systems Ltd., London, England

**HONORS AND AWARDS**

2019 Student Team won University design competition

2009 Awarded **IEEE Spectrum in the Service of Society ACE Award** for involvement in the design of the DARPA Revolutionizing Prosthetics projects.

2007 Awarded *POPULAR MECHANICS* 2007 Breakthrough Innovator Award for the design of the Proto 2 myoelectric arm as part of the Revolutionizing Prosthetics 2009 (RP2009) team led by John Hopkins University Applied Physics Laboratory (JHUAPL).

2002 **Recipient of a 3 year Career Development Award** (B0928CD) **“**Rehabilitation Research And Development Of Gait Instrumentation And Upper-Extremity Prostheses.” from the Department of Veterans Affairs.

1995 Recipient Annual **Postdoctoral Research Fellowship** awarded by the National Institute on Disability and Rehabilitation Research (NIDRR), US Department of Education.

1992, 1993, Recipient Annual **Predoctoral Fellowship** awarded by the National Institute on Disability and

1994 Rehabilitation Research (NIDRR), US Department of Education.

1989 **Winner Easter Seal US National Student Design Competition** for “The Design and Development of a Synergetic Partial Hand Prosthesis with Powered Fingers”.

**PATENTS**

2021 **Awarded United States Patent 10,905,570**: Segil; Jacob, Huddle; Stephen, Sliker; Levin, Weir; Richard (2021): Prosthetic partial fingers, February 2, 2021.

2020 **Awarded United States Patent 10,794,453**: *Weir; Richard*, Huddle; Stephen, Murali; Barathwaj, Celik; Ozkan (2020): High Torque Density Miniature Laminar Gear Transmission. Application CU4504D, 1306.2004PR. October 6, 2020.

2020 **Awarded United States Patent US 10,632,003**: Segil; Jacob, *Weir; Richard* (2020): Systems and Methods for Postural Control Of A Multi-Function Prosthesis. April 28, 2020 International Application No. PCT/US2014/040569 [United States Provisional Patent 61830504 06-03-2013 – initial filing 2013](currently licensed to Infinite Biomedical Technologies LLC).

2020 **Awarded United States Patent: 10,634,899**; Gopinath; Juliet T., Gibson; Emily A., Bright; Victor M., Weir; Richard, Restrepo; Diego, Ozbay; Baris (2020): Optical imaging devices and variable-focus lens elements, and methods for using them. April 28, 2020.

2005 **Awarded US Patent US 6,921,419 B2: Weir, R. F. *ff*.,** and Grahn, E. G., (2002): A New Externally-Powered Hand Prosthesis Suitable for the Restoration of Prehension of Persons with Amputations at or more Proximal to the level of the Meta-carpophalangeal Joint. United States Provisional Patent, Number: 60/432,675, Filed December 12th, 2002. **US 6,921,419 B2 Patent Awarded Jul. 26, 2005.**

1998 **Awarded US Patent 5,831,937: Weir, R. F. *ff*.,** Childress, D. S., and Licameli, J. N., (1998): Portable Ranging System for Analyzing Gait. United States Patent, Number: 5,831,937, Date of Patent: November 3rd, 1998.

**DISCLOSURES**

2019 Weir, R. F. *ff*. , Littich, S., Hogan, L., Fontaine, A., Futia, G., Arevalo, N., Caldwell, J., Gibson, E., Restrepo, D., (2019): Nerve Cuffs for Optical Relay Imaging in Peripheral Nerves and Ganglia, CU Innovations File No. CU5067H.

1. Patel, R., Segil, J. L., Klinger, J.,**Weir**, **R. F. *ff*. ,** Correll, N., (2018): Multi-Modal Fingertip Sensor with Proximity, Contact, and Force Localization Capabilities. United States Provisional Patent Application CU4737B-PPA1 (currently licensed to Robotic Materials LLC).

2017 Anderson, H, Caldwell, J**., Weir, R.F.*ff***. (2017): An Automated Method for the Quantification of Transgene Expression in Motor Axons of the Peripheral Nerve**. Disclosure** CU4611H Submitted 12/22/2017.

1. Kuiken, T. A., **Weir, R. F. *ff***. & Sensinger, J. A., (2007): System and method for improving the functionality of prostheses. United States Provisional Patent 20070038311 02/15/2007

#### PROFESSIONAL SOCIETIES

1991 Member Institute of Electrical & Electronic Engineers (IEEE) - Robotics & Automation Society.

1994 Member Sigma XI, the Scientific Research Society.

1998 Member of the American Society of Mechanical Engineers (ASME) - Bioengineering Society.

1998 Member of the International Society for Prosthetics and Orthotics (ISPO).

2007 Member Institute of Engineers of Ireland.

#### COMMITTEES/ADVISORY PANELS

2017 Track Chair Biomedical Engineering Society Meeting, Phoenix AZ, Oct.

2017 Track Myoelectric Control Symposium, Fredericton, New Brunswick, Canada, Aug.

2016 Member, American Academy of Orthotist and Prosthetists (AAOP) State of the Science Meeting on Myoelectric Control.

2010-Present Steering Committee IEEE ICORR

2010-Present Member, VA ECHCS Research Committee,

2008-Present Ad Hoc Reviewer, Career Development Award Panel, VA Merit Review.

2008-Present Member, IEEE Engineering in Medicine & Biology Society Technical Committee on BioRobotics.

2004-Present Consultant, Barrett Technologies

2004-Present Ad Hoc Reviewer, National Institutes of Health, Musculoskeletal Rehabilitation Sciences (MRS) Study Section.

2004-Present Member, Department of Veterans Affairs Rehabilitation Research and Development Service Scientific Merit Review Advisory Board Meeting.

2002-2012 Member Advisory Committee, NIDRR Rehabilitation Engineering Research Center (RERC) on “Machines Assisting Recovery From Stroke” (MARS).

2002-2006 Member, Panel D, Institutional Review Board, Northwestern University.

2000-2006 Member, RESNA Student Design Competition Review Panel.

2010 Chairman, Powered/Controlled Devices Session, VA/DoD State of the Art Conference on Prosthetics/Orthotics, Washington DC, March 15th -17th.

2007 Chairperson, Rehabilitation Engineering Review Panel, VA Merit Review

2007 Reviewer National Science Foundation.

2006 Speaker at Senate Subcommittee Hearing on VA Research Funding

2005 Co-Chair, International Conference on Rehabilitation Robotics (ICORR 2005).

2005 Speaker, DHHS NIH NICHD/DARPA Translating Civilian & Defense Technologies for Pediatric Critical Care and Rehabilitation Research Rockville, MD, May 16th-17th

2005 Associate Editor, IEEE Transactions on Neural Systems and Rehabilitation Engineering (TNSRE).

2005 Member Advisory Panel, DARPA Advanced Prosthesis Workshop, Maryland, Jan 10th –11th, 2005.

2003 Member Upper-Limb Advisory Panel, Walter Reed Army Medical Center (WRAMC)/VA Prosthetics Workshop, Washington DC, Nov 17th –18th, 2003. [ <http://www.vard.org/meet/wramc03.htm>]

2000-2001 Member, Panel C, Institutional Review Board, Northwestern University.

1999-2003 Member, Research Committee, VA Chicago Health Care System - Lakeside Division.

1998 Research Committee, Rehabilitation Institute of Chicago (RIC).

1998 Physical Medicine & Rehabilitation, Departmental Program Review, Subcommittee On Cross-Unit Relations, 10/98.

***PENDING* FEDERALLY FUNDED RESEARCH PROJECTS**

I01 RX002830-01(Weir, Segil) 10/01/2021 - 09/30/2024 (1.0 CM-no-cost)

VA ORD RR&D $745,939

Artificial Digit Replacements for Women Veterans with Individual Digit Loss

*Competitive renewal of a project to develop a ratcheting prosthetic finger using 3D Metal Printing for women veterans with loss of one or more fingers.*

**Submitted Grants NOT selected for funding.**

CDMRP(Sherk) 07/01/2021 - 06/30/2023 Co-I (1.0 CM)

CDMRP PRORP

Effects of High Fat Diet and Exercise on Bone Loss After Amputation and Osseointegration Success

***Not selected for funding***

R44 HD090811(Kaliki) 09/01/2021 - 08/31/2024 Co-PI (0.5 CM)

NIH NICHD (SBIR Fast track) $729,624

Joint Angle Transform Based Methodology for Controlling Upper Limb Prostheses

*Competitive renewal of project to transfer Dr. Segil’s & my Hand Posture Control Algorithm developed in our lab. to Infinite Biomedical Technologies, LLC, to develop it into a product and commercialize it.*

SubK to Infinite Biomedical Technologies, Spring 2020

***Not selected for funding***

Boettcher Foundation Spring 2020 06/01/2020 - 08/31/2024 Co-PI (0.5 CM)

Multi-Use 3D-printed Readily Adaptable Modular Mask (RAMM) System for COVID

***Not selected for funding***

#### CURRENT FEDERALLY FUNDED RESEARCH PROJECTS:

R44 NS122687(Sliker, Kaliki, Weir) 10/01/2021 - 09/30/2026 Co-PI (1.0 CM)

NIH NINDS $4,459,103

Development and clinical assessment of a robust, 3D printed titanium, myoelectric powered prosthetic digit system.

Develop a robust advanced mechatronic prosthesis system for individuals with partial hand loss. Approximately 600,000 people live with partial hand amputations in the United States. We are developing a new type of finger prosthesis for these individuals. This proposal enables completion of the work required for regulatory clearance of the device.

OR 200173(Kemp) 07/01/2021 - 06/30/2023 PI UCD SubK (1.0 CM)

CDMRP PRORP $750,000 (U. Michigan SubK: $362,500)

Regenerative peripheral nerve interfaces (RPNIs) for surface myoelectric control of a novel powered finger partial hand prostheses.

1. Determine the viability and signaling capabilities of subcutaneous RPNIs for sEMG prosthetic control. 2. Complete development of a powered-finger prosthesis system capable of taking advantage of the control conferred by surface EMG from RPNIs.

I21 RX003894-01(Fontaine) 10/01/2021 - 09/30/2023 (1.0 CM-no-cost)

VA ORD RR&D $229,992

Investigation of an Optogenetic Vagus Nerve Stimulation Device in an Animal Model of Post-traumatic Stress Disorder.

Post-traumatic stress disorder (PTSD) is a highly prevalent and debilitating condition afflicting the U.S. Veteran population. Vagus nerve intervention holds significant promise for treating this disorder, and associated maladies, but current electrical nerve stimulation devices lack the necessary specificity to precisely study and modulate nerve pathways associated with PTSD. Here, an optogenetic vagus nerve stimulation system will be developed, in which light-sensitive opsin actuators genetically expressed to specific cell-types enable targeted neuromodulation. This new approach to neural intervention will be applied in an electric footshock rodent model of PTSD. The impact of select vagal fiber stimulation on the extinction of associative fear, as well as anxiety, will be assessed.

R21 NS124313(Weir, Fontaine) 07/01/2021 - 06/30/2023 Co-PI (1.0 CM)

NIH NINDS $275,000

A 3D-Printed Nerve Cuff for 1-Photon Optogenetic Vagal Stimulation.

Peripheral nerve pathways of the autonomic nervous system are highly promising, therapeutic targets for a large range of diseases, including inflammatory disorders, heart disease and diabetes. This research will develop a novel 3D printed optogenetic nerve cuff system for precise optical activation of neural fibers. This system and approach may be used by the scientific and medical research community to study and test new neuromodulation-based treatments in many disease states.

IK2 RX003282-01A2(Segil) 01/01/2021 – 12/31/2026 Mentor (0.5 CM – no-cost)

VA RR&D Career Development Award – 2 $1,223,463

Investigation of Embodiment of Upper Limb Prosthetic Devices – In this study, we probe the amount of embodiment elicited with conventional prosthetic limbs as well as with sensory restoration through an artificial neural interface.

I21 RX003471-01A1(Weir) 10/01/2020 – 09/30/2022 PI (1.0 CM - no-cost)

VA RR&D $189,322

Power Hungry: Fuel Cells Harvesting Biofluids for Renewable Power of Wearable Medical Devices.

*Goal is to produce a fuel cell that can harvest electricity from blood sugars.*

R44 HD096942-02A1(Sliker) 04/01/2020 - 03/31/2022 PI UCD SubK (1.0 CM)

NIH NICHD $1,499,694

*A ratcheting prosthetic partial finger using advanced rapid manufacturing technology*

The objective of this project is to 1) scale the Point Partial to a production ready device, 2) to validate the user needs of the Point Partial for regulatory requirements in a laboratory setting, and 3) assess the utility of the Point Partial in a clinical take-home study. The take-home study will involve 11 subjects and the collection of outcome measures data at four different points in time: pre-fitting, immediately post-fitting, 30 days post-fitting, and 60 days post-fitting. By the end of the grant, we will commercially launch the Point Partial, and have a robust set of outcome measures data to provide to payers for reimbursement purposes.

R01 NS118188-01(Weir, Gibson, Caldwell) 09/30/2020 - 07/31/2025 Co-PI (1.0 CM)

NIH NINDS $3,703,873

Optimization of a Minimally Invasive Bidirectional Optogenetic Peripheral Nerve Interface with Single Axon Read-in & Read-out Specificity

*Our goal for this project is to continue the development of a novel compact Optogenetic based Optical Probe capable of optically neuromodulating individual afferent and/or efferent axons within nerves of the parasympathetic, or peripheral, nervous system. We seek to read-in or read-out from these nerves with the goal of modulating the organs or brain circuits innervated by them.*

R43 HD101162-01(Sliker) 10/01/2020 - 09/30/2022 PI UCD SubK (1.0 CM)

NIH NICHD $224,994

*The Point Powered: A Robust Actuated Prosthetic Finger for Partial Hand Amputation*

Point Designs LLC proposes to develop and commercialize a robust, powered prosthetic finger which will be custom-made for each patient using advanced metal 3D-printing technology. The amputation of full fingers can cause physical, psychosocial, and economic damage to an individual. Replacement of a full finger requires an electromechanical design that can fit on the residual limb, produce appropriate forces and speeds, and withstand the rigors of everyday life.

R42 HD097827-01A1(Weir) 05/06/2019 - 10/31/2021 Co-PI (0.9 CM)

NIH NICHD (SBIR Fast track) $1,722,786

The Point Digit: A ratcheting prosthetic finger using advanced rapid manufacturing technology.

*Goal is to develop and test a 3D metal printed prosthetic finger.* Phase 1 portion of this Fast-Track aims to 1) design and develop Point Digit prototypes based on preliminary work, and 2) internally verify the Point Digit through a battery of mechanical tests. Phase 2 efforts include a clinical trial to generate outcome measures data for the Point Digit in 11 subjects.

IK6 RX002996-02(Weir) 07/01/2018 - 06/30/2023 Grantee (7.5 CM)

VA Eastern Colorado Health Care System $785,575

RR&D Research Career Scientist Award Proposal

*Goal is to fund recipient for 5 years full salary to pursue current and develop future research initiatives.*

**EXPIRED THIS YEAR**

I01 RX002830-01A1(Weir) 10/01/2018 - 03/31/2021 PI (1.0 CM)

VA Eastern Colorado Health Care System $496,416

Artificial Digit Replacements for Women Veterans with Individual Digit Loss

*Project to develop a ratcheting prosthetic finger using 3D Metal Printing for women veterans with loss of one or more fingers.*

HHS F223201810127C-AMD02(Benam) 09/18/2018 - 012/31/2020 Co-I (0.8 CM)

Food and Drug Administration $unknown

Toxicity and Carcinogenicity Profiling of Tobacco Products via Organ Microengineering and Systems Biology

*Goal is to provide 3D printed test structures for lung on a chip experiments.*

Contract #36C24E18C0075(Segil) 10/01/2018 - 9/30/2020 Co-I (0.5 CM)

U.S. Dept. of Veterans Affairs $199,747

RR&D: Proximity, Contact, and Force Sensing Fingertip Material for Cleveland VA Medical Center Clinical Trial

*Goal is to develop robust fingertip sensor for take home study involving persons with FINE neural implants*.

R44 HD090811-03(Kaliki) 09/01/2017 - 08/31/2020 Co-I (0.5 CM)

NIH NICHD (SBIR Fast track ) $729,624

Joint Angle Transform Based Methodology for Controlling Upper Limb Prostheses

*Project to transfer Dr. Segil’s & my Hand Posture Control Algorithm developed in our lab. to Infinite Biomedical Technologies, LLC, to develop it into a product and commercialize it.*

OT2 OD023852(Weir, Gibson Caldwell) 09/24/2016 - 02/28/2020 Co-PI (1.0 CM)

NIH SPARC, Office of the Director $2,147,989

Development of a Bidirectional Optogenetic Minimally Invasive Peripheral Nerve Interface with Single Axon Read-in & Read-out Specificity

Our goal for this project is to develop a novel compact Optogenetic based Optical Probe capable of optically neuromodulating individual afferent and/or efferent axons within nerves of the parasympathetic, or peripheral, nervous system. We seek to read-in or read-out from these nerves with the goal of modulating the organs or brain circuits innervated by them.

IK1RX002011 (Segil): 01/01/2017 - 06/31/2019 Role: Mentor

U.S. Dept. of Veterans Affairs $245,953

*VA RR&D(Segil): Integration of a Sensory Feedback Implant with Myoelectric Prosthetic Hands*

Career Development Award 1

OEDIT AIA Grant 103,068 (Weir) 04/01/2017 – 04/30/2019 Role: PI (15% UCD)

OEDIT, State of Colorado $137,424 ($103,068 State + $34,356 CU)

*The Point Digit: A ratcheting mechanical prosthetic finger built using advanced rapid manufacturing*

Project to transfer a 3D metal printed finger developed in our lab. to Point Designs, LLC, in order to develop it into a product and commercialize it.

1-I01-RX-001341-01 (Weir) 01/01/2014 – 06/30/2017 Role: PI (30% VA)

U.S. Dept. of Veterans Affairs $794,416 (No Cost Extension)

VARR&D A1341-R: A Principle Component Paradigm for EMG Control of Advanced Prosthetic Hands

Project to Develop, optimize and fit a novel postural control algorithm for upper-limb users. This algorithm provides a novel method of controlling multi-degree-of freedom (6 DOF) prosthetic hands with only 2-3 surface myo-electrodes without requiring the user to use switch commands to move from state to state.

1-I21-RX000858-01-A1 (Weir) 11/01/2013 - 12/31/2017 Role: PI (30% VA)

U.S. Dept. of Veterans Affairs $199,933 (No Cost Extension)

VARR&D A0858-P: Exploration of Socket Cooling Using Novel Passive Heat Spreader Technology.

The goal of this project is to explore whether the Celsia nanospreader heat spreader technology can be used to confer improved heat dissipation to prosthetic sockets. We are proposing to fabricate and fit intact individuals with bypass sockets that mimic shoulder disarticulation interface. Subjects walk on a treadmill while wearing these sockets while monitoring the temperature inside the socket and measuring O2 consumption.

2R01 EB001672 (Weir) 09/01/2011 - 07/31/17 Role: PI

NIH NIBIB/NICHD: $6,630,328

Clinical Development of Implantable Myoelectric Sensors for Prosthesis Control

The primary goal of this Bioengineering Research Partnership (BRP) proposal is to demonstrate upper limb prosthesis control using our implantable myoelectric sensor (IMES) system in human amputees. By the end of this second and final five-year project period we plan to achieve our long-term vision of individual finger control of a prosthetic hand.

1R01EB011615-01 (Murray) 04/05/2011-03/31/2015 Role: PI UCD SubK

NIH NIBIB $2,189,896

Prosthesis Control by Simulation of the Intact Biomechanical System

Project to build a biomechanical model of the human hand and wrist with full musculo-tendon action and to use this model as the basis of a real-time controller to predict finger joint motion in an artificial hand.

(2009) VARR&D A3962R: Weir & Herr (Co - PIs) 08/01/09-07/31/12

Agency: U.S. Dept. of Veterans A*ff*airs $914,000

VARR&D A6586R: “Implantable Myoelectric Sensors for Control of a Powered Foot Prosthesis”

Project to use Implantable Myoelectric sensors developed by Dr. Weir to control a new powered foot ankle prosthesis developed by Dr. Herr.

Role: Co-PI

 (2010) Facilitating Use of Advanced Prosthetic Limb Technology. ALION Science and Technology

 Subcontract Army. 09/28/2010-03/27/2012Project to develop an ultrasound model of the human forearm musculature to aid in the insertion of Implantable myoelectric sensors in amputees. Telemedicine and Advanced Technology Research Center (TATRC). This work is supported by the US Army Medical Research and Materiel Command under Contract No. W81XWH-10-C-0283”.$135,396 Total Cost, Role: PI SubK

(2010) Development of Advanced Prosthetics Systems. Contract number: W81XWH-BAA08-1

Contract to develop a lightweight, modular, electric arm system.

Jon Sensinger, PI

Role: Co-Investigator

(2008) UNB Prosthetic Hand System - University of New Brunswick Collaborative Research and Development Agreement. 10/1/07-12/31/10 and the total budget is $242,588.00.

Project to develop a 3 DOF hand with sensorized glove. Our role is to lead the development of the drives.

Role: PI RIC SubK

 (2003) Multifunction Prosthesis Control using Implanted Sensors (1 R01 EB01672-01), Role PI.

5 Year Bioengineering Research Partnership (BRP) - Submitted 01/23/03 to National Institutes of Health (NIBIB) for $3,562,430 – Funded September, 2003. – No Cost Extension

This is a project in which we propose to develop a multichannel/multifunction prosthetic hand/arm controller system capable of receiving and processing signals from up to sixteen “BION®-like” implanted bipolar differential electromyographic (EMG) electrodes. An external prosthesis controller will use fuzzy-logic to decipher user intent from telemetry sent over a transcutaneous magnetic link by the implanted electrodes. The same link will provide power for the implanted electrodes.

* **Northwestern University** will develop the multifunctional prosthesis controller and perform the animal experiments necessary to demonstrate the implanted devices.
* **Rehabilitation Institute of Chicago** will perform animal experiments and help with human subject experiments.
* **Illinois Institute of Technology** will develop individually addressable integrated circuit EMG sensor packages. Each sensor will be housed in BION® hermetically sealed packages provided by the Alfred E. Mann Foundation.
* **Sigenics Corp**. will develop the transcutaneous telemetry link, (or reader). A custom-designed application-specific integrated circuit (ASIC) will “strip” the data from the link’s telemetry and send it to the prosthesis controller. Powering of the implanted electrodes will also be controlled by the ASIC. The external coil of the inductive link will be laminated into a prosthetic socket.

Development of each component of the system will occur in parallel. Throughout years 1 & 2 fine wire studies with human subjects will be used to develop multifunctional prosthesis control algorithms. Initial silicon for the implanted electrodes and reader ASIC will be ready by end of year 1. Packaged electrodes ready for animal testing and a prototype reader will be ready the middle of year 2. Year 3 is expected to be spent going through initial system integration and iterative test-redesign cycles. A definitive design is anticipated to be ready for final testing and tweaking by the middle of year 4. The final year will be spent conducting the final systems integration.

(2008) Implantable Sensors to Revolutionize Control of Prostheses. Subcontract to the Applied Physics Laboratory of John Hopkins University (JHU/APL) Contract Number: 908090, Revolutionizing Prosthetics 2009, Phase 2

2005 4 year DARPA initiative - Revolutionizing Prosthetics BAA for $1,994,672(contract under negotiation). Role PI of NUPRL Subcontract.

On this subcontract we were tasked with working with APL and Otto Bock, Vienna, to build a first generation prototype arm, Prototype 1, using “off-the-shelf” technology and to deliver it in the first year. In addition, working with Otto Bock, Vienna, New world Associates and APL we are tasked to complete an intrinsically actuated electromechanical hand solution capable of meeting the full DARPA specifications as part of the Prototype 2 arm. The Intrinsic hand is an 18 DOF hand wrist system. Our other major role in this DARPA initiative is to accelerate the development, testing and integration of a 16 channel implantable myoelectric sensor system.

(2005) Compliant Wrist For Upper-Extremity Prosthetics Applications (A3962R). Role PI.

3 Year Merit Review Proposal, Submitted 06/04 to Department of Veterans Affairs for $383,958 - Funded October, 2005

The goal of this project is to build a new compliant externally-powered two degree-of-freedom (DOF) prosthetic wrist for use in upper-extremity prostheses. We believe that a small two DOF wrist mechanism capable of high speed and torque and that appears compliant when interacting with the environment could substantially improve the function and reliability of upper-limb prostheses for persons with arm amputations, in particular for persons with trans-humeral arm amputations.

(2005) A Model-Based Approach to Multifunction Artificial Hand Control (A4207I). PIs: Murray, W., & Weir, R.F.ff., Role Co-PI. 2 Year special collaborative grant solicitation Submitted 06/05 to Department of Veteran’s Affairs RR&D for $250,000 – Funded April 2006.

The primary objective of this research is to implement 3D, computer graphics based model of the upper extremity to develop a control system for a multifunction artificial hand. A secondary objective of this research is to establish a strong collaboration between Dr. Wendy Murray, a principal investigator at the VA Palo Alto Health Care System Center of Excellence on Bone and Joint Rehabilitation and Dr. Richard Weir, a principal investigator at the Jesse Brown VAMC (Chicago, IL). This collaboration will highlight both investigators’ interests in understanding the control of upper extremity and hand movement. It will also serve as a means to integrate their complementary skills in the areas of biomechanical modeling (Dr. Murray) and the design and control of prosthetic devices for the upper limb (Dr. Weir). This work will lead to continual collaboration between the two VA investigators on the application of computer simulation to the design of upper extremity prosthesis.

(2005) 1 F31 HD049319-01 Ruth L. Kirchstein National Research Service Award, National Institutes of Health (NICHD/GMB) Fellow: Abidemi B. Ajiboye, My Role: Sponsor. $85,500. Funded Jan. 1, 2005.

(2005) Hyper-Reinervation to Improve Myoelectric Prosthesis Control in Shoulder Disarticulation (N01-HD-5-3402). Subcontract to RIC on NIH NICHD Contract for $52,806. PI: Todd Kuiken, MD, PhD. Role: Co-Investigator (PI of Subcontract). June 1, 2005-May 31, 2006.

This is a project to develop a system capable of providing force feedback directly to the skin of a woman who has undergone targeted sensory reinnervation. This new system is based on the Otto Bock Sensor hand which already has force and vibration sensors. The sensor hand has an onboard microprocessor and Otto Bock has agreed to release the proprietary information and collaborate on this project. This will provide data on the force the hand is applying to an object and vibration (the slip sensor component). A small compliant actuator will be developed that is wearable by the subject. This will likely still involve a compliant ‘plunger’ actuator; however it will be smaller and lay on the side of the socket so that there is an acceptable profile or contour to the socket. The initial controller will be PC based, however we would hope that a simple algorithm for control could be incorporated into the LTI Boston Elbow controller. If not, a separate, parallel control would be developed that could be mounted in the arm.

(2003) Technology Transfer of an Externally-Powered Trans-Metacarpal Hand Prosthesis (A3028R). Role Co-PI.

3 Year Merit Review Proposal, Submitted 10/02 to Department of Veterans Affairs for $690,896 - July 2003 – June 2006.

The purpose of this project is to develop into a commercially realizable form, a prototype externally-powered trans-metacarpal hand prosthesis developed by our laboratory using VARR&D funds. A company, Variety Ability Systems Inc. (VASI), Toronto, Canada has expressed an interest in developing this prototype into a commercial product. The expected outcome is the successful transfer of our current laboratory prototype into a viable commercial product. The current laboratory prototype mechanism needs to be refined as a prelude to a clinical evaluation. In particular the current backlock/clutch mechanism, which is a VASI component needs to be redesigned/reengineered to handle higher torques and the VASI controller needs to be modified to fit into the hand mechanism. Once this work has been done a series of trial fittings will be performed to allow us to ascertain robustness of the device in actual use outside of laboratory conditions. An aspect of the work, which we will also explore further in this project, is the development of an appropriate prosthetic interface that will preserve the residual motion of the wrist. Ideally we would like to see a prosthetic interface that consists of a self-suspending silicone sleeve-socket to which the hand mechanism is attached. An outer cosmetic glove would then be rolled over this inner silicone sleeve socket. As envisioned the silicone sleeve socket and cosmetic glove would then be rolled on and off together in a fashion similar that used in donning and doffing trans-tibial silicone suspension sleeves.

(2004) 1 R13 EB004819-01 9th International Conference on Rehabilitation Robotics (ICORR 2005), National Institutes of Health (NIBIB/NICHD) PI: Jim Patton, My Role: Co-Investigator. $21,000.

(2004) Whitaker Foundation $8,000 in support of the 9th International Conference on Rehabilitation Robotics (ICORR 2005). PI: Jim Patton, My Role: Co-Investigator. October 7th, 2004

(2001) Development of a Four Degree-of-Freedom Hand (A2364R). Role: Co-PI

3 Year Merit Review Proposal, Submitted 4/00 to Department of Veterans Affairs for $456,596 - Funded Apr. 2001.

The goal of this project is to develop and evaluate a four degree-of-freedom prosthetic hand and controller for use by persons with amputations at or proximal to the wrist. At issue is the need for a multi-functional hand prosthesis to achieve our goal of coordinated control of individual digits on an artificial hand. Given the inherent complexity of the natural hand we believe that limiting the design of this hand to four degrees-of-freedom (DOF) is an acceptable compromise that will allow most commonly used hand prehension patterns to be attained. The four degrees-of-freedom that will be implemented are:

* Flexion-extension of the index finger;
* Flexion-extension of the middle, ring, and little fingers together;
* Flexion-extension of the thumb;
* Adduction-abduction of the thumb;

For the purpose of this project it is proposed to develop a myoelectric controller based on fuzzy-logic pattern recognition to demonstrate the multi-functional aspects of the device.

(1999) Rehabilitation Research and Development of Gait Instrumentation and Upper-Extremity Prostheses.

3 Year Rehabilitation Research Career Development Award (B0928CD), Submitted 2/99 to Department of Veterans Affairs for $268,464 – Expired July, 2002.

* To develop an easily controlled multi-functional prostheses for upper-limb amputees. Our upper-limb work has been directed towards the long-term goal of achieving meaningful, simultaneous, multi-functional, control of a prosthetic arm or hand. The current focus of this work is the development of a powered finger hand for clinical use. In the longer term this hand may be controlled by surgically created miniature muscle/tendon interfaces.
* To develop low-cost tools for the evaluation of pathological gaits - specifically amputee gait. In the area of lower-limb pathological gait diagnosis and measurement, our work involves the development of portable systems which measure a person's instantaneous forward velocity. From the instantaneous velocity profile measures such as: average walking speed, cadence, stride length, left & right step length, time to steady-state walking, and peak-to-peak velocity fluctuation, etc. can be obtained. These systems have applications in the area of outcome measures for lower-limb joint implant surgery, surgical procedures used to correct gait anomalies, lower limb prosthesis alignment, and monitoring the rehabilitation of persons with gait pathologies.

(1999) Development of an Externally Powered Prosthetic Hand for Partial-Hand Amputees (A2263-RC).

2 Year Merit Review Proposal, Submitted 4/98 to Department of Veterans Affairs for $290,000 – Expired Jan. 2001.

The goal of the project was to develop an externally powered prosthetic hand for persons with trans-metacarpal amputations. At this level of amputation all except the very simplest function of the hand is lost. However, the wrist is usually still functional and its motions are extremely valuable in positioning the hand in space. Preservation of the wrist's motion maintains the ability to position the hand in space; this ability is critical to maintaining overall function. In the past there have not been prosthetic components that were functional enough or that would fit gracefully into the space available. We propose to build upon our previous experience to develop a new artificial hand that will be capable of developing 12lbsf of pinch, have a width of opening of 3 1/2" and travel at rates in excess of 2 radians/sec. Myoelectric signals from superficial intrinsic muscles of the hand will be used to control the device in partial hand fittings. This prosthesis will be applicable to prosthetic restoration of prehension (with cosmesis) in partial hand, and wrist disarticulation amputees as well as the more conventional below elbow fitting. Being light in weight it will also have application in the fitting of persons with high level transhumeral amputations.

***OTHER* FEDERALLY FUNDED RESEARCH PROJECTS**

**Projects Funded by the Department of Veterans Affairs**

(1996) Generalized EPP Position Controller for Electric-Powered Upper-Limb Prosthesis (A2087-RA), 3 Year Merit Review Proposal, Submitted 4/96 to Department of Veterans Affairs. PI: D. S. Childress, My Role: Research Engineer

(1993) Direct Muscle Attachment: Multifunctional Control of Hands & Arms (A306-4DC), 3 Year Merit Review Proposal, Submitted 4/93 to Department of Veterans Affairs. PI: D. S. Childress, My Role: Biomedical Engineer

(1990) New Control Applications for Upper-Limb Prostheses (A306-2DA/A521-2DA), 3 Year Merit Review Proposal, Submitted 4/90 to Department of Veterans Affairs. PI: D. S. Childress, My Role: Biomedical Engineer

(1987) Improved Upper-Limb Prosthetics Development Program-Development of Powered Prosthetic Fingers (A306-2A)**.** 3 Year Merit Review Proposal, Submitted 4/87 to Department of Veterans Affairs. PI: D. S. Childress, My Role: Research Assistant

**Projects Funded by the Department of Education**

**– National Institute For Disability Research And Rehabilitation (NIDRR) [Grant #H133E980023].**

Application “Rehabilitation Engineering Center in Prosthetics and Orthotics” dated August 1998 Funded for 5 years beginning October, 1998. PI: D. S. Childress, My Role: Project Director: Development of a Portable, Real-Time, 3-D Single Marker Gait Evaluation System

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7. Mussa-Ivaldi, F. A., Miller, L. E., Rymer, W. Z., and **Weir., R. F. *ff.,*** (2005): Neural Engineering. Invited Chapter in "Neuroergonomics: The Brain at Work" Raja Parasuraman and Matthew Rizzo, Editors. Oxford University Press.
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10. **Weir, R.F*.ff.*** (2012): The Design of Advanced Prosthetic Limb Systems. Chapter 1, Grasping the Future: Advances in Powered Upper Limb Prosthetics, V. Parenti-Castelli & M. Troncossi (Eds.) *Bentham Science Publishers – Open Access e-book* (<http://www.benthamscience.com/ebooks/9781608054398/index.htm>). 1st Edition, pp1-14.
11. William Kethman, **Richard F. ff. Weir (**2021): Human-Machine Integration and the Evolution of Neuroprostheses. Chapter in “Digital Surgery”, Sam Atallah, Ed., Springer Nature Switzerland AG 2021, pp.275-284. https://doi.org/10.1007/978-3-030-49100-0

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8. **Dario, P., Hogan, N., Krebs, H. I., Rahman, T., Patton, J., van der Loos, H.F. M., Harwin, W. S., Childress, D. S., Weir, R. F. *ff*., (2005): The Past, Present and Future of Rehabilitation Robotics: An Ethical View from Pioneers of the Research. Industry/Research News, *IEEE Robotics and Automation Magazine Vol. 12, No. 4, December, pp.92-95, [Website:*** [*http://www.ncsu.edu/IEEE-RAS/RAS/ICORR05EthicsRTsept9.htm*](http://www.ncsu.edu/IEEE-RAS/RAS/ICORR05EthicsRTsept9.htm)***].***
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52. C. Baschuk, R. Kaliki, R. Weir, **J.L.Segil,** “Take Home Trial of the Glide Hand and Wrist Myoelectric Control Algorithm: A Case Study”, in the MEC Symposium Conference, July 2020
53. B. Pulver, M. Lang, R. Dodson, S. Huddle, R. Weir **J.L.Segil,** L. Sliker“Case Studies: Fitting Patients with Heavy Duty Ratcheting Mechanical Thumb Prostheses for Metacarpophalangeal Level Amputations”, in the MEC Symposium Conference, July 2020
54. R. Weir, A. Fontaine, **J.L.Segil,** J. Caldwell“Demonstration of an Optogenetic Neuronal Control Interface”, in the MEC Symposium Conference, July 2020
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#### PEER REVIEWED ABSTRACTS

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**NON-PEER REVIEWED PUBLICATIONS**

1. **Weir, R. F. *ff*.,** (1992): Prosthesis Control by way of Direct Muscle Attachment. *Capabilities*, Vol. 1, No. 4, pp. 1 & 5, January 1992.
2. **Weir, R. F. *ff.*,** and Childress, D. S., (1992): Measurement of the Ability of Direct Muscle Attachment to Act as a Control Input for Prosthesis Controllers. *Proceedings of the 7th World Congress of the International Society of Prosthetists and Orthotists (ISPO),* Chicago, June 28th - July 3rd, p. 310.
3. Childress, D. S., Grahn, E., **Weir, R. F. *ff***., Heckathorne, C. H., and Uellendahl, J., (1993): Modification of a Bock Electric Hand for EPP Control by Exteriorized Tendons. *Proceedings of the 19th Annual meeting of the American Academy of Orthotists and Prosthetists (AAOP*). Las Vegas, Nevada, March 30th - April 4th.
4. Childress, D. S., and **Weir, R. F. *ff.,*** (1995): Quantitative Assessment of Direct Muscle Attachment to Act as a Control Input for Externally Powered Prostheses. *Proceedings of the 8th World Congress of the International Society of Prosthetists and Orthotists (ISPO),* Melbourne, Australia, p. 101, April 2nd –7th, 1995.
5. **Weir, R. F. *ff*.,** (1997): Precise Timing via the PC’s RS-232 Port. *Circuit Ideas, Electronics World*, Vol. 103, No. 1729, p. 46, January 1997.
6. **Weir, R. F. *ff.,*** Childress, D. S., and Licameli, J. N., (1997): A Low Cost Ultrasound Ranging System for the Analysis of Gait. *Gait and Posture*, Vol. 5, No. 2, April 1997, pp. 180 - 181.
7. **Weir, R. F. *ff.,*** (1997): Exploring a Direct Ultrasound Ranging System to Make Gait Analysis Faster and More Economical. *Capabilities,* Vol. 6, No. 2, April 1997, pp. 1 - 2 & 10 - 11.
8. **Weir, R. F. *ff.,*** (1998): A Century of the Sauerbruch-Lebsche-Vanghetti Muscle Cineplasty: The United States Experience. *Capabilities*, Vol. 7, No. 4, pp. 1 - 2 & 10 - 11, October 1998.
9. **Weir, R. F. *ff.,*** Childress, D. S., and Heckathorne, C. W., (1998): Towards Achieving the Goal of Meaningful, Coordinated, Subconscious, Multi-Functional, Control of Prostheses. *Proceedings of the VA Rehabilitation Research & Development Service 1st Annual Meeting, "Enabling Veterans: Meeting the Challenge of Rehabilitation in the Next Millennium"*, Westin City Center Hotel, Washington, D.C., October 1st - 3rd, 1998, p. 192.
10. **Weir, R. F. *ff.,*** and Gaebler-Spira, D., (2000): Clinical Experience Using Real-Time Measurement of Instantaneous Gait Velocity as an Outcome Measure*. Capabilities*, Vol. 9, No. 1, pp. 1-2 & 8, January 2000.
11. **Weir, R. F. *ff.,*** Childress, D. S., and Grahn, E. C., (2000): Development of an Externally Powered Prosthetic Hand for Persons with Partial Hand Amputations. *Proceedings of the VA Rehabilitation Research & Development Service 2nd Annual Meeting, "The Next Generation*", Crystal Gateway Marriott, Arlington, VA, February 20th - 22nd, 2000, p. 122.
12. **Weir, R. F. *ff*.,** Gaebler-Spira, D., and Patterson, K., (2000): Analysis of Orthotic Effect on Functional Gait Utilizing Real-time Measurement of Instantaneous Gait Velocity as an Outcome Measure*. Proceedings of the Association of Children's Prosthetic-Orthotic Clinics (ACPOC),* Banff, Canada, April 23rd - 26th, 2000.
13. **Weir, R. F. *ff.,*** Grahn, E. C., and Duff, S. J., (2001): A New Externally-Powered, Myoelectrically Controlled Hand Prosthesis For Persons With Partial Hand Amputations*. Proceedings of the Annual Meeting and Scientific Symposium of the American Academy of Orthotists and Prosthetists (AAOP*), Dallas, TX, March 8th - 10th.
14. **Weir, R. F. *ff*.,** Grahn, E. C., Duff, S. J., and Childress, D. S., (2001): Development of an Externally-Powered, Myoelectrically Controlled Hand Prosthesis for Persons with Partial Hand Amputations. *Proceedings of Intellectual Property In The VA: Changes, Challenges & Collaborations,* April 12th & 13th, 2001, Crystal Gateway Marriott, Arlington, VA, p. 07.
15. **Weir, R. F. *ff.,*** (2001): Development of a New Partial Hand Prosthesis. Capabilities, Vol. 10, No. 2, pp. 1-3,11, April 2001.
16. **Weir, R. F. *ff***., and Childress, D. S., (2001): A Three-Dimensional, Single Marker, Gait Analysis System for Real-Time Use in Small Clinical Facilities*. Proceedings of the 10th World Congress of the International Society for Prosthetics and Orthotics (ISPO)*, Glasgow, UK, July 1st - July 6th, p. MO8.2.
17. **Weir, R. F. *ff***., and Grahn, E. C., (2001): A New Externally-Powered Hand Prosthesis for Persons with Partial-Hand Amputations. *Proceedings of the 10th World Congress of the International Society for Prosthetics and Orthotics (ISPO),* Glasgow, UK, July 1st - July 6th, p. MO6.6.
18. **Weir, R. F. *ff***., (2001): Development of a Portable, Real Time, 3-D Single Marker Gait Evaluation System. Research Project Update*, Capabilities,* Vol. 10, No. 4, p. 4, Autumn 2001.
19. **Weir, R. F. *ff***., and Childress, D. S., (2002): Design Issues in The Development of a Four Degree-of-Freedom Multifunctional Prosthetic Hand. *Proceedings of the VA Rehabilitation Research & Development Service 3rd National Meeting, "Rehabilitation Research for the 21th Century: The New Challenges"*, Crystal Gateway Marriott, Arlington, VA, February 10th – 12th, 2002, p.121.
20. **Weir, R. F. *ff***., (2005): ICORR 2005 IEEE 9th International Conference on Rehabilitation Robotics – Frontiers of the Human-Machine Interface June 28 – July 1, 2005. *Capabilities*, Vol. 13, No. 4, pp. 1 - 3, Autumn 2005.
21. Schorsch, J. F., and **Weir, R. F. *ff.,*** (2007): Multifunction Prosthesis Control using Implanted Sensors. *Bioengineering Research Partnership Grantee Planning Meeting National Institutes of Health (NIH)*, Bethesda, MD, July 12-13, 2007.
22. Schorsch, J. F., and **Weir, R. F. *ff.,*** (2008): Multifunction Prosthesis Control using Implanted Sensors. *Bioengineering Research Partnership Grantee Planning Meeting National Institutes of Health (NIH)*, Bethesda, MD, June 23-24, 2008.

### INVITED TALKS/PRESENTATIONS

SEE University of Colorado FERPA 2011 - Present

1. **Weir R. F. *ff****.* (2009): Clinical Path to Implantable Myoelectric Sensors (IMES) for Multifunctional Prosthesis Control. Invited talk, Medical College of Milwaukee, May 21st, 2009.
2. **Weir R. F. *ff****.* (2009): Peripheral Neuroprostheses for Sensing/Stimulation. Invited Lecture, MIT, Boston, MA March 31st 2009.
3. **Weir R. F. *ff****.* and Schorch, J. S., (2008): Invited Session Contributor, “Revolutionary Neuroprosthetic Systems” Pre-Conference workshop, 30th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (IEEE EMBS), Vancouver, Canada, August 20th – 24th, 2008.
4. **Weir R. F. *ff****.* (2008): Arms Race”: discovery of neural-muscular-control of the prosthetic arm, the bionic arm. Keynote Speech: Bionic Arms Race: Advances in limb prosthetics. The 32nd Annual Great Lakes Biomedical Conference, Golden Rondelle Theatre of SC Johnson, Racine, Wisconsin April 18, 2008
5. **Weir R. F. *ff*.** (2008): Prosthetic Arm and Hand control with Myoelectric (Nerve-Muscle) Sensors. Invited Speech, Bionic Arms Race: Advances in limb prosthetics, The 32nd Annual Great Lakes Biomedical Conference, Golden Rondelle Theatre of SC Johnson, Racine, Wisconsin April 18, 2008
6. **Weir R. F. *ff*.** (2008): Hot Topics in Biomedical Research: Neural Engineering Panel, Invited Panelist Midwest Bioengineering Consortium (MBEC), Illinois Institute of Technology, Chicago, Illinois, April 4th , 2008.
7. **Weir, R. F*. ff*.,** (2008): Our New Bionic Arm Replacements: How close to the Bionic Arms of Science Fiction are they? Invited Speech, The Biomedical Engineering Research Group in University College Dublin (UCD) and The Biomedical Engineering Division of the Institute of Engineers of Ireland (IEI), Rm. 326, Engineering Building, University College Dublin, Belfield, Dublin Ireland, March 28th, 2008.
8. **Weir R. F. *ff*.** (2007): The Next Generation of Prosthetic Arm Systems. Invited Speaker, No Barriers Festival 2007, Squaw Valley, California, June 28th – July 2nd, 2007.
9. **Weir R. F. *ff*.** (2007): The latest and Greatest in Hand Replacement Technology. Symposium: Quantification & mechanisms of impaired motor control, In honor of past, present & future contributions of Dr. W. Zev Rymer, Daniel Hale Williams Auditorium, Room 2-320, McGaw Medical Center, Northwestern University Feinberg School of Medicine, 240 E. Huron St., Chicago, IL., June 26-27 2007.
10. **Weir R. F. *ff*.** (2007): “Arms for Veterans - The next Generation of Devices”, Invited Speech Student/Faculty Seminar Series, Illinois Institute of Technology, March 2nd, Chicago, IL.
11. **Weir R. F. *ff*.** (2007): The New New Things About Prosthetic Arms, Invited Speech Biomedical Engineering Department Seminar Series, Northwestern University, Thursday, January 25, 2006, 4:00 pm – 5:00 pm, Tech L361. Evanston, IL.
12. **Weir R. F. *ff*.** (2006): The New New Things About Prosthetic Arms and Hands, Invited Speech Emerging Trends in Rehabilitation Robotics session, MARS-RERC Annual Meeting, RIC 16th Floor, Magnuson Auditorium, 1:30 – 2:40 pm, Friday, November 17. RIC, Chicago, IL.
13. **Weir R. F. *ff***. (2006): From EPP and Muscle Tunnel Cineplasties to Neuroelectric Control for Artificial Arms and Hands. Dudley S. Childress Scientific Symposium, Room 1702, Rehabilitation Institute of Chicago, Chicago, Illinois, Friday October 6th, 2006. (FessSchrift for Dr. Childress).
14. **Weir R. F. *ff***. (2006): "A True Replacement for the Natural Hand and Arm - An Elusive Dream?” Invited presentation. Neural Prosthesis Seminar, Cleveland FES Center, Case Western Reserve University, Cleveland, Ohio, Friday, September 22, 2006, Wolstein Auditorium, 8::30AM to 9:30 AM.
15. **Weir R. F. *ff***. (2006): The Next Generation of Arm Prostheses: Hope or Hubris. Invited presentation. Proceedings of the Workshop on *Robotic Systems for Rehabilitation, Exoskeleton, and Prosthetics (Yoky Matsuoka & Bill Townend, Eds.,)* at *Robotics: Science and Systems*, Philadelphia, PA, August 16-19, 2006.
16. **Weir R. F. *ff***. (2006): Multifunction Prosthesis Control using Implanted Sensors. Invited Speech, Bioengineering Research Partnership Grantee Planning Meeting National Institutes of Health (NIH), Bethesda, MD, July 12-14, 2006.
17. **Weir, R. F*. ff*.,** (2005): The Next Generation of Artificial Arm and Hand Replacements: A Help or Hubris? Invited Speech, Mechanical Engineering Department, Vanderbilt University, Nashville, Tennessee, Oct 2nd, 2005.
18. **Weir, R. F*. ff*.,** (2005): The Shape of Things to Come: The Next Generation of Artificial Arm and Hand Replacements. Grand Rounds, Department Physical Medicine and Rehabilitation, University of Michigan, Ann Arbor, August 26th, 2005.
19. **Weir, R. F*. ff*.,** (2005): The Next Generation of Artificial Arm and Hand Replacements: A Help or Hubris? Invited Speech, The Biomedical Engineering Research Group in University College Dublin (UCD) and The Biomedical Engineering Division of the Institute of Engineers of Ireland (IEI), Rm. 326, Engineering Building, University College Dublin, Belfield, Dublin Ireland, July 27th, 2005.
20. **Weir, R. F. *ff*.** and Kuiken, T. A., (2005): Neural Control for Artificial Arms and Hands: Implantable Myoelectric Sensors & Targeted Reinnervation. Invited Presentation, DHHS NIH NICHD/DARPA Translating Civilian & Defense Technologies for Pediatric Critical Care and Rehabilitation Research Rockville, MD, May 16th-17th
21. Childress, D. S., Kuiken, T. A., **Weir, R. F. *ff*.** and Gard S. A., (2005): The New Artificial Limb Systems: A Help or Hubris? Domain Dinner, Williams Auditorium, 3rd Floor, McGaw Pavilion, Northwestern University, Chicago Campus, January 19, 2005.
22. **Weir,** **R. F. *ff.,*** (2004): Issues in the Control of Advanced Multifunctional Prosthetic Systems. Invited Lecture Course No. 04.B.ST.SP.NTC.A, National Joint Prosthetics & Rehabilitation services conference. Department of Veterans Affairs Employee Education System and The Prosthetic and Sensory Aids Service, Hyatt - McCormick Center, Chicago, Illinois, May 11-13, 2004.
23. **Weir,** **R. F. *ff*.,** (2004): Multifunction Prosthesis Control using Implanted Sensors. Sensory Motor Performance Program (SMPP) laboratory meeting, SMPP Conference Room, Rehabilitation Institute of Chicago (RIC), Illinois, February 26th, 2004.
24. **Weir,** **R. F. *ff*.,** (2004): Implantable Myoelectric Sensors (IMES) for Multi-functional Prosthesis Control. Department of Physical Medicine & Rehabilitation, Quarterly Departmental Faculty Meeting, February 24th, 2004.
25. **Weir, R. F. *ff*.,** (2003): Issues in the Control of Prostheses, Manipulators, and other Human Machine Systems. Invited Lecture, Third Annual Meeting of Centers for Research on Neurorehabilitation (CARN), NIH R24 Grant HD39627-03 “Restoration of Function in Neurologic Impairment”, Harrison Conference Center, Lake Bluff, Illinois, June 13-15, 2003.
26. **Weir, R. F. *ff*.,** (2003): Northwestern University/MTS Transponder System: a Proof-of-Concept System for Implantable Myoelectric Sensors (IMES). Third Annual Meeting of Centers for Research on Neurorehabilitation (CARN), NIH R24 Grant HD39627-03 “Restoration of Function in Neurologic Impairment”, Harrison Conference Center, Lake Bluff, Illinois, June 13-15, 2003.
27. **Weir, R. F. *ff*.,** (2003): The Great Divide – The Human-Machine Interface: Issues in the Control of Prostheses, Manipulators, and other Human Machine Systems. Plenary Speaker, Rehabilitation Engineering Track, 29th Annual Northeast Bioengineering Conference, New Jersey Institute of Technology, New Jersey, March 22nd - 23rd, 2003
28. **Weir, R. F. *ff*.,** (2002): Prosthetics Hardware, Invited Speaker, Proceedings of the Myoelectric Controls Conference (MEC2002), Fredericton, New Brunswick, Canada, August 19th - 23rd, University of New Brunswick, New Brunswick, Canada.
29. Silver-Thorn, M. B., and **Weir, R. F. *ff*.**, (2002): Open Session Discussion Leaders, State-of-the-Science Meeting in Prosthetics and Orthotics (P&O), May 17th – 18th, 2002, hosted by Northwestern University Rehabilitation Engineering Research Program in Prosthetics and Orthotics, Chicago, Illinois.
30. **Weir, R. F. *ff****.,* (2001): Speaker for the Advanced Training Course: Overview of Gait Analysis for Prosthetists and Orthotists. American Academy of Orthotists and Prosthetists (AAOP). Northwestern University September, 2001.
31. Heckathorne, C. W., Hungspreugs, P., and **Weir, R. F. *ff****.,* (2001): Developments in Upper Extremity Prosthetic Devices. Sensory Motor Performance Program (SMPP) laboratory meeting, SMPP Conference Room, Rehabilitation Institute of Chicago (RIC), Illinois, July 26th, 2001.
32. **Weir, R. F. *ff***. and Gard, S. G., (2000): Vertical Movement of the Body during Normal Walking. Demonstration: Motion Analysis Research Laboratory. Annual Research Colloquium, Rehabilitation Institute of Chicago (RIC), Illinois, June 6th, 2000.
33. **Weir, R. F. *ff.,*** (1999): New Horizons in Prosthetics Research. Invited Speaker UnLIMBited Potential, Amputee Support Group at the Rehabilitation Institute of Chicago. Hayworth Room, Rehabilitation Institute of Chicago (RIC), June 24th, 1999.
34. **Weir, R. F. *ff*.,** (1999): A Portable Gait Analyzer System. McCormick School of Engineering & Applied Science Tech Corporate Partners Annual Technology Review, Technological Institute, Northwestern University Evanston Illinois, March 23rd, 1999.
35. Rymer, W. Z., **Weir, R. F. *ff*.,** Healy, K. E., (1998): Novel Engineering Applications in Rehabilitation: From Machines to Materials. Invited Speaker Shirley Ryan Seminar -- Lifelong Learning Course, Fall 1998 lecture series “Globalization Technology and the Beginning of the 21st Century.” McCormick Auditorium, Allen Center, Evanston Campus, Northwestern University, Illinois, November 24th, 1998.
36. **Weir, R. F. *ff*.,** (1998): Towards Achieving the Goal of Meaningful, Coordinated, Subconscious, Multi-Functional, Control of Prostheses. Poster Presentation, Rehabilitation Institute of Chicago (RIC), October 15th, 1998.
37. **Weir, R. F. *ff.,*** (1998): **A Century of Cineplasty - Implications for the Future of Upper-limb Prosthetic Control.** Invited Speaker Grand Rounds Series, The Rehabilitation Institute of Chicago and Northwestern University Medical School Department of Rehabilitation Medicine, Magnusson Auditorium, Rehabilitation Institute of Chicago (RIC), Chicago, Illinois, May 27th, 1998.
38. **Weir, R. F. *ff.,*** (1998): **Clinical Applications of Movement Instrumentation: Measurement Technology for Small Offices**. Senior Research Colloquium, Research Department, Rehabilitation Institute of Chicago (RIC), May 22nd, 1998.
39. **Weir, R. F. *ff.,*** and Childress, D. S., (1997): The Gait Velocigram as a Tool for Evaluating Gait. *Invited Speaker Gait Analysis Symposium honoring Susan Sienko Thomas, M.S. at Children’s Memorial Hospital*, Bigler Auditorium, Chicago, Illinois, November 6th, 1997.
40. **Weir, R. F. *ff.,*** (1997): Design, Development, and Use of a Portable, Real-Time, Ultrasound Ranging System for the Analysis of Gait Velocity*.* *Invited Speaker Friday series Seminar, Department of Biomedical Engineering, Marquette University,* Milwaukee, Wisconsin, October 24th, 1997.
41. **Weir, R. F. *ff.,*** (1996): Cineplasty Revisited: Muscles as a Control Input for Powered Prostheses*. Invited Speaker Midwest Chapter of the American Academy of Orthotists and Prosthetists (AAOP), Fall Scientific Seminar,* Chicago, Illinois, September 28th, 1996.
42. **Weir, R. F. *ff.,*** (1996): Cineplasty Revisited: Muscles as a Control Input for Powered Prostheses. *FestSchrift honoring Univ.-Prof. Dr. med. Rene Baumgartner*, *Sponsored by the Northwestern University Rehabilitation Engineering Research Center and Prosthetics Research Laboratory,* Chicago, Illinois July 2nd, 1996.
43. **Weir, R. F. *ff.*,** Chan, R. B., and Childress, D. S., (1995): Single Marker Gait Analysis. *Invited Speaker Gait Analysis Symposium honoring Dr. David Winter at Children’s Memorial Hospital*, Bigler Auditorium, Chicago, Illinois, October 19th, 1995.
44. **Weir, R. F. *ff.,*** (1994): Direct Muscle Attachment as a Control Input for Powered Prostheses. *Symposium on upper-limb amputation surgical techniques in honor of Dr Robert Beasley*, *Sponsored by the Northwestern University Rehabilitation Engineering Research Center and Prosthetics Research Laboratory,* Chicago, Illinois, June 10th, 1994.

#### COURSES, SESSIONS, PANELS, SYMPOSIA

***SEE UNIVERSITY OF COLORADO FERPA 2011 - PRESENT***

1. **SEE UNIVERSITY OF COLORADO FERPA 2011 – PRESENT**
2. **Co-Track Chair**, BMES Phoenix AZ Oct. 2017.
3. **Track Chair,** Myoelectric Controls Symposium, U. New Brunswick, Fredericton, CA, August 14-18, 2017.
4. **Panel Member**, Future of 3-D printing in Prosthetics, Myoelectric Controls Symposium, U. New Brunswick, Fredericton, CA, August 14-18, 2017.
5. **Reviewer, Track Co-Chair,** Design of Medical Devices Conference (DMD 2010), Minneapolis, MN April 13-15, 2010
6. **Member, Scientific Program Committee** of the Design of Medical Devices conference 2010, Minneapolis, MN April 13-15, 2010
7. **Reviewer,** 2009 IEEE International Conference on Robotics and Automation (ICRA), Kobe, Japan, May 12-17, 2009.
8. **Reviewer,** 30th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (IEEE EMBS), Vancouver, Canada, August 20th – 24th, 2008.
9. **Organizer and Session Chair** (Micera , S., Thakor, N., & **Weir R. F. *ff****.*) - Pre-Conference Workshopon “Revolutionary Neuroprosthetic Systems”, 30th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (IEEE EMBS), Vancouver, Canada, August 20th – 24th, 2008.
10. **Reviewer,** IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), Sheraton Hotel, San Diego, California, USA October 29th - November 2nd, 2007.
11. **Reviewer,** Biomedical Engineering Society Meeting (BMES), Los Angeles, September 26th, 2007.
12. **Reviewer and Invited Session Contributor,** Session 6.1.2 IS**:** *29th Annual International Conference of the IEEE Engineering in Medicine Society (EMBS) Lyon, France*, August 23rd – 26th, 2007.
13. **Reviewer and Session Chair,** 10th International Conference on Rehabilitation Robotics, Noordwijk, The Netherlands, June 13th – 15th, 2007.
14. **Reviewer and Session Chair, “**Orthopaedics and Rehabilitation Engineering I”, Biomedical Engineering Society Meeting (BMES), Chicago, IL, October 12, 2006.
15. **Symposium Organizer and Chair**, The Role of Instrumentation in Prosthetics and Orthotics. Invited Symposium. 11th World Congress of the International Society for Prosthetics & Orthotics (ISPO), Hong Kong, August 1st - 6th, 2004.
16. **Panelist,** Debate and Round table Discussion: “What is Neural Engineering?” Featuring: Elliot Roth, MD, Enrico Mugniani, MD, W. Zev Rymer, MD, PhD, Edward Colgate, PhD, John Troy, PhD, Richard Weir, PhD. Neural Engineering Workshop, Chicago Campus, Northwestern University, Chicago Il, April 30th, 2004.
17. Sholas, M., Malas, B., Carls, L., **Weir, R. F. *ff*.,** Gaebler-Spira, D. J., (2003): Pediatric Orthotics: A Practical and Outcome Driven Discussion on Orthotic Prescription and Evaluation. M108, October 9, 8:30am-10:00am, Educational Program of the 64th Annual Assembly of the American Academy of Physical Medicine & Rehabilitation (AAPM&R), Hilton Chicago, Chicago, Illinois, October 9th – 12th, 2003.
18. **Session Chair**, 5.5.4 Assistive Devices and Prostheses. *25th Silver Anniversary International Conference of the IEEE Engineering In Medicine and Biology Society (EMBS*), Cancun, Mexico, September 17th – 21st, 2003.
19. **Session Chair,** “Prosthetics Hardware”, Myoelectric Controls Conference (MEC2002), Fredericton, New Brunswick, Canada, August 19th - 23rd, University of New Brunswick, New Brunswick, Canada.

**ASSOCIATE EDITOR**

***SEE UNIVERSITY OF COLORADO FERPA 2011 - PRESENT***

2005 IEEE Transactions on Neural Systems and Rehabilitation Engineering

**REVIEWER**

***SEE UNIVERSITY OF COLORADO FERPA 2011 - PRESENT***

IEEE/ASME Transactions on Mechatronics

IEEE Transactions on Neural Systems and Rehabilitation Engineering

IEEE Transactions on Biomedical Engineering

IEEE Engineering in Medicine & Biology Magazine

Journal of the International Society for Prosthetics and Orthotics (ISPO)

VA Journal of Rehabilitation Research and Development

Medical & Biological Engineering & Computing

Engineering in Medicine & Biology Magazine

Control and Intelligent Systems journal

Robotics and Autonomous Systems

Robotica

ASME Magazine

Experimental Brain Research

Journal of Biomechanics

Gait and Posture

RESNA98 Paralyzed Veterans of America, Student Design Competition

MacArthur Foundation

Canadian Funding Agency NSERC

Atlantic Innovation Fund, Canadian

**VISITING FACULTY/STUDENTS**

***SEE UNIVERSITY OF COLORADO FERPA 2011 - PRESENT***

2011/03 Joe Beltor, Student of Aaron Dollar, PhD, Yale University

2009 Laboratory volunteer Correy Pew

* 1. Preceptor to VA Predoctoral Fellow James Sulzer.

Summer 2009 David McCoul, Summer Intern

Fall 2008 Visiting Intern, Claude Lagoda, Netherlands

Fall 2008 Laboratory Volunteer, Renaldo Evans

Summer 2008 William Kethman, NIH T32 Summer intern

Summer 2008 Chris Rodell, SINE Summer intern

Summer 2007 HaeOck Lee PhD Candidate from University of Texas, San Antonio, Texas. SINE program

Summer 2007 Nathan Stackhouse, Junior in Biomedical Engineering at Northwestern University spent summer in the BioMechatronics Development lab. to get research experience in Prosthetics

Summer 2007 Prem Ramkumar, High School Student spent summer in the BioMechatronics Development lab. to get research experience in Prosthetics

06/01/2006 - 08/31/2006 Narendra Vaidya PhD Candidate from Lowell University, Mass. Internship Report “A Mathematical Model for Calculating Muscle Force”

03/2005 - 02/2006 Dr. Kengo Onishi, from Oita University in Japan, Dr. Onishi worked with Dr. Richard Weir in the area of Upper-Limb Prosthetics.

**LABORATORY STAFF**

 2018-Present Stephanie Lorelli, MS, Bioengineering,

2012-Present Stephen Huddle, MS, Mechanical Engineer, Lab. Manager, Project Leader

2009-2010 Janina Madoff, MS, Biomedical Engineer

2008-2009 Jacob Segil, BS, Mechanical Design Engineer, Project Leader

2007-2010 Michelle Becker, BS, Administrative Coordinator

2006-2010 Jack Schorsch, MS, Biomedical Engineer, Regulatory Affairs, Lab. Manager, Project Leader

2006-2010 Steve Clark, BS, Senior Mechanical Design Engineer, Machine Shop Coordinator, Project Leader

2008-2009 Martin Schroeder, BS, Mechanical Design Engineer

2006-2008 Michael Mitchelle, Mechanical Design Engineer, Project Leader

**TEACHING EXPERIENCE**

***SEE UNIVERSITY OF COLORADO FERPA 2011 - PRESENT***

**2009-2010 Co-Instructor – BMD ENG 306:** Biomedical systems analysis. This is the second of a Mandatory three coarse sequence for all juniors. The course covers basic aspects of the quantitative analysis of biological systems, focusing on linear systems analysis. Topics covered are impulse responses and convolution, Laplace transforms, z-transforms, and Bode plots. Both discrete and continuous time analyses are covered.

**1997-2008 Adjunct Faculty - Fundamentals of Biomaterials for Prosthetists and Orthotists,** Fall & Winter semester, (12 lecture course each semester), [Northwestern University Prosthetics and Orthotics School (NUPOC)](http://www.repoc.nwu.edu/nupoc/nupoc.html).

2004Guest Lecturer – BMD ENG 495 Biomedical Robotics, May 5th & 7th, 2004. Spring Quarter [Department of Biomedical Engineering](http://www.nwu.edu/bme/), [Northwestern University](http://www.nwu.edu/).

2004-2008Co-Instructor – BMD ENG 365 Human Limbs and Their Artificial Replacements, Winter Quarter [Department of Biomedical Engineering](http://www.nwu.edu/bme/), [Northwestern University](http://www.nwu.edu/).

2003 PBL Tutor – Problem Based Learning Block 103, Group 21, Northwestern University Feinberg School of Medicine, Winter Quarter, 2003.

2003 **Guest Lecturer -** BMD ENG 365 Human Limbs and Their Artificial Replacements**,** March 2003, Winter Quarter, [Department of Biomedical Engineering](http://www.nwu.edu/bme/), [Northwestern University](http://www.nwu.edu/)

2002Guest Lecturer – BMD ENG 495 Biomedical Robotics, May 22nd, 2002. Spring Quarter [Department of Biomedical Engineering](http://www.nwu.edu/bme/), [Northwestern University](http://www.nwu.edu/).

2002Co-Instructor – BMD ENG 365 Human Limbs and Their Artificial Replacements, Winter Quarter [Department of Biomedical Engineering](http://www.nwu.edu/bme/), [Northwestern University](http://www.nwu.edu/).

2001 **Guest Lecturer -** [**765(BME)-C95 Human Limbs and Their Artificial Replacements**](http://www.nwu.edu/bme/bmecrs.htm#c65)**,** February 28th & March 2nd 2001, Winter Quarter, [Department of Biomedical Engineering](http://www.nwu.edu/bme/), [Northwestern University](http://www.nwu.edu/).

2000 Guest Lecturer – 765(BME)-C66: Biomechanics of Movement, May 18th, 2000, Spring Quarter, [Department of Biomedical Engineering](http://www.nwu.edu/bme/), [Northwestern University](http://www.nwu.edu/).

1999 Guest Lecturer – 765(BME)-C66: Biomechanics of Movement, May 13th, 1999, Spring Quarter. [Department of Biomedical Engineering](http://www.nwu.edu/bme/), [Northwestern University](http://www.nwu.edu/).

1999 Guest Lecturer – PBL 104 Problem Based Learning, in the Structure/Function Course for First Year Medical Students, Northwestern University Medical School, May 3rd, 1999.

1998 **Guest Lecturer -** [**765(BME)-C95 Human Limbs and Their Artificial Replacements**](http://www.nwu.edu/bme/bmecrs.htm#c65)**.** [Department of Biomedical Engineering](http://www.nwu.edu/bme/), [Northwestern University](http://www.nwu.edu/).

1997 Guest Lecturer - Problem Based Learning, in the Structure/Function Course for First Year Medical Students, Northwestern University Medical School.

1996 **Guest Lecturer - Externally Powered Prostheses, Upper and Lower-Limb Prosthetics and Orthotics for Physicians and Surgeons -** 723, Section B, [Northwestern University Prosthetics and Orthotics School (NUPOC)](http://www.repoc.nwu.edu/nupoc/nupoc.html).

**1994 Guest Lecturer -** [**765(BME)-C65 Control of Human Limbs and Their Artificial Replacements**](http://www.nwu.edu/bme/bmecrs.htm#c65)**,** [Department of Biomedical Engineering](http://www.nwu.edu/bme/), [Northwestern University](http://www.nwu.edu/).

## **MENTORING EXPERIENCE**

***SEE UNIVERSITY OF COLORADO FERPA 2011 - PRESENT***

2014-Present Advisor: Bioengineering Ph.D. Student: Laura Elson, Ph.D. Candidate, Department of Bioengineering, University of Colorado - Denver, 2014-Present.

2012-2017 Advisor: Bioengineering Ph.D. Student: Matthew Davidson, Ph.D. Candidate, Department of Bioengineering, University of Colorado - Denver, 2012-Present.

2011-2017 Advisor: Bioengineering Ph.D. Student: Arjun Fontaine, Ph.D. Candidate, Department of Bioengineering, University of Colorado - Denver, 2011-Present.

2011-2017 Advisor: Mechanical Engineering Ph.D. Student: Hans Anderson, Ph.D. Candidate, Department of Bioengineering, University of Colorado - Denver, 2011-Present.

2011-2014 Advisor: Bioengineering Ph.D. Student: Jacob Segil, *Development and Validation of a Myoelectric Postural Control System for Advanced Prosthetic Hands*, Ph.D. Candidate, Department of Mechanical Engineering, Colorado University - Boulder, 2011-2014.

2011-2013 Advisor: Mechanical Engineering MS. Student: Daniel Cano, Anthropomorphic Adaptation And Control Of A Mechanically-Variable, Near-Infinite Range-Of-Stiffness Mechanism, Master of Science Thesis, Department of Mechanical Engineering, Colorado School of Mines, 2011-2013.

2007-2012 Advisor: Mechanical Engineering Ph.D. Student: Alex Birdwell, “*Investigation of Extrinsic Finger and Thumb Muscles to Command Individual Digits on a Multi-Functional Artificial Hand*.” Ph.D. Dissertation, Department of Mechanical Engineering, Northwestern University, Evanston, IL, January 2012.

2008-2010 Advisor: Biomedical Engineering MSc. Student: Agatha Lee: *Magnetic Field of the External Power Coil for the Implantable Myoelectric Sensor System*. Department of Biomedical Engineering, Northwestern University, Evanston, IL,

2007-2010 Advisor: Biomedical Engineering MSc. Student: Jeff Christenson: *Design and Analysis of a Series Elastic Actuator for Use as a Prosthetic Wrist with Accompanying Control Strategies*. Master of Science Thesis, Department of Biomedical Engineering, Northwestern University, Evanston, IL,

2007-2010 Advisor: Biomedical Engineering MSc. Student: Jeff Schroeder, *A New Mechanism with a Mechanically Variable Near-Infinite Range of Stiffness*. Master of Science Thesis, Department of Biomedical Engineering, Northwestern University, Evanston, IL,

2009 Committee member MS thesis: James Buffi Department of Biomedical Engineering, Northwestern University, Evanston, IL,

2009 Committee member MS thesis: Elliot Rouse, Department of Biomedical Engineering, Northwestern University, Evanston, IL.

2009 Committee member MS thesis: Dave Nahlik Department of Biomedical Engineering, Northwestern University, Evanston, IL,

2005-2007 Advisor: Biomedical Engineering Ph.D. Student: Sensinger, Jon: *User-modulated Impedance control of a prosthetic elbow*. Ph.D. Dissertation, Department of Biomedical Engineering, Northwestern University, Evanston, IL, June 2007.

2003-2007 Advisor: Biomedical Engineering Ph.D. Student: Farrell, Todd R.: *Issues in Multifunctional Myoelectric Control of Powered Prostheses: The Use of Surface vs. Intramuscular Electromyograms and the Determination of the Optimal Controller Delay*. PhD Dissertation, Department of Biomedical Engineering, Northwestern University, Evanston, IL, June 2007.

2003-2007 Advisor: Biomedical Engineering Ph.D. Student: Ajiboye, Abidemi Bolu: *Neuromotor Muscle Synergies for EMG Pattern Recognition of Prehension Grasps for Control of Multifunctional Myoelectric Prostheses*. Ph.D Dissertation, Department of Biomedical Engineering, Northwestern University, Evanston, IL, December 2007.

2002-2005 Advisor: Biomedical Engineering MSc. Student: Sensinger, Jon: *Design & Analysis of a Non-Backdrivable Series Elastic Actuator for Prosthetic Use*. Master of Science Thesis, Department of Biomedical Engineering, Northwestern University, Evanston, IL, June 2005.

**2004 Preceptor** Student Design Project, [**BMD ENG 390 Biomedical Engineering Design**](http://www.nwu.edu/bme/bmecrs.htm#c90), Winter Quarter, 2004:

2001-2003 Advisor: Biomedical Engineering MSc. Student: Farrell, Todd R.: *The Effect of Non-Linearities on Extended Physiological Proprioception (EPP) Control of a Powered Prosthesis.* Master of Science Thesis, Department of Biomedical Engineering, Northwestern University, Evanston, IL, June 2003.

2001-2003 Advisor: Biomedical Engineering MSc. Student: Ajiboye, Abidemi Bolu: *Investigation of Fuzzy Logic as a Classification Algorithm of EMG for the Control of Multifunctional Myoelectric Prostheses.* Master of Science Thesis, Department of Biomedical Engineering, Northwestern University, Evanston, IL, June 2003.

2001 Advisor: Biomedical Engineering Senior Ahoni, Beverly: *Redesign of the Synergetic Hand Controller.* Summer 2001.

1999-2001 Advisor: Biomedical Engineering MSc. Student: Al-Angari, Haitham Mohammed: *A Design of two Degrees-of-freedom Microprocessor-Based E.P.P. Position Controller for Upper-Limb Prostheses.* Master of Science Thesis, Department of Biomedical Engineering, Northwestern University, Evanston, IL, June 2001.

1999-2000 Advisor: Mechanical Engineering MSc. Student: Doering, Ernest: *Modeling the Interaction Between the User and Machine in an EPP Unbeatable Position Servomechanism*. Master of Science Thesis, Department of Mechanical Engineering, Northwestern University, Evanston, IL, June 2000.

**2000 Preceptor** Student Design Project, [**765 (BME)-C90 Biomedical Engineering Design**](http://www.nwu.edu/bme/bmecrs.htm#c90), Winter Quarter, 2000: Chi, Linda; Korona, Margaret; Leung, Nicky; Odden, Michelle; Whang, Naree: *"The Capstan Trans-Humeral Rotation Device".*

2000 Client for the Northwestern University Engineering Design and Communication Course - Design Team B: Shaw, Shinie; Valasek, Bill; Martinez, Joaquin; Provost, Louie; Yao, Di: *Website Design for Inside Ireland.* March 14th, 2000.

2000 Client for the Northwestern University Engineering Design and Communication Course - Section 13: Ray, Jehana; Hood, Andrew; Carter, Matt; Roman, Brenda: *Website Design for the Meteorite Mining Company.* March 16th, 2000.

**1997-1999 Technical Advisor:** Electrical Engineering MSc. Student: Bertos, Yiorgos A.: “[The Design and Development of an Embedded Microcontroller System for an E.P.P. Based Position Controller for Upper-Limb Prostheses](file:///C%3A%5CUsers%5CLocal%20Settings%5CTemporary%20Internet%20Files%5COLK58%5Cprogress%5Cjrrd_dva_9709_EPPCont.htm)”. Master of Science Thesis, Department of Electrical and Computer Engineering, Northwestern University, Evanston, IL, June 1999.

1999 **Preceptor** Student Design Project, [**765 (BME)-C90 Biomedical Engineering Design**](http://www.nwu.edu/bme/bmecrs.htm#c90), Winter Quarter, 1999: Findlay, Michael; Radtke, Michael; Tabayoyong, William; Tran, Dinh; Yuen, Jonathon: *“Improved Prosthetic Wrist.”*

1998 **Project Director:** Master of Science Student doing software development for the **Direct ultrasound Ranging System.** June-December, 1998.

1997 **Preceptor:** Student Design Project, [**765 (BME)-C90 Biomedical Engineering Design**](http://www.nwu.edu/bme/bmecrs.htm#c90), Winter Quarter, 1997: Ayson, Jason; Dumbauld, Pat; Messing, Katie; and Monje, Aaron; “MMAD: A Motor Driven Humeral Rotator Equipped with a Continuous Externally-Activated Locking Mechanism”.

1. **Project Director:** Research Assistant, Summer 1996: McCormick, Jeremy: “[DURS Research Report - Measurement and Calibration of the DURS Zone of Operation](file:///C%3A%5CUsers%5CLocal%20Settings%5CTemporary%20Internet%20Files%5COLK58%5Cgrants.htm#PROJECT DIRECTOR)”.

**1996 Project Director:** Research Assistant, Summer 1996: Israel, Adina: “[Construction and Calibration of the Flip-Side Direct Ultrasonic Ranging System Transponder](file:///C%3A%5CUsers%5CLocal%20Settings%5CTemporary%20Internet%20Files%5COLK58%5Cgrants.htm#PROJECT DIRECTOR)”.

# **MEDIA/INTERVIEWS**

***SEE UNIVERSITY OF COLORADO FERPA 2011 - PRESENT***

1. DARPA 2009 Arm featured on cover of National Geographic, January 2010. Our lab. (mentioned in small print on p150) built the thumb drives, Ab-Ad drive, and the index and middle fingers <http://ngm.nationalgeographic.com/2010/01/table-of-contents>

2009 UNB Hand mentioned on Quebec TV

2009 Featured in October VA Research Currents <http://www.research.va.gov/resources/pubs/docs/va_research_currents_oct_09.pdf>

2009 Our Implantable Myoelectric Sensor paper on the cover of IEEE Trans. Biomed Eng. January.

2008 Intrinsic Hand on cover of IEEE Spectrum Magazine

2007 Interviewed for Esquire Magazine

2007 Featured in Popular Mechanics

2007 “The World's Most Advanced Bionic Arm” by Michael Belfiore, WIRED, August, 2007. <http://www.wired.com/science/discoveries/news/2007/08/bionic_arm?currentPage=all>

2006 WGN News Saturday August 12th Disabled Veterans Convention, with the Secretary of the VA <http://wgntv.trb.com/news/local/eveningnews/?track=nav>

2006 The American Veteran, Episode 208, August 23, 2006

2006 VA Senate Subcommittee Hearing on VA Research Funding with Under Secretary of the VA and head of VA Research and Development, and Senator Craig, Chairman of the Subcommittee – New York Times - <http://www.research.va.gov/news/features/default.cfm>

2006 “Robotic Hand Showcases VA Research at Hearing” by Stephan Spotswood, U.S. Medicine, Vol. 42, No. 6, page 1, June 2006.

2006 Featured in Crain’s Business News

2005 “Creating a Smart Arm” by Dan Ferber, Popular Science, December, 2005, p. 70.

<http://www.popsci.com/popsci/bown2005/personalhealth/19e6ee82ea447010vgnvcm1000004eecbccdrcrd.html>

2005 “Prosthetics of future will mesh body, mind and machine”, October 26, 2005 Featured Article VA Research and Development Web site. <http://www1.va.gov/resdev/news/features/prosthetics.cfm>

2005 “Re-wiring the body” by Chuck Murray, Design News, 10.24.05, p67 [http://www.designnews.com/article/CA6275330.html&](http://www.designnews.com/article/CA6275330.html%26)

# 2005 “Making a better helping hand” by Jordan Weissmann, Daily Northwestern, Friday, October 21, 2005, p.3,

# <http://www.dailynorthwestern.com/vnews/display.v/ART/2005/10/21/4358781062a71?in_archive=1>

2005 “Arm Amputees Rely on Old Devices” by Dave Muniz, USA Today. p3., October 6th, 2005; <http://news.yahoo.com/s/usatoday/20051006/ts_usatoday/armamputeesrelyonolddevices>

2005 “Rehabilitation Medicine Welcomes a Robotic Revolution.” By Rebecca Voelker, JAMA. September 14th 2005; Vol. 294, No. 10, pp.1191-1195;

<http://jama.ama-assn.org/cgi/content/full/294/10/1191>

2005 “Robots help patients help themselves.” By Jim Ritter, Health Reporter, Chicago Sun Times, J*une 29, 2005* <http://www.suntimes.com/output/health/cst-nws-robot29.html>

* 1. “Chicago team crafts more lifelike artificial hand” by Rick Merritt, EE Times, September 22, 2003 URL: <http://www.eetimes.com/story/OEG20030922S0064>

2002 Mentioned under *Partners in Design* in “Iris Miller: Teaching Students the Meaning of Human Centered Design” by John Anderson, Burn Support News, Winter Edition 2002, Issue 4, p13.

2002 MEC’02 Presentations Mentioned in O&P Business News 11/2002.

2001 "High-Tech Lab Helps Amputees 'Just do it'", Chicago Sun Times interview by Adrienne Drell. pp. 18A,19A, Sunday, May 6th, 2001.

2001 Contributor for BBC Radio 4 Programme "Flesh and Chips", Produced by Jeremy Grange broadcast February & March 2001 [02/28/2001] BBC Wales Programme No. 00CL0846CHO.

2000 Segment for German Television ZDF by Christiane Blatter on the state of upper-limb prosthetics research. June 2000.

1998 "Prosthetics Laboratory Research". SCIENTIA-Idea Television. Segment for a Brazilian Television Station.

1997 “Science of the Impossible”. Segment for Discovery Channel. Sept. 1998.

1993 In: O&P Research and Engineering: Improving the Quality of Life in Today’s World, , O&P Almanac, P37-43, July 1993.

1989 Program Digest, National Easter Seal Society, Vol. 3, No. 2, p. 12, Fall, 1989.

**Powered Fingers** featured in:

2000 Advertisement (Flyer) for the Graduate Program in Biomedical Engineering Northwestern University, ©2000.

1997 FDA Consumer Vol. 31, No. 2, p. 9, 1997.

1996 In Motion Magazine Vol. 6, No. 5, p. 29, Oct. 1996.

 Chicago Sun Times,

 CBS News w/ Marianne Childers,

1990 Northwestern University Prospective Magazine, p. 4, Winter 1990.

# **SPECIAL SKILLS**

* 30+ years of experience in mechanical design using 3D CAD: Electric Powered Devices, Small DC Motors and Gear trains.
* 30+ years of Analog and Digital electronics designer - Medical Instrumentation, Microprocessor Systems, Motor Control Circuitry.
* 30+ years’ experience in the development of low power, small volume, light weight electronic and electro-mechanical devices. Extensive knowledge of the constraints imposed by limited space, power, and weight.
* 30+ years computer programming experience - Machine Language, 80x86 and 68000 series Assembler, C, Pascal, FORTRAN, Paracode (APV controller language), Delphi, Visual C++.
* 30+ years of Real-time and embedded system programming – PCs, Industrial Controllers and Embedded Microcontrollers, VxDs.
* 30+ years of experience with computers - DOS, Windows, Windows 95, Windows 98, Windows 2000, and Macintosh OS, VME, UNIX, CPM, and even card punch systems. Transducers, Instrumentation Design.
* 30+ years of experience in the installation, use and troubleshooting of CAD/Graphics Programs, Wordprocessors, Internet Browsers, and the Setup of Modems, PC System Integration, Cross compilers, Math Programs (Matlab, Maple etc.).
* In depth knowledge of : Rehabilitation Technology; Man/ Machine Interfaces; Robot Design - control and research; Control Theory; Information Theory; Personal Computer Industry; Science in General; Power Spectrum Analysis, Ultrasound and Infra-red Transducers and Circuits; Fuzzy Logic, neural networks, and genetic algorithms; Biomechanics of Gait; Upper and Lower Limb Prosthetics Research.
* 30+ years’ experience project management, including work that resulted in a patent for a direct ultrasonic ranging system.
* Effective liaison skills in communicating with external customers possessing a wide range of interests (consumers and government funding agencies).
* Strong leadership and credibility with staff resulting in effective motivation and coordination of a broad range of personalities and interests toward a common goal on time.
* Strong presentation skills as lecturer, regular speaker at conferences and publisher of journal articles.
* Experience in Black & white Photography, Metal working, Wood working, Electronic repair, Engineering Drawing.
* Prosthetic fitting, Human Anatomy.
* Certified SCUBA diver
* Speak French and Gaelge.

### RECENT TRAINING COURSES ATTENDED

***SEE UNIVERSITY OF COLORADO FERPA 2011 - PRESENT***

2002: Completed the Machine Shop Course offered by the Applied Physics Dept., Northwestern University, Evanston, IL, Four hours each week for eight weeks, Winter Quarter 2002.

2000: Completed the Trans-Tibial Section of the Northwestern University Prosthetics and Orthotics Center (NUPOC) Prosthetics Course. February-March, 1999.

2000 Completed Gross-Anatomy Course of the Northwestern University Prosthetics and Orthotics Center (NUPOC) Prosthetics Course. January, 2000.

1999: Completed the Upper-limb Section of the Northwestern University Prosthetics and Orthotics Center (NUPOC) Prosthetics Course. August-September, 1999.

1999: Otto Bock Myoelectric Training Course - August 1999.

1998: Completed Cardio-Pulmonary Resuscitation (CPR) training for infants conducted by Northwestern Memorial Hospital. 8th September, 1998.

1998: One day course "Practical Design Techniques for Power and Thermal Management" Sponsored by Analog Devices Corp. April, 1998.

1998: One day course "Clinical Applications of Human Movement Analysis" Sponsored by Computerized Functional Testing Corp., 25th April, 1998.

**PERSONAL INFORMATION**

Born: Dublin, Ireland, December 30th, 1960.

Citizenship: US Citizen (naturalized 7/1/97)

Married: September 7th, 1996.

**PERSONAL INTERESTS**

Running, Skiing, Swimming, Bicycling, Camping, Hiking, Shooting, Fishing, Opera, Science fiction Books, Film, Carpentry, Growing Plants, Drawing/Sketching, making and fixing things (anything).

 **PERSONAL MILESTONES**

* Getting our son into Denver University, Sept. 2017
* Completing our House, Oct. 2009
* Moving to Boulder County, June 2008
* Delivery of the 18 DOF Intrinsic Hand, August 2007
* Delivery of the Prototype 1 Arm, Jan 2006
* Moving to RIC and getting my own lab. Sept. 2005
* PI on my first Funded NIH BRP Proposal, Sept. 2003.
* PI on my first Funded Proposals Jan. 1999, & June 1999.
* Birth of my son, Teaghan Meneghini *ff*rench Weir, Sept. 26th, 1998.
* Granted US citizenship 1997.
* Getting married 1996.
* Obtaining Ph.D. 1995.
* Mrs. T's Chicago Triathlon 1995.
* Moore Marathon 1993.
* Obtaining MSc. 1989.
* Arrival in USA 1986.
* Graduating from Trinity 1983.