Curriculum Vitae

Anindo Roy, Ph.D.
Associate Professor, Department of Neurology
University of Maryland School of Medicine

Adjunct Associate Professor, Department of Mechanical Engineering
Faculty, Maryland Robotics Center, Institute for Systems Research
Lecturer, Office of Advanced Engineering Education
Affiliate, Department of Bioengineering
University of Maryland, College Park

Date: April 29, 2017

Contact Information

- Department of Neurology, University of Maryland School of Medicine, 110 S Paca St, Baltimore, MD 21210
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- Email: ARoy@som.umaryland.edu
- Foreign Languages: Hindi (native, fluent), Bengali (native, fluent)

Education

Jul 1998	Bachelor of Technology (B.Tech.) Major: Electrical Engineering JMI University, New Delhi, India Department of Electrical Engineering, Faculty of Engineering and Technology Senior Design Project: "Design of a Magnetic Levitation System"
Jan 2000	Master of Philosophy (M.Phil.) Engineering (Major: Control Systems) University of Sussex, Brighton, Sussex, UK Department of Engineering and Design, School of Engineering Thesis: "Design of Optimal Sampled Data Control Systems" Thesis Advisor: Derek P. Atherton, Ph.D., D.Sc.
May 2005	Doctor of Philosophy (Ph.D.) Applied Science (Major: Engineering Science and Systems) University of Arkansas at Little Rock, Little Rock, Arkansas, USA Department of Applied Science, College of Engineering & Information Technology Thesis: "Robust Stabilization of Multi-Body Biomechanical Systems: A Control Theoretic Approach" Thesis Advisor: Kamran Iqbal, Ph.D.

Post Graduate Education and Training

2005-2006	Post-Doctoral Fellow (Neuromechanics) Georgia Institute of Technology (GeorgiaTech)/Emory University Laboratory for Neuroengineering (Neuromechanics Group)

Department of Biomedical Engineering, GeorgiaTech School of Engineering/Emory University School of Medicine, Atlanta, Georgia, USA
Mentor: Lena Ting, Ph.D.

2006-2009 Post-Doctoral Associate (Rehabilitation Robotics)
Massachusetts Institute of Technology (MIT)
Newman Laboratory for Biomechanics and Human Rehabilitation
Department of Mechanical Engineering, School of Engineering
Cambridge, Massachusetts, USA
Mentors: Neville Hogan, Ph.D., Hermano I. Krebs, Ph.D.

2006-2009 Research Fellow (Stroke Neurorehabilitation)
Maryland Exercise and Robotics Center of Excellence (MERCE)
Rehabilitation Research and Development (VA RR&D)
Baltimore Veterans Affairs Medical Center
Department of Veterans Affairs
Baltimore, Maryland, USA
Mentor: Richard F. Macko, MD

Employment

Academic Appointments

2009-2016 Assistant Professor
Department of Neurology
University of Maryland School of Medicine
Baltimore, Maryland USA

2009-2012 Assistant Professor (Secondary Appointment)
Department of Physical Therapy and Rehabilitation Science
University of Maryland, School of Medicine
Baltimore, Maryland USA

2012-2015 Adjunct Assistant Professor
Fischell Department of Bioengineering
Clark School of Engineering
University of Maryland, College Park, Maryland USA

2014-present Faculty, Maryland Robotics Center, Institute for Systems Research
University of Maryland, College Park, Maryland USA

2015-2016 Adjunct Assistant Professor
Department of Mechanical Engineering
Clark School of Engineering
University of Maryland, College Park, Maryland USA

2015-present Member, Graduate Faculty
University of Maryland Graduate School
Baltimore, Maryland, USA

2015-present Affiliate, Department of Bioengineering
Clark School of Engineering
University of Maryland, College Park, Maryland USA

2016-present	Associate Professor Department of Neurology Division of Neuroscience University of Maryland School of Medicine Baltimore, Maryland USA
2017-present	Adjunct Associate Professor Department of Mechanical Engineering Clark School of Engineering University of Maryland, College Park, Maryland USA
2017-present	Lecturer Office of Advanced Engineering Education Clark School of Engineering University of Maryland, College Park, Maryland USA

Other Appointments

1998-1999	Tutor (UK equivalent of Graduate Teaching Assistant) - Engineering Department of Engineering and Design School of Engineering University of Sussex, Brighton, Sussex, UK
Jan-May 2002	Graduate Research Assistant Department of Systems Engineering College of Engineering & Information Technology University of Arkansas at Little Rock, Little Rock, Arkansas, USA
2002-2005	Graduate Teaching Assistant Departments of Applied Science and Systems Engineering College of Engineering and Information Technology University of Arkansas at Little Rock, Little Rock, Arkansas, USA
Aug-Dec 2003	Lecturer Department of Systems Engineering College of Engineering and Information Technology University of Arkansas at Little Rock, Little Rock, Arkansas, USA
2009-2013	Robotics Engineer US Department of Veterans Affairs, VA Maryland Health Care System Baltimore Veterans Affairs Medical Center, Baltimore, Maryland, USA
2014-2016	Chief Robotics Engineer US Department of Veterans Affairs, VA Maryland Health Care System Baltimore Veterans Affairs Medical Center, Baltimore, Maryland, USA
2016-present	Director, Engineering Core Veterans Affairs (VA) RR&D Center of Excellence Baltimore VA Medical Center, VA Maryland Health Care System Baltimore, Maryland USA

Professional Society and Committee Memberships

2004-present	Full Member, The Sigma Xi Scientific Research Society
2005-2011	Member, The Institute of Electrical and Electronics Engineers (IEEE)
2005-present	Committee Member, International Federation of Automatic Control, Technical Committee on Modeling and Control of Biomedical Systems
2005-present	Member, Society for Neuroscience
2011-present	Senior Member, The Institute of Electrical and Electronics Engineers (IEEE)

Honors and Awards

2003	Student Travel Grant, Institute of Electrical and Electronics Engineers IEEE International Conference on Systems, Man, and Cybernetics Society
2003	First Place – Graduate Student Research Forum Graduate School University of Arkansas at Little Rock, Little Rock, Arkansas, USA
2003	Publications and Presentations Award University of Arkansas at Little Rock, Little Rock, Arkansas, USA
2003	M.K. Testerman Award for Excellence in Research Graduate School University of Arkansas at Little Rock, Little Rock, Arkansas, USA
2004	Publications and Presentations Award University of Arkansas at Little Rock, Little Rock, Arkansas, USA
2012	Subject in: Marquis Who's Who in America, 67th edition
2010	Classification as an "Alien of Extraordinary Ability" United States Department of Homeland Security/Department of State
2014	Subject in: American Men and Women in Science, 32nd edition
2015	*Abell Foundation Award*, "Bio-Based Software Engine for Adaptive Control of Modular Robots for Clinical Neuro-Rehabilitation," 2015. Press Release
2015	UMB President's Entrepreneurial Fellowship – Anklebot was selected by the Office of Research & Development (ORD) as a project for its high innovation and potential.

Institutional Service

2016-present	Scientific Review Committee on Intellectual Property (SRC) Office of Research & Development (ORD), University of Maryland, Baltimore
2015	School of Medicine Council (Alternate Member)
2015	Member, Junior & Mid-Level Faculty Group Neurology Chair Search Committee
2009	Judge, 32nd Annual Medical Student Research Day (MSRD), University of Maryland School of Medicine

Local, National, and International Service

Technical Committees, Conferences, Symposia, and Workshops

2003	Session Chair (Advanced Control) IEEE International Symposium on Intelligent Control Houston, Texas, USA
2004	Session Chair (Engineering) The 88th Annual Meeting of the Arkansas Academy of Science Jonesboro, Arkansas, USA
2007	Session Chair (Methods) Northeast American Society for Biomechanics Conference University of Maryland at College Park, Maryland, USA
2005-present	Member, Technical Committee on Modeling and Control of Biomedical Systems, International Federation of Automatic Control
2010	Member, International Program Committee IASTED International Conference on Robotics and Applications Cambridge, Massachusetts, USA
2011	Member, International Program Committee IASTED International Conference on Robotics and Applications Vancouver, British Columbia, Canada
2013	Session Chair (Rehabilitation Robotics-II), IEEE International Conference on Robotics and Automation (IEEE ICRA), Karlsruhe, Germany.
2014	Session Chair (Rehabilitation - Technical Aids - Exoskeletons), IEEE International Conference on Biomedical Robotics and Biomechatronics (IEEE BioRob), São Paulo, Brazil.
2014	Co-Chair (Journals & Conference Proceedings), IEEE International Conference on Biomedical Robotics and Biomechatronics (IEEE BioRob), São Paulo, Brazil.
2014	Panellist, Committee for Best Student Paper Award, IEEE International Conference on Biomedical Robotics and Biomechatronics (IEEE BioRob), São Paulo, Brazil.

Peer-Review Activities* and Editorial Boards

*Note: number in parenthesis after each listing indicates number of papers reviewed in that year.

2004	Reviewer, Computing, Communications and Control Technologies (1)
2004	Reviewer, IASTED Journal of Control and Intelligent Systems (1)
2005	Reviewer, IASTED Journal of Control and Intelligent Systems (1)
2005	Reviewer, Journal of Experimental Psychology (1)
2005	Reviewer, IEEE Transactions on Neural Systems and Rehabilitation Engineering (7)
2005	Reviewer, Joint IEEE and European Conference on Control and Decision (1)
2006	Reviewer, IEEE Conference on Decision and Control (3)
2006	Reviewer, ASME Journal of Biomechanical Engineering (1)
2006	Reviewer, IEEE Transactions on Biomedical Engineering (1)
2006	Reviewer, Journal of Rehabilitation Research and Development (2)
2007	Reviewer, American Control Conference (2)

2007	Reviewer, Computers in Biology and Medicine (1)
2007	Reviewer, IEEE International Conference on Rehabilitation Robotics (3)
2007	Reviewer, International Federation of Automatic Control World Congress (1)
2007	Reviewer, International Journal of Adaptive Control (1)
2008	Reviewer, Medical Engineering and Physics (1)
2010	Reviewer, IEEE Transactions on Robotics (1)
2010	Reviewer, Mathematical Biosciences (1)
2010	Reviewer, Journal of Neuroengineering and Rehabilitation (3)
2011	Reviewer, Journal of Motor Behavior (1)
2012	Reviewer, IEEE International Conference on Biomedical Robotics and Biomechatronics (2)
2012	Reviewer, IASTED International Conference on Robotics and Application (2)
2012	Reviewer, IEEE Transactions on Mechatronics (1)
2013	Reviewer, PLoS ONE (2)
2014	Reviewer, Archives of Physical Medicine and Rehabilitation (1)
2014	Reviewer, Part C: Journal of Mechanical Engineering Science (1)
2014	Reviewer, ASME Journal of Mechanisms and Robotics (1)
2014	Reviewer, IEEE Transactions on Human-Machine Systems (1)
2014	Reviewer, Neurorehabilitation and Neural Repair (1)
2015	Reviewer, IEEE International Conference on Robotics and Automation (1)
2015	Reviewer, BMC Neurology (1)
2015	Internal Reviewer, VA Merit Review Proposal "Translating Intensive Arm Rehabilitation in Stroke to a Telerehabilitation Format."
2016	Reviewer, IEEE Transactions on Neural Systems and Rehabilitation (2)
2017	Reviewer, Neurorehabilitation and Neural Repair (1)
2017	Reviewer, IEEE International Conference on Rehabilitation Robotics (ICORR) (2)

Teaching Service

2003	Instructor, Department of Systems Engineering University of Arkansas at Little Rock Optimization Methods in Systems Engineering (SYEN 3312, 3 credits) 30 Senior and Junior Undergraduate students.
2009	Course Section Instructor Rehabilitation Sciences I (PTRS 688/03, 3 credits) Engineering Approaches in Rehabilitation Sciences 5 1st year Doctoral students, 1 hour per week, 1 week Department of Physical Therapy and Rehabilitation Science University of Maryland School of Medicine Total: 5 student-hours
2011	Instructor Special Topics: Basic Matlab® (PTRS688/04, 3 credits) 4 1st year Doctoral students, 1 hour per week, 14 weeks. Department of Physical Therapy and Rehabilitation Science University of Maryland School of Medicine Total: 56 student-hours
2013	Instructor Special Topics: Basic Matlab® (PTRS688/04, 3 credits) 2 1st year Doctoral students, 2 Fellows, 1 hour per week, 14 weeks. Department of Physical Therapy and Rehabilitation Science

University of Maryland School of Medicine
Total: 56 student-hours

2014 Guest Lecturer
Assistive Robotics (ENME444, 3 credits) – Rehabilitation Robotics
35 Senior Undergraduates students, 1 hour per week, 2 weeks
Department of Mechanical Engineering
Clark School of Engineering, University of Maryland, College Park
Total: 70 student-hours

2015 Instructor
Assistive Robotics (ENME444, 3 credits)
28 Senior Undergraduate students, 2.5 hours per week, 14 weeks
Department of Mechanical Engineering
Clark School of Engineering, University of Maryland, College Park
Total: 980 student-hours

2016 Instructor
Assistive Robotics (ENME444, 3 credits)
28 Senior Undergraduate students, 2.5 hours per week, 14 weeks
Department of Mechanical Engineering
Clark School of Engineering, University of Maryland, College Park
Total: 980 student-hours

2017 Instructor
Rehabilitation Robotics (ENPM 808J - Technical Elective, 3 credits)
9, Masters and Doctoral students, 2.67 hours per week, 12 weeks
Office of Advanced Engineering Education (OAEE)
Maryland Robotics Center, University of Maryland, College Park
Professional Master's Program in Engineering (Meng) – Robotics
Total: 288 student-hours

Other Teaching

1999 Tutor (UK equivalent of Graduate Teaching Assistant), School of Engineering
University of Sussex
Feedback Control Laboratory (H6026)
30, Senior and junior-level students, 2-12 credits/yr.

2002-2005 Graduate Teaching Assistant, Department of Systems Engineering
University of Arkansas at Little Rock

a. Linear System Theory (SYEN 4320.01, 5320.01)
   30, Senior and Junior Undergraduates, 3 credits/yr.

b. Systems Modeling (SYEN 3310)
   30, Senior and Junior Undergraduates, 3 credits/yr.

c. Optimization Methods in Systems Engineering (SYEN 3312)
   30, Senior and Junior Undergraduates, 3 credits/yr.

d. Probability and Random Signals (SYEN 3314)
   30, Senior and Junior Undergraduates, 3 credits/yr.

Continued Medical Education (CME) and National Symposia Teaching

2014 "Robotics in Stroke" Operation Stroke: 9th Annual Update
Office of Continuing Medical Education, St. Elizabeth Health Center, Youngstown, OH
(7 AMA PRA Category 1 Credits, 7.25 contact hours for RNs, LPNs)

Professional Course Development

2016 Graduate Course in Rehabilitation Robotics (ENPM 808J, 3 credits)
As part of the Professional Master's Program in Engineering – Robotics
Offered by the Office of Advanced Engineering Education (OAEE)
Maryland Robotics Center, University of Maryland, College Park

Description: This graduate course provides the *theoretical knowledge* of automatic control systems deployed in rehabilitation robots and insight into selection of appropriate control systems based on different robots targeting different disability conditions, provides information about the design and development considerations underlying different rehabilitation robots taking into account clinical and biomechanical needs of the targeted disabilities, introduces *experimental techniques* used in human movement science to enable understanding of how bioinstrumentation is used to evaluate human performance, and provides *knowledge* about the state of the art.

Profession Tutorials and Workshops

2010 "Design, control, and mechatronics perspectives on the MIT-anklebot" Workshop on Rehabilitation and Therapeutic Robotics for Upper and Lower Extremity, ASME Dynamic Systems and Controls Conference, IFAC Symposium on Mechatronic Systems, Cambridge, MA

Description: 1-day tutorial to provide a concise yet broad-based introduction to key topics in the field of rehabilitation and therapeutic robotics, such as basic neuroscience and rehabilitation, impairment based approaches, design and control of devices from a mechatronics perspective, and clinical implications. Target audience included researchers in the areas of dynamics systems, controls, robotics, and mechatronics not necessarily in this area of rehabilitation and therapeutic robotics.

2010 "Lower Extremity Robotics in Stroke Rehabilitation: Intervention Development and Research Directions" Scientific Updates in Exercise, Robotics, and Neuro-Rehabilitation Webcast, Baltimore, MD

Description: 1-day webcast symposium sponsored by the Geriatrics Research, Education, and Clinical Center, which attracted >100 attendees.

2011 "Research in robotics post stroke" Stroke Seminar for Health Professions – Student Training in Aging Research (HP-STAR) Program Trainees, University of Maryland School of Medicine/Office of Student Research

2011 "Going Distal: Lower Extremity Robotics for Chronic and Acute Stroke" Workshop on Rehabilitation and Therapeutic Robotics for Upper and Lower Extremity, 33rd Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBS), Boston, MA

Description: 1-day tutorial to provide a concise yet broad-based introduction to key

topics in the field of rehabilitation and therapeutic robotics, such as basic neuroscience and rehabilitation, impairment based approaches, design and control of devices from a mechatronics perspective, and clinical implications. Target audience included researchers in the areas of dynamics systems, controls, robotics, and mechatronics not necessarily in this area of rehabilitation and therapeutic robotics.

2014 "Ankle Robotic Gait Therapy in Stroke: Some "Success" Stories Organized Workshop ("Physiology and Robotics, A Happy Marriage"), IEEE International Conference on Biomedical Robotics and Biomechatronics, São Paulo, Brazil

2014 "Robotic Gait Therapy - The Pitfalls and Success Stories: Are we finally getting it right?" Organized Workshop ("Human Robot Interaction"), IEEE International Conference on Biomedical Robotics and Biomechatronics, São Paulo, Brazil

2014 "Motor Learning and Robotic Therapy: A Happy Therapeutic Marriage" Maryland Comprehensive Stroke Conference, Baltimore, MD

Description: Contribute to the knowledge base of providers caring for the complex stroke patient in the state of Maryland. Target audience included physicians, registered nurses, physician assistants, nurse practitioners, rehabilitation providers, paramedics and any provider caring for the stroke patient.

Research & Career Mentor and Career Advisor

2005-2006 Secondary Advisor to Graduate Student Alexander C. Koenig (Masters in Electrical & Computer Engineering)
Department of Electrical and Computer Engineering, Georgia Institute of Technology
Thesis: Simulation of agonist & antagonist muscle activation patterns in bidirectional postural perturbation in cats.
Current/Last Known Position: Postdoctoral Research Fellow, Harvard Medical School

2009-2010 Co-Mentor* to Post-Doctoral Fellow Ronald Goodman, PhD
Health Research Scientist, VA CDA-1 Awardee
Project: Cortical and Biomechanical Dynamics of Lower Extremity Robot Assisting at Different Levels of Motivational Incentive: Implications for Stroke Survivors
*Shared with Dr. Larry W. Forrester
Mentoring Output: 2 refereed journal articles, 1 refereed conference proceedings article, 5 meeting abstracts/posters

2010 Co-Mentor* to Medical Student Sailesh Balasubramanium (M.D. Candidate)
University of Maryland School of Medicine - Class of 2010
4th Year Summer Research Internship as part of AAN Fellowship
Project: Feasibility of Robot-Assisted Ankle Training with Concurrent EEG Monitoring in Multiple Sclerosis.
*Shared with Dr. Christopher T. Bever
Current/Last Known Position: Resident, Duke University Medical School
Mentoring Output: 1 refereed conference proceedings article, 2 meeting posters/abstracts

2010-2011 Co-Mentor* to Post-Doctoral Fellow Priya Narayanan, Ph.D.
VA RR&D Maryland Exercise and Robotics Center of Excellence
Project: Ankle robotics task-oriented treadmill training in chronic stroke.
*Shared with Drs. G.W. Wittenberg, L.W. Forrester
Current/Last Known Position: GE Fellow, Army Research Lab

2011	Co-Mentor* to Medical Student Kevin McGehrin (M.D. Candidate) University of Maryland School of Medicine - Class of 2014 1st Year Summer Research Internship as part of AAN Fellowship Project: Within-session changes in ankle impairment during anklebot training in hemiparetic stroke patients. Current/Last Known Position: Resident, University of Maryland School of Medicine *Shared with Dr. Christopher T. Bever Mentoring Output: 2 abstracts/posters
2011-2013	Mentor to High School Student Nathaniel Macko Summer STEM Internship as part of "Project Lead the Way" and Pre-Engineering Programs (through the VA Volunteer Program) Project: Incorporating artificial intelligence into modular Anklebot. Current/Last Known Position: Undergraduate Student in Electrical Engineering and Computer Science (ECE) – Class of 2018, University of Maryland, College Park Mentoring Output: 1 refereed conference proceedings article
2012	Doctoral Committee Member of Graduate Student Elizabeth Brokaw, MS (Biomedical Engineering) Department of Biomedical Engineering, Catholic University of America (CUA) Doctoral Dissertation: Upper limb rehabilitation after stroke through functional task intervention. Current/Last Known Position: Post-Doctoral Fellow, Rehabilitation Institute of Chicago
2013-2014	Research Advisor* to Undergraduate Student Quentin Sanders (Bachelors in Mechanical Engineering Class of 2015) Independent Study for-credit Department of Mechanical Engineering, University of Maryland Baltimore County 2013 Project: Lower limb robotic therapy and underlying control systems. 2014 Project (Independent Study, 3 Credits): Design of ergonomic, facile pelvic mechanical attachment for Anklebot. *Off-Campus; On-Campus Advisor: Dr. Neil Rothman Current/Last Known Position: Doctoral Student, Department of Mechanical and Aerospace Engineering, University of California, Irvine (UCI)
2013-present	Co-Mentor* to Post-Doctoral Scholar Alyssa Stookey, Ph.D. VA RR&D Maryland Exercise and Robotics Center of Excellence Provide training in basic understanding of human biomechanics, bioinstrumentation, and quantitative movement analyses. *Shared with Drs. F. Ivey, C. Hafer-Macko, R.F. Macko Current/Last Known Position: Program Manager, VA Office of Rural Health (ORH) sponsored Interactive Video Tele-Rehabilitation
2014	Co-Mentor* to Medical Student Christine Kang (M.D. Candidate) University of Maryland School of Medicine - Class of 2017 1st Year Summer Research Internship as part of the NIH HP-STAR Training Program Project: Kinematic Analysis of Shoulder and Elbow Movements in Neurologically Impaired and Unimpaired Healthy Patients. *Shared with Dr. Christopher T. Bever, Susan Conroy (Dsc.PT) Current/Last Known Position: Year 3 Medical Student, University of Maryland School of Medicine Mentoring Output: 1 refereed conference proceedings article, 2 meeting posters/abstracts

2014	Mentor to Undergraduate Student Lauren Bergamo (Bachelors in Kinesiology Class of 2015) Summer Internship for-credit Department of Kinesiology, Towson University Training: Human Biomechanics and Stroke Rehabilitation Current/Last Known Position: Exercise Phsyiologist, Baltimore VA
2014	Mentor to Undergraduate Student Shannon Will (Bachelors in Kinesiology Class of 2015) Summer Internship for-credit Department of Kinesiology, University of Maryland, College Park Training: Human Biomechanics and Stroke Rehabilitation Current/Last Known Position: 2nd Year Doctor of Physical Therapy (DPT) Student, University of Maryland School of Medicine
2014	Mentor to Undergraduate Student Amy Bourke (Bachelors in Kinesiology Class of 2015) Summer Internship for-credit Department of Kinesiology, Towson University Training: Human Biomechanics and Stroke Rehabilitation Current/Last Known Position: Swim Instructor, US Navy
2014	Mentor to High School Student Ilona Wittenberg Summer STEM Internship (through VA Volunteer Program) Training: Human Biomechanics and Robotic Neuro-Rehabilitation Current/Last Known Position: Undergraduate Student – Class of 2018, University of Maryland, College Park
2014	Mentor to High School Student David Kittner Summer STEM Internship (through VA Volunteer Program) Training: Human Biomechanics and Robotic Neuro-Rehabilitation Current/Last Known Position: Undergraduate Student in Electrical and Computer Engineering (ECE) – Class of 2019, University of Maryland, College Park
2014-2015	Mentor to High School Student Sonal Khosla Summer STEM Internship (through VA Volunteer Program) Training: Human Biomechanics and Robotic Neuro-Rehabilitation
2014-2015	Mentor to High School Student Ronan O'Shea Summer STEM Internship (through VA Volunteer Program) Training: Human Biomechanics and Robotic Neuro-Rehabilitation Current/Last Known Position: Undergraduate Student in Neuroscience - Class of 2019, Brown University
2015	Co-Mentor* to Medical Student Tahreem Iqbal (M.D. Candidate) University of Maryland School of Medicine - Class of 2019 1st Year Summer Research Internship as part of AAN Fellowship Project: Kinematic and Kinetic Outcomes of Robot Assisted Neurorehabilitation in Chronic Moderate-to-Severe Hemiparetic Stroke. Current/Last Known Position: Year 2 Medical Student, University of Maryland School of Medicine Mentoring Output: 2 posters/abstracts

Grant Support

Active

01/01/17 - 09/30/17 PIs: Richard F. Macko, Anindo Roy
"Portable Deficit-Adjusted Ankle Robot for Neurologically Disabled Populations"
Maryland Innovation Initiative (MII)
Total Direct Costs: $115,000

01/01/15 - 12/31/18 PIs: Richard F. Macko, Anindo Roy
"Adaptive ankle robot control system to reduce foot-drop in chronic stroke."
VA RR&D Merit Review (1I01RX001699-01A1)
Total Direct Costs: $1,097,835

01/01/11 - 12/31/15 (Co-I, 62%) PI: Richard F. Macko
"Task-oriented exercise & robotics in neurological disease."
VA RR&D Center of Excellence Grant (B9215-C)
Total Direct Costs: $4,153,100

10/01/15 - 09/30/16 (Co-I, 12%) PI: Richard F. Macko
"Interactive Video Exercise Tele-rehabilitation (IVET)."
VA Office of Rural Health (ORH) (N05-FY14Q1-S2-P01050)
Year 1 Direct Costs: $308,900, Year 2 Direct Costs: $309,375

10/01/14 - 09/30/16 (Co-I, 11%) PI: Richard F. Macko
"Exercise + MOVE for Chronic Disease Management of Rural Veterans (eMOVE)."
VA Office of Rural Health (ORH) (N05-FY15Q1-S1-P01504)
Year 1 Direct Costs: $308,108, Year 2 Direct Costs: $308,077

07/01/12 - 06/30/14 (Co-I, 5%) PI: Larry W. Forrester (under no cost extension)
"Developing a brain-machine interface for an ankle robot."
VA RR&D Merit Review Pilot (1-IO1-RX000592-01)
Total Direct Costs: $190,120

06/01/15 - 05/30/16 (Co-PI, 100%) PI: Anindo Roy, Richard F. Macko, Larry W. Forrester
"Bio-Based Software Engine for Adaptive Control of Modular Robots for Clinical Neuro-Rehabilitation," Abell Foundation (Top Innovation Award)
Total Direct Costs: $50,000 [*Funding Continues as of April 29, 2017*]

Completed

07/01/11 - 06/30/14 (Co-I, 20%) PI: Larry W. Forrester
"Ankle robotics training after stroke: effects on gait and balance."
VA Merit Review Pilot Award (1-I01-RX000351-01 A7461P)
Total Direct Costs: $101,450

07/01/09 - 06/30/10 (Co-I, 30%) PI: Larry W. Forrester
"Robot-assisted training of ankle movements in acute stroke survivors."
NIH Pepper Center Pilot Grant
Total Direct Costs: $25,000

01/01/06 - 12/30/10 (Co-I, 62%) PI: Richard F. Macko
"Task-oriented exercise & robotics in neurological disease." (H-27061)

VA RR&D Center of Excellence Grant
Total Direct Costs: $4,965,000

09/22/06 - 09/22/10 (Co-I, 100%) PI: Larry W. Forrester
"Modular Lower Extremity Robotics Assisted Exercise after Stroke."
5-year sub-study under VA RR&D Center of Excellence Grant
Annual Direct Costs: $200,000

Under Review / Pending

National Institute of Aging (P01), "Mechanisms for Activity-Dependent Plasticity in Stroke and Aging," Submitted January, 2017 (PI's: Anindo Roy, Richard F. Macko).

Project 1: "Adaptive ankle robotics to improve neuromotor function in chronic stroke" (PI: Anindo Roy).
Project 2: "Robotics and exercise to improve mobility & muscle in cerebrovascular disease" (PIs: Anindo Roy, Alice Ryan).
ART Core: "Assistive Rehabilitation Technologies" (PI: Anindo Roy).

NIH Center for Medical Rehabilitation Research (R01), "Exercise and Robotic Therapy in Stroke," Scored 59%, Resubmitted March, 2017 (PI's: Alice Ryan, Anindo Roy, Charlene Hafer-Macko).

NIH National Institute of Aging (R01), "Adaptive Ankle Robotics to Improve Neuromotor and Mobility Function in Chronic Stroke," Planned Resubmission: October, 2017 (PI: Anindo Roy).

Publications*

*Note: Conference proceeding articles including those published by the IEEE are full-length, peer-reviewed, and paginated articles that are indexed in PubMed and/or IEEEXplore databases.

Peer-reviewed Journal Articles (including Conference Proceedings)

1. Roy, A., Iqbal, K. PID stabilization of a position-controlled manipulator with wrist sensor. Proceedings of the IEEE Conference on Control Applications, 1:209-14, 2002.
2. Iqbal, K., Roy, A. PID controller design for the human-arm robot manipulator coordination problem. Proceedings of the IEEE International Symposium on Intelligent Control, 121-24, 2002.
3. Roy, A., Iqbal, K. Contributors to postural stabilization: a modeling-simulation study. Proceedings of the IEEE-NIST Conference on Performance Metrics, 1-6, 2003.
4. Iqbal, K., Roy, A., Imran, M. Passive and active contributors to postural stabilization. Proceedings of the IEEE Conference on Systems, Man & Cybernetics, 5:4502-07, 2003.
5. Roy, A., Iqbal, K. PID controller stabilization of a single-link biomechanical model with multiple delayed feedbacks. Proceedings of the IEEE Conference on Systems, Man & Cybernetics, 1:642-47, 2003.
6. Roy, A., Iqbal, K. PID controller design for first-order-plus-dead-time model via Hermite-Biehler theorem. Proceedings of the American Control Conference, 6:5286-91, 2003.
7. Roy, A., Iqbal, K., Atherton, D.P. On using prioritized optimization in sampled-data control systems: a new variable weight. Proceedings of the IEEE Conference on Control Applications, 1:764-69, 2003.
8. Roy, A., Iqbal, K., Atherton, D.P. New criteria for model reduction of sampled-data control systems. Proceedings of the IEEE International Symposium on Intelligent Control, 146-51, 2003.
9. Roy, A., Iqbal, K. PID Stabilization of a position-controlled robot manipulator acting independently or in collaboration with human arm. Journal of Arkansas Academy of Sciences, 57:131-39, 2003.
10. Roy, A., Iqbal, K. PID stabilization of a position-controlled manipulator with wrist Sensor. Society of

Manufacturing Engineers Technical Paper, 129:1-7, 2003.

11. Roy, A., Iqbal, K. PID Stabilization of a Single-Link Biomechanical Model with Control Effort Constraints. Proceedings of the IASTED International Conference on Control Applications, 441:018, 2004.
12. Roy, A., Iqbal, K., Atherton, D.P. Optimum tuning of PI-PD controllers for unstable sampled-data control systems. Proceedings of the Asian Control Conference, 1:478-85, 2004.
13. Roy, A., Iqbal, K. Analytical framework for constraining the initial control effort in a biomechanical model. Proceedings of the IEEE Conference on Control Applications, 1:562-67, 2004.
14. Iqbal, K., Roy, A. Robust stabilization in a single-link biomechanical model: a time-domain analysis. Proceedings of the IEEE Conference on Systems, Man & Cybernetics, 1:847-52, 2004.
15. Roy, A., Iqbal, K. Analytical framework for jerk minimization in a single-link biomechanical model with feedback delays. Proceedings of the IASTED International Conference on Biomechanics, 463:017, 2004.
16. Iqbal, K. Roy, A. Stabilizing PID controllers for an inverted pendulum-based biomechanical model with position, velocity, and force feedback. Journal of Biomechanical Engineering, 126(6): 838-43, 2004.
17. Roy, A., Iqbal, K. Synthesis of stabilizing PID controllers for biomechanical models. Proceedings of the IFAC World Congress, 16:1–6, 2005.
18. Roy, A., Iqbal, K. Optimization of goal-oriented voluntary movements. Proceedings of the IEEE International Conference on Engineering in Medicine and Biology, 4998-5001, 2005.
19. Roy, A., Iqbal, K. PID controller tuning for first-order-plus-dead-time process via Hermite-Biehler theorem. ISA Transactions, 44(3): 363-78, 2005.
20. Iqbal, K., Roy, A. Kinematic trajectory generation in a neuromusculoskeletal model with somatosensory and vestibular feedback. Proceedings of the IFAC Symposium on Modeling Control in Biomedical Systems, 363-68, 2006.
21. Roy, A., Krebs, H.I., Patterson, S.L., Judkins, T.N., Khanna, I., Forrester, L.W., Macko, R.F, Hogan, N. Measurement of human ankle stiffness using the anklebot. Proceedings of the IEEE International Conference on Rehabilitation Robotics, 356-63, 2007.
22. Iqbal, K. Roy, A. A novel theoretical framework for the dynamic stability analysis, movement control, and trajectory generation of a multi-segment biomechanical model. ASME Transactions on Biomechanical Engineering, 131(1):011002, 2009.
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Book Chapters

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4. Roy, A., Forrester, L.W., Macko, R.F. Adaptive Control of Modular Ankle Exoskeletons in Neurologically Disabled Populations. In: Adaptive Control for Robotic Manipulators, First Edition, Dan Zhang, Bin Wei, Editors. 172-207, CRC Press/Taylor & Francis Group, 2017.

Selected Abstracts

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6. McGehrin, K., Roy, A., Goodman, R., Rietschel, J., Forrester, L., Bever, C. Ankle Robotics Training in Sub-Acute Stroke Survivors: Concurrent Within-Session Changes in Ankle Motor Control and Brain Electrical Activity. Medical Student Research Day (MSRD), Baltimore, Maryland, 2011.
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11. Roy, A., R.F. Macko, J.E Barton, R.G. Goodman, L.W. Forrester. Modular Ankle Robotics for Locomotor Training Post-Stroke: A Novel Deficit-Adjusted Approach. Society for Brain Mapping and Therapeutics (SBMT), Abstract 167, 88-89, Baltimore, MD, 2013.
12. Kang, C.Y., Conroy, S.S., Roy, A., Bever, C.T. Kinematic Analysis of Arm Reaching Movements in Diverse Neurologic Populations. Summer Research Training Programs Student Research Forum, Poster O.27, University of Maryland School of Medicine, Baltimore, Maryland, 2014.
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14. Iqbal, T., Conroy, S.S., Roy, A., Bever, C.T. Kinematic and Kinetic Outcomes of Robot Assisted Neurorehabilitation in Chronic Moderate-to-Severe Hemiparetic Stroke. Summer Research Training Programs Student Research Forum, Poster P.44, University of Maryland School of Medicine, Baltimore, Maryland, 2015.

Published Multimedia & Media Coverage

1. CNN.com, "Robotic workout for stroke sufferers", August 15, 2005.
2. CNN Live edition of Pioneers, May 14, 2006.
3. Press Release, US Department of Veterans Affairs, "Veterans affairs researchers study benefits of robot for ankle rehabilitation", June 15, 2009.
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10. Advances in Aging, Gerontology Program Newsletter at the University of Maryland, Baltimore, "Study evaluates benefits of ankle robotic training in chronic stroke survivors", 13(1): 1-3, Spring 2009.
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15. VA Office of R&D (ORD) film [YouTube], "Anklebot aids in stroke recovery," November 14, 2013. http://www.youtube.com/watch?v=7vMjc3ohxqw
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17. American Heart Association (AHA) "AHA Stroke Maryland" ("Top 15 Global Innovations of 2014"), 2014. http://www.youtube.com/watch?v=XTFkbdJ4Xug
18. The American Veteran, US Department of Veterans Affairs, 2014.
19. Baltimore WMAR ABC 2 News Channel, November 2014.
20. Abell Foundation Top Innovation Award, "Bio-Based Software Engine for Adaptive Control of Modular Robots for Clinical Neuro-Rehabilitation," 2015. Press Release

Invited and Plenary Talks

1. Robotics in stroke neurorehabilitation. Leaders in Mechanical Engineering Lecture Series, A. James Clark School of Engineering, University of Maryland, College Park, MD, March, 2009.
2. Lower Extremity Robotics in Stroke Rehabilitation: Intervention, Development, and Research Directions. National Rehabilitation Hospital, Washington D.C., May, 2010.
3. Design, control, and mechatronics perspectives on the MIT-anklebot. Workshop on Rehabilitation and Therapeutic Robotics for Upper and Lower Extremity, Dynamic Systems and Controls Conference, IFAC Symposium on Mechatronic Systems, Cambridge, MA, September, 2010.
4. Lower Extremity Robotics in Stroke Rehabilitation: Intervention Development & Research Directions. Scientific Updates in Exercise, Robotics & Neuro-Rehabilitation Webcast, Baltimore, MD, September 2010.
5. Research in robotics post stroke. Stroke Seminar for Health Professions – Student Training in Aging Research (HP-STAR) Program Trainees, University of Maryland School of Medicine/Office of Student Research (supported and sponsored by: The National Institute on Aging), July, 2011.
6. Going Distal: Lower Extremity Robotics for Chronic and Acute Stroke. Workshop on Rehabilitation and Therapeutic Robotics for Upper and Lower Extremity, 33rd Annual International Conference of the IEEE Engineering in Medicine and Biology Society, Boston, MA, August, 2011.
7. Lower Extremity Robotics for Task-Oriented Locomotor Training After Stroke. Mechanical Engineering Department Seminar, Rice University, Houston, TX, January 2013.
8. Anklebot-Assisted Locomotor Training After Stroke: A Novel Deficit-Adjusted Control Approach. Society for Brain Mapping and Therapeutics, Baltimore, MD, May 2013.
9. Anklebot-Assisted Locomotor Training After Stroke: A Novel Deficit-Adjusted Approach, VA VISN5 Leadership Meeting, Baltimore, MD, July 2013.
10. Rehabilitation Robotics: The Past, Present, and Future. Fischell Bioengineering Research Day, University of Maryland, College Park, MD, October, 2013.
11. Robotic and Motor Learning: A Happy Therapeutic Marriage. Operation Stroke: 9th Update,

Youngstown, OH, April 2014.
12. Robotic Ankle Rehabilitation in Stroke, University of Houston, TX, April 2014.
13. Ankle Robotic Gait Therapy in Stroke: Some "Success" Stories. Organized Workshop ("Physiology and Robotics, A Happy Marriage"), IEEE International Conference on Biomedical Robotics and Biomechatronics, São Paulo, Brazil, August 2014.
14. Robotic Gait Therapy - The Pitfalls and Success Stories: Are we finally getting it right? Organized Workshop ("Human Robot Interaction"), IEEE International Conference on Biomedical Robotics and Biomechatronics, São Paulo, Brazil, August 2014.
15. Motor Learning and Robotic Therapy: A Happy Therapeutic Marriage, Maryland Comprehensive Stroke Conference, Baltimore, MD, November 2014.
16. Robotic Gait Therapy: Are we finally getting it right? Lockheed Martin-sponsored Maryland Robotics Center Seminar Series, Maryland Robotics Center, Institute of Systems Research, University of Maryland, College Park, MD, April, 2017.

Other Talks

1. Engineering Advances in Robotic Gait Therapy: Are We Doing It Right? University of Maryland, College Park Leadership Visit, August 2013.
2. Anklebot-Assisted Gait Training, US Senator Aides Visit, June 2014.

Intellectual Property (Patents and Statutory Copyrights)

1. US Copyright (Registration No. TXu 1-909-039) "Software Engine for Deficit-Adjusted, Task-Specific Adaptive Control of Modular Neuro-Robots," 2013.
2. US Patent Pending 14/549,370 "Methods and Apparatus for Providing Deficit-Adjusted Adaptive Assistance During Movement Phases of an Impaired Joint," 2015. *[First Notice of Action Issued]*
3. US Provisional Patent **"**Interactive Video Exercise Tele-rehabilitation," 2015 (UMB Intellectual Property Disclosure, Docket No. RM-2015-136, in-preparation).
4. Patent Cooperative Treaty (PCT) Application Patent Pending PCT/US2016/038370, "Method and Apparatus for Providing Low Cost, Portable Deficit-Adjusted Adaptive Assistance During Movement Phases of an Impaired Ankle," 2016.