

PROMOTION RECOMMENDATION
THE UNIVERSITY OF MICHIGAN
MEDICAL SCHOOL
DEPARTMENT OF PHYSICAL MEDICINE AND REHABILITATION
DEPARTMENT OF BIOMEDICAL ENGINEERING
THE UNIVERSITY OF MICHIGAN-FLINT
COLLEGE OF HEALTH SCIENCES

Chandramouli Krishnan, Ph.D., assistant professor of physical medicine and rehabilitation, Department of Physical Medicine and Rehabilitation, Medical School, assistant professor of biomedical engineering, Department of Biomedical Engineering, Medical School and College of Engineering, University of Michigan-Ann Arbor, and assistant professor of physical therapy, College of Health Sciences, University of Michigan-Flint, is recommended for promotion to associate professor of physical medicine and rehabilitation, with tenure, Department of Physical Medicine and Rehabilitation, Medical School, associate professor of biomedical engineering, without tenure, Department of Biomedical Engineering, Medical School and College of Engineering, University of Michigan-Ann Arbor, and associate professor of physical therapy, without tenure, College of Health Sciences, University of Michigan-Flint.

Academic Degrees:

Ph.D.	2009	University of Iowa
M.A.	2006	University of Iowa
B.S.	1998	Tamil Nadu Dr. M.G.R. Medical University, Chennai, Tamil Nadu, India

Professional Record:

2018-present	Assistant Professor in Physical Therapy, University of Michigan Flint
2013-present	Adjunct Assistant Professor in Kinesiology, University of Michigan
2013-present	Assistant Professor in Biomedical Engineering, University of Michigan
2012-present	Assistant Professor in Physical Medicine and Rehabilitation, University of Michigan
2012-2013	Visiting Scientist, Sensory Motor Performance Program, Rehabilitation Institute of Chicago
2001-2004	Guest Lecturer, Sardar Bhagwan Singh Post Graduate Institute of Biomedical Sciences and Research, Dehradun, Uttar Pradesh, India

Summary of Evaluation:

Teaching: Dr. Krishnan's teaching activities cover a wide array of topics and course levels including undergraduate courses to courses for advanced doctoral work. He has conducted several institutional, national and internal research seminars and didactic lectures and has established recurring Physical Medicine and Rehabilitation courses for undergraduate and graduate students. Dr. Krishnan is very actively involved with the Undergraduate Research Opportunity Program, where he mentors undergraduate students on independent research projects. He also serves on many masters thesis and Ph.D. dissertation committees. He has also mentored students for internal awards, including scholarships and grants from the Rackham Graduate School and for national awards including the graduate research fellowships from the National Science Foundation. He has mentored 38 undergraduate students, 33 graduate students, one medical student, three faculty, one resident and three fellows. Dr. Krishnan has served on 11 dissertation committees.

Research: Dr. Krishnan's overall research goal is to develop effective and efficient rehabilitation methods for individuals with neurological and orthopaedic dysfunctions. He is the director of the Neuromuscular and Rehabilitation Robotics Laboratory in the Department of Physical Medicine and Rehabilitation. He is

a core faculty member of the University of Michigan Robotics Institute and holds joint appointments in the Departments of Biomedical Engineering, Kinesiology, and Physical Therapy in Flint. Dr. Krishnan has focused on developing and testing low-cost robotic technologies and neuromodulatory techniques for rehabilitation. He has four federally funded projects, three through the National Institutes of Health and one through the National Science Foundation. His current NIH R01 grant involves the development has published more than 55 peer-reviewed articles and has been invited to present his research on 16 occasions regionally, nationally and internationally.

Recent and Significant Publications:

Krishnan C: Learning and interlimb transfer of new gait patterns are facilitated by distributed practice across days. *Gait Posture*. Feb 23;70:84-89, 2019.

Washabaugh EP, Treadway E, Gillespie RB, Remy CD, Krishnan C: Self-powered robots to reduce motor slacking during upper-extremity rehabilitation: a proof of concept study. *Restor Neurol Neurosci*. 36(6):693-708, 2018.

Chang CK, Washabaugh EP, Gwozdzowski A, Remy CD, Krishnan C: A Semi-passive Planar Manipulandum for Upper-Extremity Rehabilitation. *Ann Biomed Eng*. Jul;46(7):1047-1065, 2018.

Washabaugh EP, Claflin ES, Gillespie RB, Krishnan C: A Novel Application of Eddy Current Braking for Functional Strength Training During Gait. *Ann Biomed Eng*. Sep;44(9):2760-73, 2016.

Krishnan C, Washabaugh EP, Seetharaman Y: A low cost real-time motion tracking approach using webcam technology. *J Biomech*. Feb 5;48(3):544-548, 2015.

Service: At the institutional level, Dr. Krishnan serves on numerous committees to advance the department and university mission. He is a member of the departmental Research Advisory Committee and Research Operations Committee, also the FFMI innovation chief for the Department of Physical Medicine and Rehabilitation, where he serves as the bridge connecting faculty innovators with FFMI's entrepreneurial resources. He serves on numerous thesis and dissertation committees and also as an examiner in Engineering and Kinesiology students qualifying and comprehensive exam proposals. At the national and international level, he serves on numerous editorial boards and grant reviewing panels. He is a regular reviewer for NIH and also serves as a grant reviewer for several international panels. He is an associate editor for two international journals and a section editor for another. He serves as an ad hoc reviewer for about 40 peer reviewed journals.

External Reviewers:

Reviewer A: "Dr. Krishnan has been successful in obtaining funding to support his research program... The innovation and impact of Dr. Krishnan's research is driven by a deep commitment to fundamental science, as well as clinical applications. Of his papers, the two that most impact my work are 'Factors explaining chronic knee extensor strength deficits after ACL reconstruction,' which appeared in the Journal of Orthopaedic Research in 2011. In that first-authored article he showed why there are quadriceps Page 2 of 2 strength deficits following ACL reconstructive surgery, which greatly impacts functional recovery. The second paper is 'Learning new gait patterns is enhanced by specificity of training rather than progression of task difficulty,' which appeared in the Journal of Biomechanics in 2019. In this first authored paper he showed that tracking error associated with treadmill walking was significantly lower in the group that did the most practice, independent of task difficulty and type. This is important when forming rehabilitation protocols following impairment from neurological injury such as stroke... In summary, based on Dr. Krishnan's excellence in scholarship, teaching, and academic service, I enthusiastically support his promotion to Associate Professor with tenure."

Reviewer B: “Dr. Chandramouli Krishnan is one of the first pioneers who applied concepts related to motor synergies to rehabilitation robotics, that is also one of my primary fields of interest. His work in Rehabilitation Robotics introduced a major technology innovation for gait robot-assisted training and I look forward to see the results of the prosecution of this work...I think that his formal training as [a] physical therapist makes Dr. Chandramouli Krishnan an outstanding researcher with a unique expertise in the multiple aspects of the assistive and rehabilitative research fields... I am quite confident that Dr. Krishnan’s CV would allow him to be considered worth promotion with tenure at my institution.”

Reviewer C: “I consider him to be one of the brightest researchers in Physical Therapy with a solid expertise in engineering technologies and more particularly in Biomechanics. I think that precisely because of this broad multidisciplinary exposure and competence, the impact of Dr. Krishnan in the field of clinical rehabilitation is already significant and will most likely grow further and consolidate...One element of importance in the tenure decisions at major institutions is the success at securing the funding of research. In this respect too Dr. Krishnan has impressive track record, which demonstrate a consistent ability to lead as PI and also to participate in collaborative projects. In summary, based on my experience as well as objective metrics I have no doubt in expressing the strongest support for the promotion of Dr. Chandramouli Krishnan to the tenured position as Associate Professor in the Instructional Track. If I may just add, like in a footnote, while my personal interactions with Chandramouli have been only occasional, I have been able to enjoy is friendly, supportive and collegial character. I think therefore that on all counts I can consider he will be a wonderful professional and human asset to your department.”

Reviewer D: “One of the best metrics of research impact is the request to perform service to the scientific community. Mouli’s service record is extraordinary for an assistant professor. He is currently on the editorial boards for four journals and a standing member of the NIH NCMRR study section on Function, Integration, and Rehabilitation Sciences (FIRS). These are prestigious positions reserved for colleagues considered to be creative in their own work, thoughtful in their assessment of others, and fair in their judgement. Mouli fits all of these categories.”

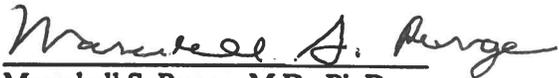
Reviewer E: “His research productivity, at this point in his career, is excellent compared to others in his field...In my opinion, his work with gait retraining following ACL reconstruction is particularly outstanding...Overall the number of presentations he has given to this point in his career is extraordinary, and I believe this demonstrates his ability to disseminate his work to multiple audiences and demonstrates the impact of his work to both the scientific community and clinical audiences... Dr. Krishnan has excelled in scholarship, teaching, and service in his early career and appears to have developed the capability to continue his research success in the future. In my assessment Dr. Krishnan should be viewed as an excellent candidate for promotion and tenure at your institution. I believe he would meet the requirements for tenure and promotion at my institution.”

Reviewer F: “Dr. Krishnan has been well trained and has taken advantage of these opportunities. He also has a very clear vision of how he wants to have a national impact which includes using technology for rehabilitation. His special niche in rehabilitation technology/intervention is the emphasis on low cost technology that has higher likelihood of being translated into use by patients. I think he is special in that he understands the potential complexity of devices and can transform this into simpler yet effective technology. Thus, he has the potential for high impact for our patients...Dr. Krishnan would certainly be promoted to Associate Professor at [my institution] which is based on productivity...There is no question that his professional citizenship and his research innovation, that can have significant impact for patients, would qualify him for tenure at [my institution].”

Summary of Recommendations:

Dr. Krishnan is an exceptional researcher, educator and scholar who examines the alterations in neuromuscular function, plasticity, and movement control after an injury to the neuro-musculoskeletal

system and connects these insights to applications in rehabilitation using robotics, motor learning, and exercise interventions. I am pleased, therefore, to recommend Chandromouli Krishnan, Ph.D. for promotion to associate professor of physical medicine and rehabilitation, with tenure, Department of Physical Medicine and Rehabilitation, Medical School, associate professor of biomedical engineering, without tenure, Department of Biomedical Engineering, Medical School and College of Engineering, University of Michigan-Ann Arbor, and associate professor of physical therapy, without tenure, College of Health Sciences, University of Michigan-Flint. .



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