

November 20, 2021

Department of Biomedical Engineering  
New Jersey Institute of Technology  
Fenster Hall, Room 605  
University Heights  
Newark, New Jersey 07102

Dear Members of the Faculty Search Committee,

I am writing to apply for the Tenure Track Assistant Professor in Biomedical Engineering Position (req3536). I am currently an Oskar Huttunen Postdoctoral Research Fellow at the UT Southwestern Medical Center. I am a neuroengineer and a brain stimulation scientist with clinical and industrial experience.

My current research focuses on identifying the neurophysiological effects and predictors of response for repetitive transcranial magnetic stimulation (rTMS). I have shown that in individuals with severe psychiatric disorders, the rTMS treatment responders and non-responders have different neural inhibitory characteristics at baseline. This finding could be significant in developing predictive biomarkers that allow providing the treatment only to individuals that likely benefit from it. Several postdoctoral fellowships from non-profit organizations, such as Instrumentarium Science Foundation, have funded this work. Within the past year, I have been selected as a Rising Star by Columbia University and Cornell University. Further, my pending NIMH Pathway to Independence Award (K99/R00) proposal, which extends my findings in treatment responders and non-responders, was recently scored as high impact.

This research grew out of my Ph.D. work in which I developed novel transcranial magnetic stimulation (TMS) methods to study cortical neurophysiology and optimized TMS parameters to induce more substantial neurophysiological effects. I showed that we can use TMS to evaluate neural features unobtainable with other methods and that with minor changes in TMS parameters, we can substantially change the induced neurophysiological effects. These findings could provide novel biomarkers and guide the development of more efficient rTMS treatments. This work was funded by several Finnish predoctoral fellowships, such as Finnish Foundation for Technology Promotion, resulted in 9 first-author original research papers, and I graduated with distinction, which is an honor that only the top 5% of all Ph.D. theses at the University of Eastern Finland receive.

In the next stage of my research program, I plan to apply neural engineering approaches that allow personalizing brain stimulation to an individual's neural features to treat both current responders and non-responders and thus, increase the efficacy and applicability of brain stimulation. To do this, I have three Research Thrusts: 1) study how individuals' neural features influence brain stimulation outcome, 2) determine how brain stimulation-induced electric field's features influence outcome, and 3) develop more accurate brain stimulation methodology to evaluate neural features.

As my research focuses on developing brain stimulation methodology and clinical and neuroscientific applications of brain stimulation, it offers several collaborative possibilities within the Department of Biomedical Engineering, especially with research programs focusing on neural engineering, neurorehabilitation, and imaging. For example, including brain stimulation methodology for the study of brain and brain disease, combining brain stimulation with brain imaging, both online and offline, developing novel treatments, and modeling and analyzing brain stimulation-induced effects in the brain

with new approaches. My research would also bring unique expertise and techniques in brain stimulation to the Department.

As an educator and mentor, I am committed to providing an inclusive learning environment for all my students and trainees. Having taught graduate-level courses in neuroimaging and clinical neurophysiology and having completed degrees in engineering and physics, I am well-prepared to teach a wide range of introductory and advanced courses in biomedical engineering. Most closely to my expertise would be courses related to neural engineering, medical devices, medical imaging, electromagnetism, and electrical engineering. In my teaching, I always include team-based learning activities to provide engaging and interactive classes and prepare the students for the workforce. I have extensive mentoring experience and have been an officially appointed research advisor in undergraduate and graduate research theses.

My CV and Research, Teaching, and Diversity Statements are enclosed. In addition, Drs. Carol Tamminga, Petro Julkunen, Angel Peterchev, and Risto Ilmoniemi have agreed to submit letters of recommendation on my behalf.

Thank you for considering my application. I look forward to hearing from you soon.  
Sincerely,

A handwritten signature in cursive script that reads "Elisa Kallioniemi".

Elisa Kallioniemi