**Lampe Joint Department of Biomedical Engineering** | UNC CHAPEL HILL | NC STATE UNIVERSITY

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## R e h a b i l i t a t i o n  E n g i n e e r i n g

# Re-Engineering Treadmill Therapy for Gait Rehabilitation

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Dr. Brian Schmit received his bachelor's degree in engineering from Marquette University and his master's degree in biomedical engineering from Case Western Reserve University. He earned his Ph.D. in Biomedical Engineering at Case Western Reserve University in the laboratory of Dr. J. Thomas Mortimer, where he developed a diaphragm pacing system that is now manufactured and marketed as the NeuRx DPS® by Synapse Biomedical Inc. He completed postdoctoral training in the Department of Physical Medicine and Rehabilitation at Northwestern University, working at the Rehabilitation Institute of Chicago under the mentorship of Dr. W. Zev Rymer. Dr. Schmit later served as Associate Director of the Sensory Motor Performance Program at the Rehabilitation Institute of Chicago before joining Marquette University in 2000. He is currently the Hammes Family Endowed Professor of Biomedical Engineering at Marquette University and the Medical College of Wisconsin, Associate Dean for Research in the Opus College of Engineering, Director of the Integrative Neural Engineering and Rehabilitation Laboratories, and a Fellow of AIMBE. His research focuses on engineering approaches to understanding and improving movement control and rehabilitation following neurologic injury or disease.

## ABSTRACT

Technological innovations in treadmill-based therapy have the potential to substantially improve gait rehabilitation for people with neurologic injury or disease. While treadmills enable repetitive walking practice in a safe and controlled environment, traditional treadmill training has important limitations. In particular, it fails to challenge balance, which is a critical requirement for successful community ambulation, and it removes natural visual flow cues essential for dynamic gait control. In addition, treadmill training typically operates at low effort levels that limit cardiopulmonary benefit. In this talk, I describe our laboratory's efforts to address these limitations through targeted modifications to treadmill therapy, including balance-challenging environments, high-intensity exercise training, and immersive virtual reality. We have investigated treadmill stepping under destabilizing force-field perturbations and walking on a novel treadmill platform capable of motion in six degrees of freedom. These approaches have been evaluated in individuals with multiple sclerosis, stroke, and cervical myelopathy, demonstrating feasibility and promising effects on gait and balance control. Building on this work, we are conducting a clinical trial in people with multiple sclerosis examining high-intensity, balance-perturbing treadmill training, and exploring virtual reality–based approaches to restore visual flow and augment visual feedback. Together, these advances represent a practical, near-term pathway to improving the effectiveness of treadmill-based gait rehabilitation.

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