Docket #: S23-085

RISE: A Wearable Multichannel Neuromuscular Electrical Stimulation (NMES) Device

Stanford scientists have developed a lightweight, wearable multichannel NMES system that provides real-time, AI-driven gait assistance and muscle strengthening — with a particular focus on children with walking disabilities.

Our neuromuscular electrical stimulation (NMES) device delivers low-level electrical current through skin-surface electrodes to promote muscle contraction. NMES is widely used in rehabilitation to strengthen weakened muscles in individuals with neuromuscular conditions such as cerebral palsy, traumatic brain injury, stroke, and spinal cord injury, as well as in sports injury recovery. Approximately 1 in 345 children in the U.S. is diagnosed with cerebral palsy, many of whom require assistance with walking. Gait impairment in these children tends to worsen over time, often leading to loss of independent mobility in adolescence and adulthood.

Despite its benefits, current NMES technology has significant limitations. Most devices target only a single muscle group (e.g., ankle lift during the swing phase of walking), which is insufficient for the more complex gait problems common in pediatric patients. Multichannel systems that can coordinate stimulation across multiple muscle groups exist, but they are typically tethered to clinical equipment, require expert supervision, and are not suitable for home or community use.

To address these challenges, researchers at Stanford have developed RISE, a wireless, modular system of small wearable stimulator units — one per muscle group — that work in concert. Each unit independently senses the wearer's movement and communicates with the others in near real time, allowing the system to automatically detect the phase of the walking cycle and deliver precisely timed stimulation to the appropriate muscles (including the gluteal, quadriceps, calf, and shin muscles). An on-board machine learning algorithm adapts to each user's

individual gait pattern, enabling personalized, automated therapy in both clinical and home environments.

Stage of Development
Prototype

Applications

- Improve walking patterns in individuals with neuromuscular and orthopedic conditions, with particular emphasis on the pediatric population
- Rehabilitation for sports injuries
- Muscle strengthening and pain management in clinical and home care settings
- Exercise training and surgical preparation

Advantages

- Lightweight, wearable, battery-operated, and fully wireless
- Coordinates stimulation across up multiple muscle groups simultaneously for more complete gait support
- Real-time communication between units via Bluetooth
- Tablet-controlled, user-friendly system suitable for home and community use without specialist supervision
- AI-enabled system that automatically detects gait events and adapts to individual gait patterns
- Improved safety with low-voltage (~33V) stimulation
- Adjustable stimulation levels for user comfort

Patents

- Published Application: WO2025054600

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