



## Non-Invasive, Innovative FES Treatments for Stroke

Stroke commonly results in loss of hand function. Contralaterally-Controlled Functional Electrical Stimulation (CCFES) is a rehabilitation technique developed by FES Center investigators to improve recovery of hand function after stroke. With CCFES, stroke patients control stimulation to their paretic finger and thumb extensors with an instrumented glove worn on the unaffected, contralateral hand and practice using it in therapy sessions to incorporate principles that are important for driving neuroplasticity and motor relearning. To address proximal arm paresis in severely impaired stroke patients, FES Center investigators are combining FES with robotics to reduce effort-related hypertonia and thus provide full upper limb function. For lower limb function after stroke, FES Center investigators are implementing multi-channel implantable stimulators targeting hip, knee, and ankle impairments to augment retained gait capabilities.

Virtual reality environments and interactive video games are being used more and more in neurorehabilitation. FES Center investigators have developed a unique set of hand therapy video games specifically for integration with CCFES to create the first integrated FES videogame therapy in which the two approaches are working synergistically and simultaneously on the patient. FES Center investigators also create and use virtual reality environments to train SCI participants to modulate

cortical activity in BCI control of FES systems.

Non-invasive brain stimulation with repetitive transcranial magnetic stimulation (rTMS) has been increasingly used for investigating the neuroanatomy and effects of therapeutic interventions as well as a therapeutic modality itself. Transcranial direct current stimulation (tDCS) is another non-invasive method to activate cortical networks and facilitate beneficial neuroplastic changes. FES Center investigators use these methods along with fMRI, diffusion tensor imaging (DTI), cortical thickness analyses, EEG-based assessments, and functional near-infrared spectroscopy to enhance gait training in stroke patients and to individualize and optimize brain stimulation treatment for stroke patients. rTMS is also being used by investigators to enhance recovery of sensory function, an important issue in stroke rehabilitation.

FES Center investigators are active participants in the national StrokeNet program sponsored by the NIH National Institute of Neurological Disorders and Stroke (NINDS). Case Western Reserve University became a StrokeNet site in 2013. Currently, we are conducting a StrokeNet study investigating the efficacy of telerehabilitation. FES Center participation in StrokeNet provides greater opportunities for nation-wide collaboration, as well as for development of multi-site studies to disseminate FES Center expertise.

*For more information about FES research and programs*  
[info@FEScenter.org](mailto:info@FEScenter.org) | [www.FEScenter.org](http://www.FEScenter.org) | (216) 231-3257

### About the Cleveland FES Center

The Cleveland FES Center is a consortium of the Louis Stokes Cleveland VA Medical Center, MetroHealth Medical Center, Case Western Reserve University, University Hospitals, and the Cleveland Clinic Neurological Institute. With their support, researchers, engineers and clinicians collaborate together to develop innovative solutions that improve the quality of life of individuals with neurological or other muscular skeletal impairments. Through the use of neurostimulation and neuromodulation research and applications, the Cleveland FES Center leads the translation of this technology into clinical deployment.

