Abstract:
Currently, activity-based therapies are the only medical practices that are commonly used to address impairments of motor control and balance caused by a spinal cord injury (SCI). Despite progress in the field of assistive technologies for people with SCI, current devices to control wheelchairs and computers require as little effort as possible from the user and fail to maintain or strengthen the neural and muscular resources that survived the injury. In this talk, I will first introduce the development of body-machine interfaces that serve as assistive and rehabilitative devices that promote the use of—and re-strengthen—motor and sensory functions that survived the injury. I will then discuss targeted neurotechnologies for delivering spatiotemporal epidural electrical stimulation (EES) to the spinal cord and allow people with chronic SCI to regain voluntary control of paralyzed muscles and weight-bearing locomotion. By expanding the functional range targeted by activity-based training, EES-enabled rehabilitation promotes neural plasticity that translates into meaningful functional improvements, even without stimulation. Finally, I will discuss advancements towards a new generation of personalization of neuroprosthetics and brain-controlled EES in non-human primates. Linking brain-decoded commands to the delivery of EES allows individuals to voluntarily control the timing and amplitude of stimulation pulses which could improve gait performance, training intensity, and neurological recovery in people with SCI.

Bio:
Dr. Seáñez earned a B.S. in Mechanical Engineering (2010) with College Honors in Engineering from the University of Texas at San Antonio. He earned an M.S. (2013) and Ph.D. (2016) in Biomedical Engineering from Northwestern University with a specialization in rehabilitation at the Rehabilitation Institute of Chicago (now Shirley Ryan Ability lab). His doctoral work, advised by Prof. Ferdinando Mussa-Ivaldi, focused on the development of body-machine interfaces for the control of assistive devices, rehabilitation, and brain plasticity in individuals with high-level spinal cord injury. Dr. Seáñez is now a Postdoctoral Fellow working with Prof. Grégoire Courtine at the Swiss Federal Institute of Technology (EPFL) on implantable neuroprosthetics. He formed part of a First-in-Man clinical trial using epidural electrical stimulation to restore sensation and movement of otherwise paralyzed muscles during standing and walking in people with chronic SCI. He currently leads a 4 member team of graduate students and staff in a collaborative project between EPFL, the Wyss Center, and the University of Fribourg developing brain-spine interfaces where real-time brain recordings are used to predict leg movements and trigger stimulation protocols reinforcing these movements in healthy adult macaque monkeys.