

# NEURAL PROSTHESIS WEBINAR



## Developing an Interface with Dorsal Root Ganglia for Closed-Loop Bladder Control



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Biomedical Engineering

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Reception immediately following  
Biomedical Research Building, Room 105  
Case Western Reserve University

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Dr. Bruns' lab develops interfaces with the peripheral nervous system to restore function and examine systems-level neurophysiology. This talk will review their progress in developing a closed-loop bladder neuroprosthesis, centered around using neural recordings from dorsal root ganglia (DRG) to estimate and act on the bladder pressure. They have identified and tracked bladder sensory neurons in anesthetized and long-term feline studies with microelectrode arrays in sacral-level DRG, and determined that a Kalman filter algorithm provides good accuracy for tracking pressure trends. Applying this algorithm, they have performed real-time closed-loop bladder control in anesthetized felines. Upon the detection of a bladder contraction, a Medtronic Summit research development kit initiates inhibitory sacral-root stimulation with an RC+S neurostimulator. These closed-loop trials yielded a similar bladder capacity increase as traditional continuous stimulation but with significantly less applied stimulation. While this approach shows promise for non-continuous neuromodulation to provide as-needed stimulation therapy, further development is required. Recording neural interfaces are essential that are minimally invasive and maintain high signal-to-noise ratios for the duration of an implant, as current technologies lose efficacy over time. To help design new devices, they are studying the underlying neural anatomy. They have quantified the distribution of neurons in feline and human DRG, showing that both have a greater density of cell bodies in superficial locations. They designed flexible microelectrodes that took advantage of this anatomical feature to identify bladder and other sensory signals from the surface of DRG. They have also used microelectrodes with reduced cross-sectional areas to record with high resolution within DRG. Each neural interface holds promise for long-term bladder monitoring that facilitates improved care. Looking forward, long-term studies using these new interfaces and the integration of control over on-demand voiding may provide a path towards fully-functional closed-loop neuroprostheses.

