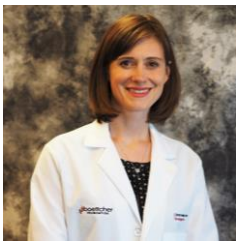
2016 Webb-Waring Biomedical Research Awards
Investigator Research Profile

Cristin Welle, Ph.D.



University of Colorado Anschutz Medical Campus

Dr. Welle is currently an assistant professor in the department of neurosurgery & bioengineering at the University of Colorado School of Medicine Anschutz Medical Campus. She previously completed postdoctoral training at the U.S. Food and Drug Administration, and earned her Ph.D. in neuroscience at the University of Pennsylvania.

Select Honors

Dr. Welle has received numerous awards from the U.S. Food and Drug Administration Center for Devices and Radiological Health (CDRH), including the 2011 CDRH Reward and Recognition Award, the 2012 CDRH Diversity Award and Recognition Award, the 2012 CDRH Leveraging/Collaboration Award and the 2015 CDRH Director's Special Citation Award.

Medical Focus

Medical devices that interface with the nervous system play a crucial and growing role in treating neurological and neuropsychiatric disorders. Cochlear implants, deep-brain stimulators, retinal prostheses and brain-computer interface devices have transformed lives of patients, restoring sight and hearing, eliminating tremors, preventing seizures, treating Parkinson's and obsessive compulsive disorder and providing movement capabilities for paralyzed patients. Despite incredible advances in neural interface technology, existing technology remains relatively simplistic and the small number of electrode channels currently limits therapeutic potential. Improvements in medical device technology are needed to enable more effective therapeutic effects for a greater number of neurological disorders. Cutting-edge developments in technology include closed-loop devices, which can read out a patient's physiological state and deliver treatment at the precise time and to a targeted location, and higher-density electrode arrays, which will be needed to convey physiologically relevant information to the brain, such as more realistic visual representations in blind patients. Clinical trials of these systems have identified problems with reliable sensing of neural signals using high-density electrode arrays. Understanding factors that limit performance of these systems can be instructive for improving not only brain-computer interface devices, but also a vast array of next generation technology that relies on the same principles.

Research Proposal

Dr. Welle's goal is to use advanced electrophysiological and imaging techniques in animal models to identify parameters of high-density recording arrays that will allow for optimal performance over the lifetime of use in patients. One aim of her work will be to assess the origins of electrode failure and its effects on neural recording performance by separating the effects of material corrosion and damage from encapsulation by reactive glial nerve cells (glial scarring). Results from this work will inform future efforts at developing durable materials for neurological medical devices. Dr. Welle will also investigate the effects of electrode density on the health of neural tissues and circuit dynamics. High-density neural interfaces bring the potential for extremely high-resolution read-in and read-out capabilities for therapeutic interventions in the nervous system. However, overloading a volume of neural tissue with a dense array of foreign objects may trigger excessive neuroinflammation and damage the structure of neuronal processes, creating dysfunction in the local neural circuit. To achieve this aim, Dr. Welle will implant arrays, identical except for the spacing of electrodes, in transgenic animals and monitor the dynamics of projecting apical dendrites using in vivo two-photon imaging, and correlate them with

electrophysiological properties of the neural recordings. A second animal model will use in vivo functional calcium imaging to evaluate the effects of electrode density on circuit dynamics.