CARL-SJR: A Socially Assistive Robot with Rich Tactile Sensory Interaction

Liam D. Bucci[1], *Ting-Shuo Chou*[2], *and Jeffrey L. Krichmar*[1,2]
[1]Department of Cognitive Sciences and [2]Department of Computer Science,
University of California, Irvine, CA 92697 USA

Research studies show that children with Autism Spectrum Disorders (ASD) or Attention Deficit Hyperactivity Disorders (ADHD) respond well to robot artifacts and suggest that robots nicely fitting into the goals of Sensory Integration Theory (SIT) might be a form of therapy for children with ASD or ADHD. SIT is intended to focus directly on the neurological processing of sensory information as a foundation for learning of higher-level (motor or academic) skills. Treatment goals center on improving sensory processing to either (a) develop better sensory modulation as related to attention and behavioral control, or (b) integrate sensory information to form better perceptual schemas and practical abilities as a precursor for academic skills, social interactions, or more independent functioning. To aim these goals, we present a novel neuromorphic robot that interacts with users through touch sensing and visual signaling on its whole surface. Our robot, which is called the Cognitive Anteater Robotics Laboratory – Spiking Judgment Robot (CARL-SJR), has a convex, hemispheric shell containing a matrix of trackballs for sensing touch and LEDs for communication with users. Currently CARL-SJR is in the prototype stage. It rides on Roomba for mobility and only incorporates a spiking neural network (SNN) modeling somatosensory cortex. We explore tactile sensory decoding through rate coding and temporal coding. We also compare the performance of the two coding schemes for classifying different tactile inputs from hand movements. Our evaluation of the network's ability to categorize hand movements shows both rate and temporal coding performed well. The results could guide us to build a sophisticated spiking neural network to achieve treatment goals through learning, adapting, and shaping users' behaviors.