NeuRobotics: A Spiking Neural Network Model of the Oculomotor System for Controlling a Biomimetic Robotic Head

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Presentation Abstract Summary Robotic vision introduces requirements for real-time processing of fast-varying, noisy information in a continuously changing environment. In a real-world environment, convenient assumptions, such as static camera systems and deep learning algorithms devouring high volumes of ideally slightly-varying data, are hard to survive. Leveraging on recent neural studies that show smooth pursuit - that is the slow movement of the eyes - and saccade - their rapid movement - being handled by the same neuronal circuitry, we designed a neuromorphic oculomotor controller and placed it at the heart of a biomimetic robotic head prototype that we developed. The controller is unique in the sense that 1) information was encoded and processed via models of biological neurons sending and receiving spikes, and 2) it mimics brain connectivity and therefore requires no training to operate. Here, we report the tracking performance of the robotic head and show that the robotic eye kinematics are strikingly similar to those reported in human eye studies. This work contributes to the overarching goal of ComBra Lab, which is to develop neurobiologically plausible "bottom-up" computational models of brain networks, and employ the emerged intelligence to efficiently control robots.

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