P075 A virtual reality exploration tool for multi-scale data from brain-scale simulations

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Simulated activity of neuronal networks is, to a large extent, limited to a single description level, comprising exclusively either microscopic or macroscopic structure. In this case, data analysis is still feasible by standard methods using static displays and visualization is limited to the appealing illustration of results. Brain-scale simulations simultaneously represent the local microcircuit and the long-range connectivity of cortical areas [1]. Their multi-scale structure and activity requires novel approaches to an exploration tool. Primarily, the complexity of the data requires both, optimized visualization and dynamic interaction of the researcher and the data, to cope with the combination of microscopic and macroscopic structure and activity.

We develop a new interface for neuroscientists -ranging from theoreticians to experimentalists and medical scientists- to explore and interact with brain-scale simulations. The initial phase describes the development of a virtual reality (VR) environment capable of interacting with simulated activity data of networks that comprise local and long-range connectivity: Based on the initial deployment of the VR system including basic functionality to visualize spiking and subthreshold activity of single neurons in multiple cortical areas, we design a framework to allow for the interaction with meta-data and analysis tools.

We extend a previous prototype [2], showing exclusively the spiking activity of a single local cortical microcircuit model [3], to include additionally color-coded continuous variables such as the membrane potential and an online estimation of the instantaneous firing rate. Furthermore, we add functionality to simultaneously show the activity in two cortical areas. This extension will be essential to investigate the interdependencies of cortical areas in brain-scale simulations.

Rendering this visualization framework into a 3D exploration tool for data analysis requires dynamic interaction of the user and the data: Inspired by experimental procedures, the system allows to virtually introduce an electrode into the layered cortical network model to select single cells or populations of neurons for further analysis. A user uses a tracked presenter device whose position and orientation will be mapped into the virtual 3D world. This interaction will allow to intuitively access statistics or derived measures of the neuronal activity. As an initial step, we focus on the visualization of time dependent scalar variables, such as the local field potential created in a given layer or the time-dependent instantaneous population firing rate. This metaphor is extensible to simultaneously include multiple information, e.g. from different neuronal populations.

In conclusion, our exploration tool complements the development of brain-scale simulations with new means to build up intuition and to boost the development of new analysis methods.

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References

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