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Feedback control of the spatiotemporal firing pattern of a basal ganglia microcircuit model

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One of the fundamental objectives in systems neuroscience is to precisely control the spatiotemporal firing patterns of cortical neurons to elicit a desired pattern of activity. In this work, we study the effects of intracortical micro-stimulation on the dynamics of a basal ganglia microcircuit model, and explore the feasibility of controlling the spatiotemporal firing patterns of the modeled population in the presence of unobserved inputs. Results from the simulation study suggest that properly designed Multiple-Input-Multiple-Output (MIMO) feedback control paradigm can force a subpopulation of observed output neurons to follow a prescribed spatiotemporal firing pattern despite the presence of unobserved inputs. The accuracy of the spike timing of the controlled neural firing with respect to the reference spike trains is in the order of tens of milliseconds.

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