Exploring the visual system with functional digital twins and inception loops

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Deep nonlinear system identification models have set new standards in modeling the responses of large-scale populations of neurons to natural stimuli, yielding models that can accurately predict the response of thousands of neurons to arbitrary stimuli and can account for how behavior modulates responses of visual neuron. This allows us to treat the model as a functional digital twin of the neural population and probe neurons in ways that would not be feasible experimentally. With that, we can derive new hypotheses about the neural populations in silico and consequently verify them in vivo, in a paradigm we call inception loops. In the talk, I will give an overview over the models and how they can be used to gain new insights about visual cortex in mouse and monkey. We believe that the combination of large-scale recordings under natural stimulation and deep data-driven modeling is a paradigm shift in systems neuroscience towards understanding computations in sensory system on complex ecological stimuli.