Field:

Medical/Neuroscience

Session Topic:

Modeling Brain Circuits, Brain/Machine Interface – Learning

Speaker:

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Title: New neural population codes with unprecedented representational accuracy

The brain represents and transforms external variables to perform computations. Representation is inherently noisy when performed by neurons. In recursive computations, such noise accrues and can lead to catastrophic error. One way to extract a less noisy estimate of the encoded variable is by averaging over large neural populations. Classical population codes, as widely seen in sensory and motor areas, lead to only modest (polynomial, or ~N) improvements in inverse squared error with increasing neuron number (N).

Is there a better way?

I will show that the grid cell code for animal location in the entorhinal cortex is in a qualitatively different performance class than classical population codes. It allows unprecedented accuracy, enabling nearly exact removal of noise from noisy neural representations, with inverse squared error that improves exponentially (~e^{aN} for some a>0) with population size. The noise removal is enabled by the peculiar structure of the grid code. I will show that a simple, biologically plausible neural network, resembling the hippocampus, can decode the grid represenation to take advantage of its error-control properties. This is the first demonstration that the brain contains, and may exploit, exponentially strong error-correcting codes for analog variables.