

Dynamics of plastic networks of excitatory and inhibitory spiking neurons

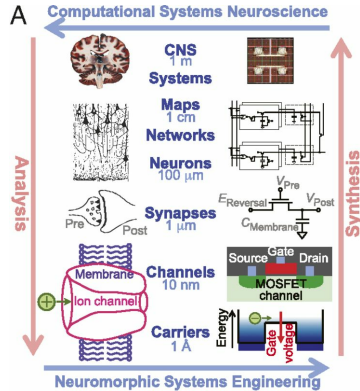
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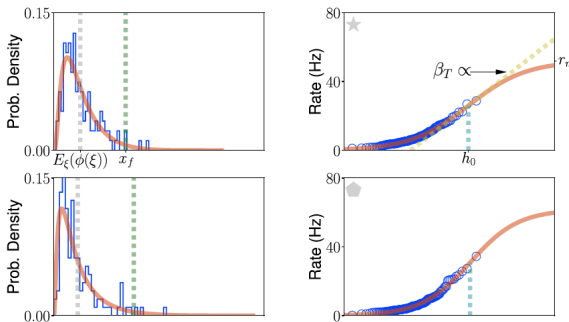
A loopy picture of computational neuroscience

Biological neural networks

- Store and recall enormous amounts of information
- Function at very low power
- Rely only on basic neural primitives



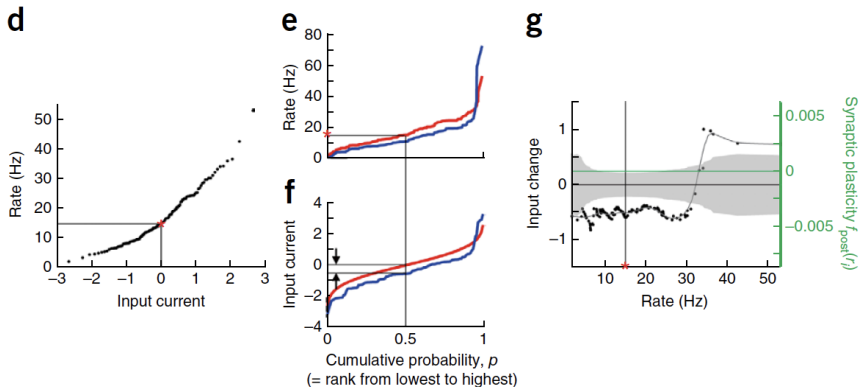
Inferring the transfer function from ITC data



Measuring the *static* transfer function from novel images assuming that input currents are Gaussian variables

$$\phi(\xi) = \frac{r_{max}}{1 + \exp \beta(\xi - \xi_0)}$$

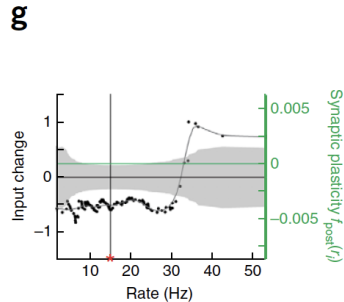
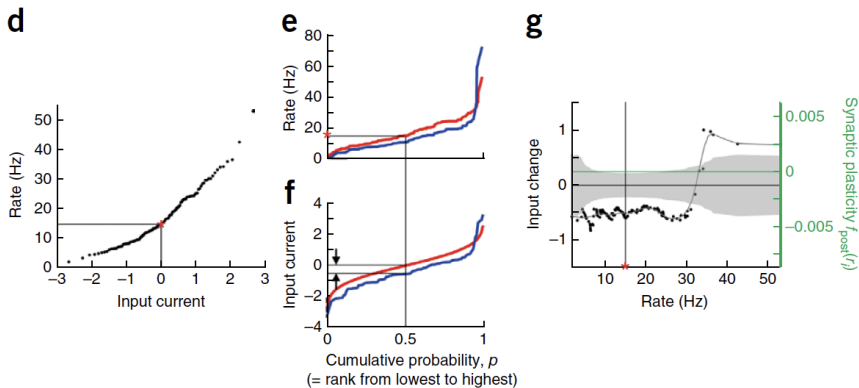
Inferring the learning rule from ITC data



Inferring the change in input current ξ_{in} from the change in firing rate in **novel** relative to **familiar** stimuli

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Inferring the learning rule from ITC data



The change in input current to a neuron can then be read from the firing rate of that neuron when presented a novel stimulus

$$\Delta \xi_i(r) \propto (2q + 1 - \tanh(\beta(r - x)))$$

A Hebbian update for synaptic weights

Assuming that $\Delta W_{ij} \propto f(r_i)g(r_j)$, the change in input current is related to synaptic plasticity by

$$\Delta \xi_i \propto f(r_i) \sum_j g(r_j) r_j$$

which we have fit from the data as

$$\Delta \xi_i(r) \propto (2q + 1 - \tanh(\beta(r - x)))$$

so we can write

$$f(r_i) = \frac{(2q + 1 - \tanh(\beta(r - x)))}{\sum_j g(r_j) r_j}$$

Presenting novel and familiar stimuli to the network

