Active learning of neural response functions with Gaussian processes

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Question: how to efficiently learn neural response nonlinearities?
Adaptive stimulus selection

- “closed-loop” experiment
- select $x$ for which $f(x)$ has highest uncertainty

Mathematical expression:

$$p(f|r, X, \theta) \propto p(r|f, X)p(f|\theta)$$

- Poisson likelihood
- GP prior

Diagram:

- Select stimulus
- Experiment
- Update posterior
- Update hyper-parameters
- $\sigma^2(f)$ has highest variance
- Stimulus
- Neuron
- Spike count
- $\hat{\theta} = \theta_{ml}$
Experimental Methods

- color-tuned neurons in macaque V1
- spectrally-modulated Gabor stimuli (3D cone-contrast space)
Results

• example V1 complex cell

1D nonlinearity:

2D nonlinearity:

For more details, visit poster T020!