Estimating Subunit Receptive Field Models of Thalamic Neurons with Deep Learning.

Submission ID 3000151

Submission Type Poster

Topic Neuroscience

Status Submitted

Submitter Amol Gharat

Affiliation McGill University Faculty of Medicine

SUBMISSION DETAILS

Presentation Type Either Poster or Oral Presentation

Presentation Abstract Summary Spatial nonlinearities emerging at the level of the retina are thought to be important for processing texture boundaries in the visual cortex. However, previous studies have modeled receptive fields of subcortical neurons as linear filters with a static output nonlinearity. Although such "LN" models are relatively easy to estimate with reverse-correlation they cannot capture spatial nonlinearities within receptive fields. Here we model retinorecipient receptive fields of cat lateral geniculate nucleus (LGN) neurons as a two-layer convolutional neural network model with an intermediate parametric nonlinearity (pReLU). We train such a neural network model for each neuron, using its spiking responses to naturalistic texture stimuli. The convolutional filter is initialized with random weights, and no constraints are imposed on its shape. The learned models converge on to filters with clear Gaussian or DoG (Difference of Gaussians) like shapes, and often exhibit a high predictive performance on test datasets. The trained models of Y-type LGN neurons have a higher degree of nonlinearity compared to those for X-type neurons. In conclusion, a nonlinear two-layer convolutional model that is based on retinal neurobiology is better at predicting responses of Y-type neurons to novel test stimuli compared to an LN model.

Co-author Information

* Presenting Author

First Name	Last Name	Affiliation	E-mail
Amol *	Gharat *	McGill University Faculty of Medicine	amol.gharat@mail.mcgill.ca
Philippe	Nguyen	McGill University	philippe.nguyen2@mail.mcgill.ca
Curtis	Baker	McGill University	curtis.baker@mcgill.ca

Keywords

Keywords
vision
Texture
subunit model
receptive field
convolutional neural network
LGN
Spatial nonlinearity
Retina