

KEJI LI

SYSTEM NEUROSCIENTIST

 (615)818-7103  keji-li-64080620  mail@keji.li  Palpatineli  Malden MA  ORCID: 0000-0002-0737-2558

Summary Neuroscience/Quantitative Methods PhD. Expertise in the encoding of sensory and motor cortical activities, motor learning, visual thalamus, and autism disease models. Extensive experience in 1) the application of simple and complex statistical/neural network models both in signal analysis/data analysis and in modeling brain activity; and 2) acquiring and analyzing multimodal neuronal recording combined with animal behavioral and physiological recording. Strong ability both to work in teams and to lead small multi-disciplinary teams. Work authorization in the States not needed.

STATISTICS

■ multivariate graphical models ■ variational autoencoders ■ hidden markov models ■ convolutional and residual networks
■ recurrent network regressors ■ manual feature and CNN based object detection/motion tracking ■ basic numerical (PDE) modeling

HARDWARE DEVELOPMENT

■ digital circuit design ■ 3D modeling with AutoCAD/FreeCAD/Blender for 3D printing/laser cutting/assembly/rendering
■ programming for: ◦ NIDAQ ◦ STM32 ◦ Arduino ◦ Beaglebone / Raspberry Pi ◦ AM335x-PRU

PROGRAMMING LANGUAGES AND MAJOR LIBRARIES

■ C/C++: Boost/Qt4/Qt5/OpenGL ES 2.0 ■ Rust: Rusqlite/Diesel
■ Python: Sklearn/OpenCV/XGBoost/Tensorflow/Pytorch/Psychopy/SQLAlchemy/Blender plugin ■ Matlab: PsychToolbox ■ R, SQL, Haskell

NEUROSCIENCE RESEARCH

■ extracellular electrophysiology with single electrode, linear and Utah array ■ light, confocal and electron microscopy
■ 3D reconstruction of brain areas and neural projections ■ optical imaging of BOLD or Ca²⁺ signal
■ two-photon and three-photon Ca²⁺ and Cl⁻ imaging of awake animals

Rettsyndrome.org foundation grant #3213: mentored training fellowship **Role:** Principle investigator

Synaptic mechanisms and novel therapeutic strategies for Rett Syndrome

National institute of health R01 grant EY01778-36 **Role:** Graduate student

Visual system organization and development

Victor and William Fung foundation Fung scholar fellowship

Ministry of education, China People's scholarship, second class

Massachusetts Institute of Technology Cambridge, MA Post-doctoral fellow

■ Collaborated in a project to identify the role of astrocytes in neuron coding and motor learning.

Performed analysis for neuronal encoding of forearm motion.

○ Built a lever push behavioral task rig and integrated it with 2p microscopy.

○ Decoded motion trajectory from neuronal activity with support vector regression, GRU-RNN and particle filtering; evaluated with a continuous estimate of mutual information based on k-nearest neighbors.

○ Built a GLM encoding model of behavior features in neuronal activity; found that astrocyte-manipulation wiped out neuron encoding of task delay.

■ Led a project in neuron ensemble formation in M1 during motor learning and transfer learning, by chronically tracking same neurons with 2p Ca²⁺ imaging. Developed a motorized lever push rig to apply force field or change movement gain.

■ Led an investigation in the effect of inhibition reduction in Rett Syndrome on both neuron coding and behavioral phenotypes, as well as their rescue. Adapted and validated a chloride imaging method to use with *in vivo* 2p imaging.

■ Led a team to collaborate in a larger translational project that created drug screening platform and screened drugs targeting a chloride transporter (KCC2) to treat Rett Syndrome. Directed research assistants and students to perform pre-clinical physiological and behavioral tests. Performed statistical analysis on the whole project, using mixed linear models and two-way aligned rank ANOVA.

■ Created and optimized automatic system for two-photon imaging data processing pipeline, including aligning, ROI extraction, and Ca²⁺ trace deconvolution.

MIT class: IAP 2017 Introduction to neuron population recording methods Lecturer

Gave introductory lectures on neuron recording methods including electrode, optical imaging, and two photon imaging methods.

Vanderbilt University class: BSCI 258 Vertebrate Physiology Guest lecturer (invited by Dr. Clint Carter)

Gave lectures on central nervous system, wrote and graded related test questions.

Vanderbilt University Nashville, TN PhD in Psychology, neuroscience focus/quantitative methods subfocus

■ Worked in a team to investigate the modulatory effect of high order thalamic nucleus (pulvinar) on primary visual cortex using large scale electrode array. I designed and implemented a comprehensive set of control experiments to support the unexpected finding of strong modulation.

■ Led project on how pulvinar/V2 inputs to MT confer motion response differentially.

■ Led project to chart retinotopic map in primate lateral pulvinar with single electrode and 3D reconstruction. Managed two undergraduates on the project.

■ Collaborated with other laboratories in a project to identify the distribution pattern and targets of pulvinar neural projections to the cortex (V1 & MT); performed tracer injection, fluorescent confocal and electron microscopy.

Fudan University Shanghai BS in Life Sciences

■ Built continuous intrinsic signal optical imaging system; adapted the algorithm to allow online analysis.

SKILLS

HONORS AND AWARDS

PROFESSIONAL EXPERIENCE

EDUCATION

- Gopathy Purushothaman, Roan T. Marion, [Keji Li](#), Vivien A. Casagrande (2012). Gating and control of primary visual cortex by pulvinar. *Nature Neuroscience*, **15**(6), 905-912
 - Roan T. Marion, [Keji Li](#), Gopathy Purushothaman, Yaoguang Jiang, Vivien A. Casagrande (2012) Morphological and neurochemical comparisons between pulvinar and V1 projections to V2. *Journal of Comparative Neurology*, **521**, 813-832
 - [Keji Li](#), Jay Patel, Gopathy Purushothaman, Roan T. Marion, Vivien A. Casagrande (2013). Retinotopic maps in the pulvinar of bush baby (*Otolemur garnettii*). *Journal of Comparative Neurology*, **521**, 3432-3450
 - Abhishek Banerjee, Rajeev V. Rikhye, Vincent Breton-Provencher, Xin Tang, Chenchen Li, [Keji Li](#), Caroline A. Runyan, Zhanyan Fu, Rudolf Jaenisch, and Mriganka Sur (2016). Jointly reduced inhibition and excitation underlies circuit-wide changes in cortical processing in Rett syndrome. *PNAS*, **113**(46), E7287-E7296
 - Jacque Pak Kan Ip, Ikue Nagakura, Jeremy Petravicz, [Keji Li](#), Erik Wiemer, and Mriganka Sur (2018). Major vault protein, a candidate gene in 16p11.2 microdeletion syndrome, is required for the homeostatic regulation of visual cortical plasticity. *Journal of Neuroscience*, **38** (16) 3890-3900
 - Abhishek Banerjee, Meghan T. Miller, [Keji Li](#), Mriganka Sur, Walter E. Kaufmann. Towards a better diagnosis and treatment of Rett syndrome: a model synaptic disorder (2019) *Brain*, **142**(2), 239–248
 - Brandon Moore, [Keji Li](#), Jon H Kaas, Chia-Chi Liao, Andrew M Boal, Julia Mavity-Hudson, Vivien Casagrande. Cortical projections to the two retinotopic maps of primate pulvinar are distinct. (2019) *Journal of Comparative Neurology*, **527**(3), 577-588
 - Xin Tang, Jesse Drotar, [Keji Li](#), Cullen D. Clairmont, A. Sophie Brumm, Austin J. Sullins, Hao Wu, X. Shawn Liu, Jinhua Wang, Nathanael S. Gray, Mriganka Sur, Rudolf Jaenisch. Identification of KCC2 Expression Enhancing Compounds as a Basis for Treatment of Rett Syndrome (2019) *Science Translational Medicine*, **11**(503), eaau0164
- TALKS AND PRESENTATIONS**
- Gopathy Purushothaman, Roan T. Marion, Sam Walston, [Keji Li](#), Dmitry Yampolsky, Yaoguang Jiang, Vivien A. Casagrande (2010). Functional role of pulvinar input to primary visual cortex in the primate. Program No. 126.5, 2010 Neuroscience Meeting Planner. San Diego, CA: Society for Neuroscience, 2010. Online
 - Gopathy Purushothaman, Roan T. Marion, Sam Walston, [Keji Li](#), Dmitry Yampolsky, Yaoguang Jiang, Vivien A. Casagrande (2011) Visual information processing in the absence of pulvinar input. *Journal of Vision* **11**: 171.
 - Roan T. Marion, [Keji Li](#), Gopathy Purushothaman, Dmitry Yampolsky, Yaoguang Jiang, Julia A. Mavity-Hudson, Vivien A. Casagrande (2011) A quantitative comparison between geniculate axons in V1 and pulvinar axons in V2. Program No. 428.11. 2011 Neuroscience Meeting Planner. Washington, DC: Society for Neuroscience, 2011. Online.
 - Gopathy Purushothaman, [Keji Li](#), Roan T. Marion, Dmitry Yampolsky, Yaoguang Jiang, Vivien A. Casagrande (2011) Lateral Pulvinar and the salience of stimulus representation in primary visual cortex. Program No. 482.02. 2011 Neuroscience Meeting Planner. Washington, DC: Society for Neuroscience, 2011. Online.
 - [Keji Li](#), Jay Patel, Gopathy Purushothaman, Roan T. Marion, Dmitry Yampolsky, Yaoguang Jiang, Julia A. Mavity-Hudson, Vivien A. Casagrande (2011) Retinotopic organization of pulvinar in a prosimian primate. Program No. 269.20. 2011 Neuroscience Meeting Planner. Washington, DC: Society for Neuroscience, 2011. Online.
 - Gopathy Purushothaman, Roan T. Marion, [Keji Li](#), Vivien A. Casagrande (2012) Gating of the Primary Visual Cortex by Pulvinar for Controlling Bottom-Up Salience. *Journal of Vision*, **12**: 1370.
 - Jay Patel, M. Koo, [Keji Li](#), Julia A. Mavity-Hudson, Roan T. Marion, Gopathy Purushothaman, Dmitry Yampolsky, Yaoguang Jiang, Vivien A. Casagrande (2012) The distribution of synapsin I & II in the visual thalamus of bush babies. Program No. 880.26, 2012 Neuroscience Meeting Planner. New Orleans, LA: Society for Neuroscience, 2012. Online.
 - [Keji Li](#), Jay Patel, Gopathy Purushothaman, Roan T. Marion, Vivien A. Casagrande (2013) The Retinotopy of a Prosimian (Bush Baby) Pulvinar. *Journal of Vision* **53**: 455.
 - [Keji Li](#), Gopathy Purushothaman, Roan T. Marion, Yaoguang Jiang, Dmitry Yampolsky, Julia A. Mavity-Hudson, Vivien A. Casagrande (2013) Pulvinar affects the middle temporal area (MT) activity in primate. Program No. 360.23. 2013 Neuroscience Meeting Planner. San Diego, CA: Society for Neuroscience, 2013. Online.
 - [Keji Li](#), Gopathy Purushothaman, Julia A. Mavity-Hudson, Yaoguang Jiang, Dmitry Yampolsky and Vivien A. Casagrande (2014) Mechanisms of pulvinar control of the primary visual cortex (V1). Program No. 434.13. 2014 Neuroscience Meeting Planner. Washington, DC: Society for Neuroscience, 2014. Online.
 - Roan T. Marion, [Keji Li](#), Julia A. Mavity-Hudson and Vivien A. Casagrande (2014) Morphological comparison of inputs to primate visual areas MT, V1 and V2. Program No. 434.12. 2014 Neuroscience Meeting Planner. Washington, DC: Society for Neuroscience, 2014. Online.
 - [Li Keji](#), Rajeev V. Rikhye, Abhishek Banerjee, Mriganka Sur (2016). Depolarizing GABA receptor causes cortical network deficits in Rett Syndrome. Program No. 764.06. 2016 Neuroscience Meeting Planner. San Diego, CA: Society for Neuroscience, 2016. Online.
 - [Li Keji](#), Rajeev V. Rikhye, Chenchen Li, Zhanyan Fu and Mriganka Sur (2017). Altered intracellular chloride level leads to reduced inhibition and cortical network deficits in Rett Syndrome. Program No. 450.08. 2017 Neuroscience Meeting Planner. Washington D.C.: Society for Neuroscience, 2017. Online.
 - [Keji Li](#). Altered intracellular chloride level leads to reduced inhibition and cortical network deficits in Rett Syndrome. Neural Developmental Disorder Symposium. (2018) poster - 31
 - [Keji Li](#), Jacque K. P. Ip, Mriganka Sur. Emergence of neuron clusters in mouse motor cortex during learning. (2018) Program No. 493.17. 2018 Neuroscience Meeting Planner. San Diego, CA: Society for Neuroscience, 2018.