

Stanford



Sergey Stavisky

Postdoctoral Research Fellow, Neurosurgery

Bio

HONORS AND AWARDS

- Career Award at the Scientific Interface, Burroughs Wellcome Fund (2019)
- IOP Publishing Outstanding Reviewer Award, Journal of Neural Engineering (2018)
- Interdisciplinary Postdoctoral Scholar Fellowship, Stanford Neurosciences Institute (2018)
- Postdoctoral Research Fellowship & Career Development Award, A. P. Giannini Foundation (2018)
- Milton Safenowitz Postdoctoral Fellowship, ALS Association (2016)
- 1st place, BRAIN Best Student Paper Competition, 36th Annual Meeting of the IEEE Engineering in Medicine and Biology Society (2014)
- Graduate Research Fellowship, National Science Foundation (2013)
- IGERT Video and Poster Competition Winner, National Science Foundation (2013)
- Outstanding Teaching Assistant Award, Stanford University School of Medicine (2013)
- IGERT Fellowship, National Science Foundation (2011)
- Magna Cum Laude, Brown University (2008)
- Phi Beta Kappa, Brown University Chapter (2008)
- Prize for Undergraduate Distinction in Neurosciences, Brown University (2008)

BOARDS, ADVISORY COMMITTEES, PROFESSIONAL ORGANIZATIONS

- Member, IEEE Engineering in Medicine and Biology (2014 - present)
- Member, Society for Neuroscience (2008 - present)

PROFESSIONAL EDUCATION

- Doctor of Philosophy, Stanford University , NEURS-PHD (2016)
- Bachelor of Science, Brown University , Neuroscience (2008)

COMMUNITY AND INTERNATIONAL WORK

- Co-organizer, Simons Collaboration on the Global Brain West Coast Postdoc Meeting Series
- “Brain Day”
- Guest lecturer, SIMR, EXPLORE
- Stanford Neurosciences Ph.D. Program Student Program Committee
- Judge for “Innovate to Mitigate”

PATENTS

- N Even-Chen, KV Shenoy, JC Kao, S Stavisky. "United States Patent 15/234,844 Task-outcome error signals and their use in brain-machine interfaces", Stanford University
- D Sussillo, JC Kao, S Stavisky, KV Shenoy. "United States Patent 10,223,634 Multiplicative recurrent neural network for fast and robust intracortical brain machine interface decoders", Stanford University, Mar 5, 2019

LINKS

- Neural Prosthetic Systems Laboratory: <https://web.stanford.edu/~shenoy/Group.htm>
- Neural Prosthetics Translational Laboratory: <https://sites.stanford.edu/nptl/>
- Publications (via Google Scholar): https://scholar.google.com/citations?hl=en&user=Bh9jZggAAAAJ&view_op=list_works&sortby=pubdate

Research & Scholarship

CURRENT RESEARCH AND SCHOLARLY INTERESTS

I'm trying to restore movement and communication -- and thus, independence -- to people with paralysis. To do so, I'm discovering ways to use neurotechnology to allow people to communicate far more information from their brain to the outside world.

One branch of my brain-computer interface research is to read out complex (high degree-of-freedom) arm movement commands from motor areas of cortex, so that patients can make dextrous movements with, for example, a robotic arm. The goal is to provide enough range of movement that people can perform essential activities of daily living and take care of themselves.

A second branch is to build speech brain-computer interfaces by decoding the neural signals associated with trying to talk. More specifically, I'm trying to reconstruct speech from the movement commands that the brain would normally send to the lips, tongue, jaw, etc. Most work in this space has been using electrocorticography, whereas I'm using electrodes that go into the brain, where we can potentially access more information thanks to the ability to detect individual neurons' action potentials.

My Ph.D. research spanned both fundamental motor neuroscience and applied neural engineering. On the basic science side, I investigated 1) how "internal models" of how the brain's output effects the arm are used by motor cortex. 2) how sensory information carrying information about movement errors is prevented from interfering with motor cortical output until it is "ready" to generate the appropriate output; and 3) how the dynamical rules governing motor cortical activity restrict the kinds of outputs it can generate for the purpose of commanding a neural prosthesis.

My Ph.D. neural engineering work focused on 1) how to robustly decode a user's intended movement despite minute-by-minute and day-to-day changes in neural signals, and 2) sensors' gradually losing the ability to record neuronal action potential. I also studied (3) the effect of ongoing sensory feedback on this signal, and how we can exploit this information to detect and automatically correct for errors.

LAB AFFILIATIONS

- Jaimie Henderson, Neural Prosthetics Translational Laboratory (4/1/2016)
- Krishna Shenoy, Neural Prosthetic Systems Laboratory (4/1/2010 - - 3/31/2016)

Teaching

GRADUATE AND FELLOWSHIP PROGRAM AFFILIATIONS

- Neurosciences (Phd Program)

Publications

PUBLICATIONS

- **Neural ensemble dynamics in dorsal motor cortex during speech in people with paralysis.** *eLife*
Stavisky, S. D., Willett, F. R., Wilson, G. H., Murphy, B. A., Rezaii, P., Avansino, D. T., Memberg, W. D., Miller, J. P., Kirsch, R. F., Hochberg, L. R., Ajiboye, A. B., Druckmann, S., Shenoy, et al
2019; 8
- **Motor Cortical Visuomotor Feedback Activity Is Initially Isolated from Downstream Targets in Output-Null Neural State Space Dimensions.** *Neuron*
Stavisky, S. D., Kao, J. C., Ryu, S. I., Shenoy, K. V.
2017; 95 (1): 195–208.e9
- **Speech-related dorsal motor cortex activity does not interfere with iBCI cursor control.** *Journal of neural engineering*
Stavisky, S. D., Willett, F. R., Avansino, D. T., Hochberg, L. R., Shenoy, K. V., Henderson, J. M.
2020; 17 (1): 016049
- **Neural Representation of Observed, Imagined, and Attempted Grasping Force in Motor Cortex of Individuals with Chronic Tetraplegia.** *Scientific reports*
Rastogi, A., Vargas-Irwin, C. E., Willett, F. R., Abreu, J., Crowder, D. C., Murphy, B. A., Memberg, W. D., Miller, J. P., Sweet, J. A., Walter, B. L., Cash, S. S., Rezaii, P. G., Franco, et al
2020; 10 (1): 1429
- **Brain-machine interface cursor position only weakly affects monkey and human motor cortical activity in the absence of arm movements (vol 8, 16357, 2018) SCIENTIFIC REPORTS**
Stavisky, S. D., Kao, J. C., Nuyujukian, P., Pandarinath, C., Blabe, C., Ryu, S. I., Hochberg, L. R., Henderson, J. M., Shenoy, K. V.
2019; 9
- **Accurate Estimation of Neural Population Dynamics without Spike Sorting.** *Neuron*
Trautmann, E. M., Stavisky, S. D., Lahiri, S., Ames, K. C., Kaufman, M. T., O'Shea, D. J., Vyas, S., Sun, X., Ryu, S. I., Ganguli, S., Shenoy, K. V.
2019
- **Principled BCI Decoder Design and Parameter Selection Using a Feedback Control Model.** *Scientific reports*
Willett, F. R., Young, D. R., Murphy, B. A., Memberg, W. D., Blabe, C. H., Pandarinath, C., Stavisky, S. D., Rezaii, P., Saab, J., Walter, B. L., Sweet, J. A., Miller, J. P., Henderson, et al
2019; 9 (1): 8881
- **Brain-machine interface cursor position only weakly affects monkey and human motor cortical activity in the absence of arm movements.** *Scientific reports*
Stavisky, S. D., Kao, J. C., Nuyujukian, P., Pandarinath, C., Blabe, C., Ryu, S. I., Hochberg, L. R., Henderson, J. M., Shenoy, K. V.
2018; 8 (1): 16357
- **Inferring single-trial neural population dynamics using sequential auto-encoders** *NATURE METHODS*
Pandarinath, C., O'Shea, D. J., Collins, J., Jozefowicz, R., Stavisky, S. D., Kao, J. C., Trautmann, E. M., Kaufman, M. T., Ryu, S. I., Hochberg, L. R., Henderson, J. M., Shenoy, K. V., Abbott, et al
2018; 15 (10): 805+
- **Neural Population Dynamics Underlying Motor Learning Transfer** *NEURON*
Vyas, S., Even-Chen, N., Stavisky, S. D., Ryu, S. I., Nuyujukian, P., Shenoy, K. V.
2018; 97 (5): 1177+
- **Rapid calibration of an intracortical brain-computer interface for people with tetraplegia.** *Journal of neural engineering*
Brandman, D. M., Hosman, T., Saab, J., Burkhart, M. C., Shanahan, B. E., Ciancibello, J. G., Sarma, A. A., Milstein, D. J., Vargas-Irwin, C. E., Franco, B., Kelemen, J., Blabe, C., Murphy, et al
2018; 15 (2): 026007
- **Feasibility of Automatic Error Detect-and-Undo System in Human Intracortical Brain-Computer Interfaces.** *IEEE transactions on bio-medical engineering*
Even-Chen, N., Stavisky, S. D., Pandarinath, C., Nuyujukian, P., Blabe, C. H., Hochberg, L. R., Henderson, J. M., Shenoy, K. V.
2018; 65 (8): 1771–84
- **Trial-by-Trial Motor Cortical Correlates of a Rapidly Adapting Visuomotor Internal Model.** *journal of neuroscience*
Stavisky, S. D., Kao, J. C., Ryu, S. I., Shenoy, K. V.

2017; 37 (7): 1721-1732

- **The need for calcium imaging in nonhuman primates: New motor neuroscience and brain-machine interfaces** *EXPERIMENTAL NEUROLOGY*
O'Shea, D. J., Tiautmann, E., Chandrasekaran, C., Stavisky, S., Kao, J. C., Sahani, M., Ryu, S., Deisseroth, K., Shenoy, K. V.
2017; 287: 437-451
- **Augmenting intracortical brain-machine interface with neurally driven error detectors.** *Journal of neural engineering*
Even-Chen, N., Stavisky, S. D., Kao, J. C., Ryu, S. I., Shenoy, K. V.
2017; 14 (6): 066007
- **Making brain-machine interfaces robust to future neural variability** *NATURE COMMUNICATIONS*
Sussillo, D., Stavisky, S. D., Kao, J. C., Ryu, S. I., Shenoy, K. V.
2016; 7
- **The need for calcium imaging in nonhuman primates: New motor neuroscience and brain-machine interfaces.** *Experimental neurology*
O'Shea, D. J., Trautmann, E., Chandrasekaran, C., Stavisky, S., Kao, J. C., Sahani, M., Ryu, S., Deisseroth, K., Shenoy, K. V.
2016
- **Auto-deleting brain machine interface: Error detection using spiking neural activity in the motor cortex.** *Conference proceedings : ... Annual International Conference of the IEEE Engineering in Medicine and Biology Society. IEEE Engineering in Medicine and Biology Society. Annual Conference*
Even-Chen, N., Stavisky, S. D., Kao, J. C., Ryu, S. I., Shenoy, K. V.
2015; 2015: 71-75
- **A high performing brain-machine interface driven by low-frequency local field potentials alone and together with spikes.** *Journal of neural engineering*
Stavisky, S. D., Kao, J. C., Nuyujukian, P., Ryu, S. I., Shenoy, K. V.
2015; 12 (3): 036009-?
- **Neural Point-and-Click Communication by a Person With Incomplete Locked-In Syndrome** *NEUROREHABILITATION AND NEURAL REPAIR*
Bacher, D., Jarosiewicz, B., Masse, N. Y., Stavisky, S. D., Simeral, J. D., Newell, K., Oakley, E. M., Cash, S. S., Friehs, G., Hochberg, L. R.
2015; 29 (5): 462-471
- **System identification of brain-machine interface control using a cursor jump perturbation** *2015 7th International IEEE/EMBS Conference on Neural Engineering (NER)*
Stavisky, S. D., Kao, J. C., Sorokin, J. M., Ryu, S. I., Shenoy, K. V.
2015
- **Performance sustaining intracortical neural prostheses.** *Journal of neural engineering*
Nuyujukian, P., Kao, J. C., Fan, J. M., Stavisky, S. D., Ryu, S. I., Shenoy, K. V.
2014; 11 (6): 066003-?
- **Non-causal spike filtering improves decoding of movement intention for intracortical BCIs** *JOURNAL OF NEUROSCIENCE METHODS*
Masse, N. Y., Jarosiewicz, B., Simeral, J. D., Bacher, D., Stavisky, S. D., Cash, S. S., Oakley, E. M., Berhanu, E., Eskandar, E., Friehs, G., Hochberg, L. R., Donoghue, J. P.
2014; 236: 58-67
- **Information Systems Opportunities in Brain-Machine Interface Decoders** *PROCEEDINGS OF THE IEEE*
Kao, J. C., Stavisky, S. D., Sussillo, D., Nuyujukian, P., Shenoy, K. V.
2014; 102 (5): 666-682
- **Hybrid decoding of both spikes and low-frequency local field potentials for brain-machine interfaces.** *Conference proceedings : ... Annual International Conference of the IEEE Engineering in Medicine and Biology Society. IEEE Engineering in Medicine and Biology Society. Annual Conference*
Stavisky, S. D., Kao, J. C., Nuyujukian, P., Ryu, S. I., Shenoy, K. V.
2014; 2014: 3041-3044
- **Continuous Control of the DLR Light-Weight Robot III by a Human with Tetraplegia Using the BrainGate2 Neural Interface System** *Experimental Robotics*
Vogel, J., Haddadin, S., Simeral, J. D., Stavisky, S. D., Bacher, D., Hochberg, L. R., Donoghue, J. P., van der Smagt, P.
Springer.2014: 125-136
- **Investigating the role of firing-rate normalization and dimensionality reduction in brain-machine interface robustness.** *Conference proceedings : ... Annual International Conference of the IEEE Engineering in Medicine and Biology Society. IEEE Engineering in Medicine and Biology Society. Conference*

Kao, J. C., Nuyujukian, P., Stavisky, S., Ryu, S. I., Ganguli, S., Shenoy, K. V.
2013; 2013: 293-298

- **A recurrent neural network for closed-loop intracortical brain-machine interface decoders** *JOURNAL OF NEURAL ENGINEERING*
Sussillo, D., Nuyujukian, P., Fan, J. M., Kao, J. C., Stavisky, S. D., Ryu, S., Shenoy, K.
2012; 9 (2)