Stanford

Francis Robert Willett

Assistant Professor of Neurosurgery

Curriculum Vitae available Online

Bio

BIO

Frank Willett is co-director of the Neural Prosthetics Translational Laboratory. Our group develops brain-computer interfaces (BCIs) to restore movement and communication to people with neurological disorders. Recent contributions include handwriting and speech-based BCIs that set new records for communication speed and accuracy in people with paralysis. More broadly, we are interested in computational approaches to understanding brain function and recordings, with a focus on how the human brain represents movement and language.

ACADEMIC APPOINTMENTS

- Assistant Professor, Neurosurgery
- Member, Bio-X
- Member, Wu Tsai Human Performance Alliance
- Member, Wu Tsai Neurosciences Institute

HONORS AND AWARDS

- Annual BCI Award - 2nd Place, BCI Award Foundation (2022)
- Early Career Award, BCI Society (2021)
- Annual BCI Award - 1st Place, BCI Award Foundation (2020)
- Annual BCI Award - 1st Place, BCI Award Foundation (2018)
- Graduate Research Fellowship Program Awardee, National Science Foundation (2013-2016)

Teaching

STANFORD ADVISEES

Doctoral Dissertation Advisor (AC)

Ryan Wang

Publications

PUBLICATIONS

- **A high-performance brain-computer interface for finger decoding and quadcopter game control in an individual with paralysis.** *Nature medicine*
  Willsey, M. S., Shah, N. P., Avansino, D. T., Hahn, N. V., Jamiolkowski, R. M., Kamdar, F. B., Hochberg, L. R., Willett, F. R., Henderson, J. M.
  2025

- **An Accurate and Rapidly Calibrating Speech Neuroprosthesis.** *The New England journal of medicine*
  Card, N. S., Wairagkar, M., Iacobacci, C., Hou, X., Singer-Clark, T., Willett, F. R., Kunz, E. M., Fan, C., Vahdati Nia, M., Deo, D. R., Srinivasan, A., Choi, E. Y., Glasser, et al
  2024; 391 (7): 609-618

- **Brain control of bimanual movement enabled by recurrent neural networks.** *Scientific reports*
  Deo, D. R., Willett, F. R., Avansino, D. T., Hochberg, L. R., Henderson, J. M., Shenoy, K. V.
  2024; 14 (1): 1598

- **A high-performance speech neuroprosthesis.** *Nature*
  Willett, F. R., Kunz, E. M., Fan, C., Avansino, D. T., Wilson, G. H., Choi, E. Y., Kamdar, F., Glasser, M. F., Hochberg, L. R., Druckmann, S., Shenoy, K. V., Henderson, J. M.
  2023

- **Plug-and-Play Stability for Intracortical Brain-Computer Interfaces: A One-Year Demonstration of Seamless Brain-to-Text Communication**
  Fan, C., Hahn, N., Kamdar, F., Avansino, D., Wilson, G. H., Hochberg, L., Shenoy, K. V., Henderson, J. M., Willett, F. R.
  edited by Oh, A., Neumann, T., Globerson, A., Saenko, K., Hardt, M., Levine, S.
  NEURAL INFORMATION PROCESSING SYSTEMS (NIPS).2023

- **Learned motor patterns are replayed in human motor cortex during sleep.** *The Journal of neuroscience : the official journal of the Society for Neuroscience*
  Rubin, D. B., Hosman, T., Kelemen, J. N., Kapitonava, A., Willett, F. R., Coughlin, B. F., Halgren, E., Kimchi, E. Y., Williams, Z. M., Simeral, J. D., Hochberg, L. R., Cash, S. S.
  2022

- **High-performance brain-to-text communication via handwriting.** *Nature*
  Willett, F. R., Avansino, D. T., Hochberg, L. R., Henderson, J. M., Shenoy, K. V.
  2021; 593 (7858): 249–54

- **Decoding spoken English from intracortical electrode arrays in dorsal precentral gyrus.** *Journal of neural engineering*
  Wilson, G. H., Stavisky, S. D., Willett, F. R., Avansino, D. T., Kelemen, J. N., Hochberg, L. R., Henderson, J. M., Druckmann, S., Shenoy, K. V.
  2020; 17 (6): 066007

- **Hand Knob Area of Premotor Cortex Represents the Whole Body in a Compositional Way.** *Cell*
  Willett, F. R., Deo, D. R., Avansino, D. T., Rezaii, P., Hochberg, L. R., Henderson, J. M., Shenoy, K. V.
  2020

- **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. n., Vargas-Irwin, C. E., Willett, F. R., Abreu, J. n., 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

- **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

- **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. n., Stavisky, S. D., Rezaii, P. n., Saab, J. n., Walter, B. L., Sweet, J. A., Miller, J. P., Henderson, et al
  2019; 9 (1): 8881

- **Closed-loop cortical control of virtual reach and posture using cartesian and joint velocity commands.** *Journal of neural engineering*
  Young, D., Willett, F., Memberg, W. D., Murphy, B. A., Rezaii, P., Walter, B., Sweet, J. A., Miller, J., Shenoy, K. V., Hochberg, L., Kirsch, R. F., Ajiboye, A. B.

2018

- **A Comparison of Intention Estimation Methods for Decoder Calibration in Intracortical Brain-Computer Interfaces** *IEEE TRANSACTIONS ON BIOMEDICAL ENGINEERING*
  Willett, F. R., Murphy, B. A., Young, D., Memberg, W. D., Blabe, C. H., Pandarinath, C., Franco, B., Saab, J., Walter, B. L., Sweet, J. A., Miller, J. P., Henderson, J. M., Shenoy, et al
  2018; 65 (9): 2066–78

- **Signal processing methods for reducing artifacts in microelectrode brain recordings caused by functional electrical stimulation** *JOURNAL OF NEURAL ENGINEERING*
  Young, D., Willett, F., Memberg, W. D., Murphy, B., Walter, B., Sweet, J., Miller, J., Hochberg, L. R., Kirsch, R. F., Ajiboye, A. B.
  2018; 15 (2): 026014

- **Rapid calibration of an intracortical brain-computer interface for people with tetraplegia.** *Journal of neural engineering*
  Brandman, D. M., Hosman, T. n., Saab, J. n., Burkhart, M. C., Shanahan, B. E., Ciancibello, J. G., Sarma, A. A., Milstein, D. J., Vargas-Irwin, C. E., Franco, B. n., Kelemen, J. n., Blabe, C. n., Murphy, et al
  2018; 15 (2): 026007

- **Decoding Speech from Intracortical Multielectrode Arrays in Dorsal "Arm/Hand Areas" of Human Motor Cortex**
  Stavisky, S. D., Rezaii, P., Willett, F. R., Hochberg, L. R., Shenoy, K., Henderson, J. M., IEEE
  IEEE.2018: 93–97

- **Restoration of reaching and grasping movements through brain-controlled muscle stimulation in a person with tetraplegia: a proof-of-concept demonstration.** *Lancet (London, England)*
  Ajiboye, A. B., Willett, F. R., Young, D. R., Memberg, W. D., Murphy, B. A., Miller, J. P., Walter, B. L., Sweet, J. A., Hoyen, H. A., Keith, M. W., Peckham, P. H., Simeral, J. D., Donoghue, et al
  2017; 389 (10081): 1821-1830

- **High performance communication by people with paralysis using an intracortical brain-computer interface.** *eLife*
  Pandarinath, C., Nuyujukian, P., Blabe, C. H., Sorice, B. L., Saab, J., Willett, F. R., Hochberg, L. R., Shenoy, K. V., Henderson, J. M.
  2017; 6

- **Feedback control policies employed by people using intracortical brain-computer interfaces** *JOURNAL OF NEURAL ENGINEERING*
  Willett, F. R., Pandarinath, C., Jarosiewicz, B., Murphy, B. A., Memberg, W. D., Blabe, C. H., Saab, J., Walter, B. L., Sweet, J. A., Miller, J. P., Henderson, J. M., Shenoy, K. V., Simeral, et al
  2017; 14 (1)

- **Signal-independent noise in intracortical brain-computer interfaces causes movement time properties inconsistent with Fitts' law.** *Journal of neural engineering*
  Willett, F. R., Murphy, B. A., Memberg, W. D., Blabe, C. H., Pandarinath, C. n., Walter, B. L., Sweet, J. A., Miller, J. P., Henderson, J. M., Shenoy, K. V., Hochberg, L. R., Kirsch, R. F., Ajiboye, et al
  2017; 14 (2): 026010

- **Differences in motor cortical representations of kinematic variables between action observation and action execution and implications for brain-machine interfaces.** *Annual International Conference of the IEEE Engineering in Medicine and Biology Society. IEEE Engineering in Medicine and Biology Society. Annual International Conference*
  Willett, F. R., Suminski, A. J., Fagg, A. H., Hatsopoulos, N. G.
  2014; 2014: 1334-7

- **Relationship between microelectrode array impedance and chronic recording quality of single units and local field potentials.** *Annual International Conference of the IEEE Engineering in Medicine and Biology Society. IEEE Engineering in Medicine and Biology Society. Annual International Conference*
  Jiang, J., Willett, F. R., Taylor, D. M.
  2014; 2014: 3045-8

- **Online adaptive decoding of intended movements with a hybrid kinetic and kinematic brain machine interface.** *Annual International Conference of the IEEE Engineering in Medicine and Biology Society. IEEE Engineering in Medicine and Biology Society. Annual International Conference*
  Suminski, A. J., Fagg, A. H., Willett, F. R., Bodenhamer, M., Hatsopoulos, N. G.
  2013; 2013: 1583-6

- **Improving brain-machine interface performance by decoding intended future movements.** *Journal of neural engineering*

Willett, F. R., Suminski, A. J., Fagg, A. H., Hatsopoulos, N. G.
2013; 10 (2): 026011

- **Compensating for delays in brain-machine interfaces by decoding intended future movement.** *Annual International Conference of the IEEE Engineering in Medicine and Biology Society. IEEE Engineering in Medicine and Biology Society. Annual International Conference*
  Willett, F. R., Suminski, A. J., Fagg, A. H., Hatsopoulos, N. G.
  2012; 2012: 4087-90

- **Continuous decoding of intended movements with a hybrid kinetic and kinematic brain machine interface.** *Annual International Conference of the IEEE Engineering in Medicine and Biology Society. IEEE Engineering in Medicine and Biology Society. Annual International Conference*
  Suminski, A. J., Willett, F. R., Fagg, A. H., Bodenhamer, M., Hatsopoulos, N. G.
  2011; 2011: 5802-6