

Life Sciences Reporting Summary

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Please do not complete any field with "not applicable" or n/a. Refer to the help text for what text to use if an item is not relevant to your study. For final submission: please carefully check your responses for accuracy; you will not be able to make changes later.

► Experimental design

1. Sample size

Describe how sample size was determined.

We have a single participant enrolled in our clinical study who has undergone the surgical procedure to have a microelectrode array implanted in his motor cortex.

2. Data exclusions

Describe any data exclusions.

No data were excluded in the analyses presented in this paper. The analyses included all experimental datasets collected between January 26, 2015 and June 9, 2017. Data collection details are described in depth in the Methods section of the manuscript.

3. Replication

Describe the measures taken to verify the reproducibility of the experimental findings.

Data is collected from the participant in a standardized format every session. Additionally, the parameters of the trained fixed neural network and support vector machine models were saved so that their outputs can be exactly reproduced. The output of the neural network models that use supervised or unsupervised updating might vary slightly owing to stochasticity in the updating procedures (i.e., we do not save the updated models for each individual session). However, given the parameters of the fixed neural network as the starting point, the outputs of the updated models will be similar to the results we show in the manuscript.

4. Randomization

Describe how samples/organisms/participants were allocated into experimental groups.

A single participant is enrolled in this clinical study, thus preventing the ability to randomize.

5. Blinding

Describe whether the investigators were blinded to group allocation during data collection and/or analysis.

Blinding was not used in this study due to the single participant and single treatment design. Given the invasive nature of the system, the participant is usually well aware of small changes to the system, preventing us from making changes without his knowledge. In all of the experiments demonstrating the performance of the neural network, the validity of the results are not biased by the participants knowledge of the decoder type.

Note: all in vivo studies must report how sample size was determined and whether blinding and randomization were used.

6. Statistical parameters

For all figures and tables that use statistical methods, confirm that the following items are present in relevant figure legends (or in the Methods section if additional space is needed).

n/a Confirmed

- ☐ ☒ The exact sample size (*n*) for each experimental group/condition, given as a discrete number and unit of measurement (animals, litters, cultures, etc.)
- ☐ ☒ A description of how samples were collected, noting whether measurements were taken from distinct samples or whether the same sample was measured repeatedly
- ☐ ☒ A statement indicating how many times each experiment was replicated
- ☐ ☒ The statistical test(s) used and whether they are one- or two-sided
Only common tests should be described solely by name; describe more complex techniques in the Methods section.
- ☐ ☒ A description of any assumptions or corrections, such as an adjustment for multiple comparisons
- ☐ ☒ Test values indicating whether an effect is present
*Provide confidence intervals or give results of significance tests (e.g. *P* values) as exact values whenever appropriate and with effect sizes noted.*
- ☐ ☒ A clear description of statistics including central tendency (e.g. median, mean) and variation (e.g. standard deviation, interquartile range)
- ☐ ☒ Clearly defined error bars in all relevant figure captions (with explicit mention of central tendency and variation)

See the web collection on [statistics for biologists](#) for further resources and guidance.

► Software

Policy information about [availability of computer code](#)

7. Software

Describe the software used to analyze the data in this study.

A PC running MatlabR2014b was used for data collection and custom scripts were used to convert the raw voltage recordings from the microelectrode array into the mean wavelet power features described in our Methods section. Analysis and model fitting were done on a PC using Python 2.7. All neural network models were trained and tested within python using the Keras package (v1.2.2) with Tensorflow (v1.0.1) as the backend. The support vector machine classifier was also constructed in python using the sci-kit learn package (v0.17). Python scripts were created to load the data, construct and train the classifier models (using Keras), and test the output. Scripts in R using the ggplot package were used to plot the results used in the figures.

For manuscripts utilizing custom algorithms or software that are central to the paper but not yet described in the published literature, software must be made available to editors and reviewers upon request. We strongly encourage code deposition in a community repository (e.g. GitHub). *Nature Methods* [guidance for providing algorithms and software for publication](#) provides further information on this topic.

► Materials and reagents

Policy information about [availability of materials](#)

8. Materials availability

Indicate whether there are restrictions on availability of unique materials or if these materials are only available for distribution by a third party.

Materials used in this study (data and/or code) can be made available to qualified individuals for collaboration provided that a written agreement is executed in advance between Battelle Memorial Institute and the requester's affiliated institution. Such inquiries or requests should be directed to G.S.

9. Antibodies

Describe the antibodies used and how they were validated for use in the system under study (i.e. assay and species).

No antibodies were used in this study.

10. Eukaryotic cell lines

a. State the source of each eukaryotic cell line used.

No eukaryotic cell lines were used.

b. Describe the method of cell line authentication used.

No eukaryotic cell lines were used.

c. Report whether the cell lines were tested for mycoplasma contamination.

No eukaryotic cell lines were used.

d. If any of the cell lines used are listed in the database of commonly misidentified cell lines maintained by [ICLAC](#), provide a scientific rationale for their use.

No eukaryotic cell lines were used.

► Animals and human research participants

Policy information about [studies involving animals](#); when reporting animal research, follow the [ARRIVE guidelines](#)

11. Description of research animals

Provide all relevant details on animals and/or animal-derived materials used in the study.

No animals were used in this study.

Policy information about [studies involving human research participants](#)

12. Description of human research participants

Describe the covariate-relevant population characteristics of the human research participants.

The participant is a 27-year-old male with stable, non-spastic tetraplegia from a cervical spinal cord injury that he suffered at the age of 19. His injury was complete, with an overall neurologic level of C5 AIS A with zone of partial preservation to C6. A Utah microelectrode array (Blackrock Microsystems, Inc., Salt Lake, Utah) was implanted in the hand area of his left primary motor cortex on April 22, 2014.