Closed-Loop Active Calibration for Visual Prostheses

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BACKGROUND

Retinal degenerative diseases and cortical vision loss result in profound visual impairment that can be partially addressed with neural prostheses. These devices offer a potential intervention by electrically stimulating neural tissue through arrays of electrodes, but achieving functional vision requires careful calibration of stimulation thresholds across the array. Traditional calibration techniques treat each electrode independently, using staircase or psychometric procedures to estimate thresholds one site at a time. This process is time-consuming, requires many stimulation trials, and does not scale to modern high-density implants. It also fails to account for spatial structure in neural sensitivity and must be frequently repeated due to threshold drift over time.

DESCRIPTION

Researchers at the University of California, Santa Barbara have devised a closed-loop calibration framework for neural visual prostheses that replaces electrode-by-electrode threshold testing with global, model-based inference across the entire implant. Instead of independently testing every electrode, the system treats neural sensitivity as a continuous latent field over the electrode array and actively selects each stimulation to maximally reduce uncertainty about that field. Rather than exhaustively probing individual electrodes, the system learns the full threshold landscape from a small number of strategically chosen queries. Unlike existing approaches, the framework incorporates the underlying neural geometry (e.g., geodesic distances on cortex) to guide inference and sampling, and it supports continuous re-calibration to track threshold drift over time. This enables rapid, scalable, and adaptive fitting of high-density neural interfaces.

ADVANTAGES

- Global, geometry-aware threshold inference across the neural interface
- Active query selection for efficient information gain
- Substantially reduces the number of trials required for calibration
- Scales to implants with hundreds to thousands of electrodes
- Closed-loop adaptation to drift over time
- Reduces clinic time and patient burden
- Software-based and compatible with existing hardware

APPLICATIONS

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OTHER INFORMATION

KEYWORDS

retinal, retinal degenerative diseases, degenerative diseases, visual impairment, neural prostheses, calibration, neural visual prostheses, visual prostheses, neural, neuroprosthetic calibration, neuroprosthetic, neural implants

CATEGORIZED AS

- **Medical**
  - Devices
  - Other

RELATED CASES

2026-810-0

- Rapid clinical fitting of visual prostheses, reducing calibration time from hours to practical, patient-friendly sessions
- Continuous re-calibration in chronic implants, maintaining performance despite threshold drift
- High-channel-count neural implants requiring rapid and accurate system fitting
- Next-generation neural interfaces (including visual and non-visual BCIs) with hundreds to thousands of electrodes that cannot be calibrated electrode-by-electrode
- Clinical workflows for personalized and accelerated neuroprosthetic calibration
- Adaptive research platforms for mapping spatial structure of neural sensitivity across retinal and cortical substrates

PATENT STATUS

Patent Pending

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