Thomas S. Binns, MSci

NEUROTECHNOLOGY SCIENTIST & SOFTWARE ENGINEER

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PROFESSIONAL SUMMARY

I am a highly motivated research scientist and software engineer with expertise in machine learning, HCIs, and signal processing applied to multimodal time-series. I am driven to create real-time, high-resolution precision systems at the forefront of neurotechnology. Now finishing my PhD, I am looking for a career where I can utilise my vast experience in biomedical signal analysis, real-time machine-learning-based HCIs, and software engineering to innovate and bring cutting-edge neurotechnology to market.

SKILLS AND EXPERTISE

- Biomedical time-series analysis
- Machine learning
- Real-time, multimodal HCIs
- Scientific software development
- Agile, DevOps, & MLOps
- Python software development
- Independence & team working
- Clear & concise communication
- Resilience & self-motivation

SELECTED ACHIEVEMENTS

- Google Summer of Code grant recipient; implemented real-time-compatible, data-driven signal processing algorithms for machine learning pipelines in the open-source MNE ecosystem for Python.
- Sony Global Internship Programme participant; invited for my expertise in signal processing, machine learning, and HCIs to develop a multimodal (EEG-acoustic), real-time HCI recommendation system.
- Lead author of the open-source PyBispectra toolbox for advanced non-linear time-series analyses; developed to identify biomarkers and therapeutic responses in my clinical neuromodulation work.
- Member of a $500,000 grant from the National Science Foundation, USA; invited to maintain and grow the hugely popular open-source MNE ecosystem for electrophysiological signal analysis in Python.

SELECTED PROFESSIONAL EXPERIENCE

SONY COMPUTER SCIENCE LABORATORIES, TOKYO, JAPAN

Neurotechnology Systems Intern **01/2025 – 08/2025**

I worked on a $3 Million research project for AI systems in a dynamic, interdisciplinary team of neuroscientists, computer scientists, and engineers to develop a multimodal, real-time HCI system for music recommendation using EEG and acoustic signals, delivering results on time and within budget:

- Developed a multimodal HCI system for real-time decoding, ensembling linear techniques and deep learning approaches to improve accuracies by 15% while keeping latencies <80 ms.
- Identified task-relevant features for decoding through in-depth explorations of EEG and non-neural signals using Python, producing robust and real-time-feasible decoding features.
- Designed, validated, and executed machine learning algorithms using the discovered task-relevant features in Python, establishing an accurate and modular multimodal system for decoding.
- Rapid *in-silico* and *in-vitro* prototyping and validation of a real-time HCI system, combining open-source and proprietary software tools in collaboration with engineers to meet project deadlines.

NEUROMODULATION UNIT, CHARITÉ – UNIVERSITÄTSMEDIZIN BERLIN, GERMANY

Clinical Neuromodulation Research Scientist **07/2021 – 05/2025**

I identified biomarkers and therapeutic mechanisms for a €1.5 Million neuromodulation research project in a collaborative, international team of neuroscientists, computer scientists, and clinicians, using machine learning methods applied to multimodal signals (ECoG, LFP, ECG, EMG) in Parkinson's disease patients:

- Developed real-time neurofeedback paradigms using machine-learning-based neural decoding pipelines, achieving accuracies >85% for movement-related neural activity in latencies <15 ms.

- Designed and executed advanced multimodal signal processing pipelines using novel multivariate algorithms in Python, identifying biomarkers and DBS mechanisms for the first time in humans.
- Designed and executed multimodal (ECoG-LFP) experimental paradigms through collaboration with clinical teams to acquire first-of-its-kind human Parkinson's data for biomarker identification.
- Communicated findings to biomedical professionals through international conferences and high-impact journals according to project timelines and deliverables, helping to secure future funding.

BERNSTEIN CENTER FOR COMPUTATIONAL NEUROSCIENCE BERLIN, GERMANY
Neurotechnology Research Scientist **08/2019 – 08/2020**

I worked in the Haynes group to develop and execute offline signal processing pipelines and online neurofeedback paradigms using machine learning and EEG-based BCIs with movement signals to explore human movement and decision making, delivering outcomes within deadlines to secure future funding:

- Developed real-time neurofeedback systems using machine-learning-based neural decoding pipelines, achieving accuracies ~80% for decision-related neural activity in latencies <20 ms.
- Designed, validated, and executed EEG-based paradigms for real-time neurofeedback using MATLAB and Python, identifying neural mechanisms of decision making.
- Identified task-relevant features for decoding through in-depth explorations of EEG and movement signals in MATLAB and Python, producing robust and real-time-feasible decoding features.
- Designed and executed offline machine learning algorithms applied to EEG, EMG, and accelerometer signals using MATLAB and Python, identifying neural mechanisms of movement.

EDUCATION

CHARITÉ – UNIVERSITÄTSMEDIZIN BERLIN, GERMANY
PhD Computational and Medical Neuroscience **Awaiting final assessment** **09/2021 – Present**

UNIVERSITY OF ABERDEEN, UK
MSci (Hons) Neuroscience with Psychology **First-Class** **09/2016 – 06/2021**

SELECTED PROFESSIONAL MEMBERSHIPS

MNE SOFTWARE, UNIVERSITY OF WASHINGTON, USA
Maintainer **11/2023 – Present**

I am a maintainer and developer of the MNE ecosystem, a set of Python toolboxes for electrophysiological data analysis with over 3,000 stars on GitHub and citations in over 5,000 peer-reviewed scientific papers:

- Developed toolboxes, operating in CI/CD workflows within solo to large-sized teams to implement new signal processing, machine learning, statistics, and visualisation features.
- Maintained toolboxes, following design patterns and established best practices to implement bug fixes, design and maintain automated workflows, and create software releases.
- Community support and triaging of user queries through managing forums and issue trackers to provide technical assistance to users, and handle bug reports and feature requests.
- Conducted code reviews of PRs to supervise the implementation of new features and bug fixes.

SELECTED NEUROTECHNOLOGY PUBLICATIONS

- **Binns, TS**, …, Haufe, S, Kühn, AA, Neumann, WJ (2025). Shared pathway-specific network mechanisms of dopamine and deep brain stimulation for the treatment of Parkinson's disease. *Nature Communications*. DOI: 10.1038/s41467-025-58825-z.
- **Binns, TS**, Furuya, S, Cheung, VKM (Accepted). A real-time multimodal system for music preference decoding combining EEG and acoustic features. In: *Extended Abstracts for the Late-Breaking Demo Session of the 26th International Society for Music Information Retrieval Conference*.
- **Binns, TS**, …, Haufe, S (2025). PyBispectra: A toolbox for advanced electrophysiological signal processing using the bispectrum. *Journal of Open Source Software*. DOI: 10.21105/joss.08504.

References available upon request