The Fifth
Neuroadaptive Technology Conference

NEUROADAPTIVE TECHNOLOGY

CONFERENCE PROGRAM

April 22 – 24, 2026,
Berlin, Germany

The Fifth Neuroadaptive Technology Conference

2026

Conference Program

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Conference Program

Wednesday, the 22nd of April

09:00 – 09:45 Registration
09:45 – 10:00 Welcome note
10:00 – 11:00 **Keynote:** Dr. Laurens Krol
11:00 – 11:30 Break
11:30 – 12:30 **Session 1:** Applied neuroadaptive technology
12:30 – 13:30 Lunch
13:30 – 14:30 **Session 2:** Validations and methodological advancements
14:30 – 15:00 Break
15:00 – 17:00 **Poster Presentations**
17:00 – 17:45 **Session 3:** Artifact correction methods

Thursday, the 23rd of April

09:00 – 10:00 Registration
10:00 – 11:00 **Keynote:** Dr. Mike Ambinder
11:00 – 11:30 Break
11:30 – 12:30 **Session 4:** Deep learning methods
12:30 – 13:30 Lunch
13:30 – 14:15 **Session 5:** User Experience for neuroadaptive technologies
14:15 – 15:00 Break
15:00 – 16:00 **Keynote:** Dr. Philipp Wicke
16:00 – 16:15 Break
16:15 – 17:15 **Panel Discussion / Q&A**

19:00 – 23:00 Conference Dinner, Café am Neuen See

Friday, the 24th of April – Translation

09:00 – 09:30 Registration & Welcome
09:30 – 10:00 **Thomas Jarzombek MdB:** How government can foster AI innovation
10:00 – 10:45 **Prof. Dr. Thorsten Zander:** AI science entrepreneurship
10:45 – 11:15 **Prof. Thorsten Zander & Prof. Sascha Friesike:** *Machines, Humans, Societies* | Impulse and Q&A
11:15 – 11:30 Break
11:30 – 12:15 Startup Demos I – Neuronium, Auryal, Netholabs
12:15 – 12:45 **Dr. Max Neufeind:** How radically new tech finds societal acceptance
12:45 – 13:45 Lunch
13:45 – 14:30 Startup Demos II – Zander Labs, braingrade
14:30 – 15:00 **Christoph Koch:** Loving AI – when artificial agents toy around with real feelings
15:00 – 15:30 **Dr. Tina Klüwer:** How to convince a deeptech VC to fund the future
15:30 – 16:00 Wrap-Up & Closing (Dr. Thomas Ramge / Prof. Dr. Thorsten Zander)

Keynote Lectures

Dr. Laurens Krol

Project NAFAS: The Path and the Progress towards Neuroadaptive Artificial Intelligence

Wednesday, April 22nd
10:00 – 11:00

Project NAFAS (Neuroadaptivity for Autonomous Systems) is a EUR 30M research project funded by the German federal agency Agentur für Innovation in der Cybersicherheit - "Innovation for Cybersecurity". Its goal is to research and develop both technological foundations and application demonstrators for various safe and secure forms of neuroadaptive technology, including specifically neuroadaptive artificial intelligence. Having started in late 2023, the four-year project has now completed its first phase, which focused primarily on the foundational necessities: i.a., data acquisition, plug-and-play decoders, and mobile hardware. This keynote presents the current state of the project illustrated by select achievements, and the implications for the wider field.

Dr. Laurens R. Krol is co-founder and Research Director of Zander Labs, a German-Dutch deep-tech startup pioneering passive brain-computer interfaces and neuroadaptive technology. With his doctorate from Technische Universität Berlin, Dr. Krol helped define the field of neuroadaptive technology through foundational research on implicit interaction and cognitive probing. At Zander Labs, he leads the exploration of novel ways to harness neural correlates of human intelligence, driving toward safe, human-centric neuroadaptive synergy that transforms how humans and technology interact.

Dr. Mike Ambinder

One Possible Future: How Physiologically Adaptive Video Games Create New Kinds of Play and Foster New Kinds of Industry

Thursday, April 23rd
10:00 – 11:00

For those curious about one instantiation of adaptive technology that promises to lead to many others, this talk will cover how adaptive video games represent an opportunity to push forward the development of responsive interfaces in a wide variety of other domains. Traditional gameplay converts rudimentary estimations of cognitive intention into audio and visual (and haptic) responses that aim to drive challenge, engagement, and entertainment. Incorporating physiological signal measurement as a direct input to gameplay systems produces qualitatively new kinds of play, broadens the stimulus-response space well beyond the current modalities, and offers a novel form of data collection and experimentation that informs adaptive technology and experience development both within the world of video games and certainly well beyond it.

Mike Ambinder has a BA in Computer Science and Psychology from Yale University and a PhD in Psychology from the University of Illinois. He spent 15 years leading research efforts at Valve (video game developer responsible for Steam, Half-Life, Portal, Counter-Strike, Dota, Team Fortress 2, HTC Vive, Valve Index) producing pioneering work on the application of knowledge and methodologies from psychology to game design, the formation and implementation of in-game economies, the use of statistics and machine learning (and now AI) to operationalize and evaluate game design hypotheses, non-invasive Brain-Computer Interface experiments to facilitate new forms of adaptive gameplay, and a few other things. In addition to current consulting and advisory work, he acts as the Chief Research Officer and Chief Technology Officer for a startup attempting to understand the mechanics of skill development in interactive technology.

Dr. Philipp Wicke

From Probing Concepts in Language Models to Reading Them in the Brain

Thursday, April 23rd
15:00 – 16:00

How do we compare language model conceptualisation capabilities with those arising from embodied human cognition and is this even a fair comparison to begin with? Published computational probing studies show where LLMs systematically diverge from human conceptualization: in figurative language grounded in bodily experience, in spatial schema intuitions, and across linguistic-cultural boundaries. These divergence points define a set of open questions that neuroadaptive methods are uniquely positioned to answer. If we know where models fail at human-like meaning, we can design EEG paradigms that target those exact domains, revealing what the human brain computes that statistical models do not.

Philipp Wicke is a Cognitive Scientist and AI researcher specializing in Natural Language Processing and neuroadaptive systems. He studied Cognitive Science at the University of Osnabrück and conducted research in neuroinformatics and computational storytelling at institutions including NTU Singapore and University College Dublin. He was an assistant professor at LMU Munich and currently teaches Artificial Intelligence at BTU Cottbus. Philipp Wicke is the Lead AI Scientist at AURYAL, a European neurotechnology startup supported by SPRIND, where he advances adaptive AI systems at the intersection of language, cognition, and brain-computer interfaces.

Talk Sessions Day 1

Wednesday, April 22nd

11:30 – 12:30 Session 1: Applied neuroadaptive technology

Christopher Baker — Integrating EEG and Behavioral Metrics via cBCI to Enhance Team Performance and Resilience to AI Deception

This study evaluates a collaborative Brain-Computer Interface (cBCI) for enhancing team decision-making in a VR drone task. Integrating EEG-derived SVM confidence with behavioral metrics, we demonstrate that cBCI aggregation enables teams to significantly exceed the performance of their best individuals under high workload (synergy). Furthermore, we show that the cBCI provides a critical safety net against AI deception; while human behaviors succumb to automation bias, implicit neural signals (N200/P300) maintain a preserved "truth signal" in the visual cortex. Using an exhaustive combinatorial simulation of 11.7 million team decisions, we show that a neuro-decoupled strategy maintains robust accuracy (68.3%) when traditional behavioral voting fails (42.6%). These findings highlight cBCIs as robust neuroergonomic safeguards, capable of accessing implicit neural wisdom to protect teams against flawed automated guidance in high-stakes operational environments.

Bogdan Kozyrskiy — Benchmarking Label-Revealed Online Updates for EEG BCI Decoding

Electroencephalography (EEG) signals drift over time, causing static brain–computer interface (BCI) models to degrade rapidly in practice. We outline a benchmark for online adaptation and compare two widely used pipelines: Common Spatial Patterns (CSP) and Riemannian (covariance-based) methods. Using time-ordered evaluation with prequential accuracy as the primary metric, we examine (i) which pipeline adapts with the fewest new labeled trials, (ii) whether controlled forgetting of older data improves robustness, and (iii) how much pretraining is needed before online updates become effective. We propose practical online-learning variants of CSP and Riemannian models to support systematic empirical evaluation.

Souhir Ezzedini — Toward neuroadaptive digital assistants: real-time cognitive load assessment in simplified air traffic control environment

Effective human-AI joint decision making in complex environment requires closed-loop systems capable of monitoring the human partner's state in real time. We developed a multimodal classification pipeline (EEG, ECG, EDA) from 31 participants performing a simplified air traffic control task under varying load levels. An XGBoost classifier was used within-subject rolling temporal cross-validation, trained on past data to predict subsequent blocks. The proposed pipeline achieved a mean accuracy of 78.20% (SD = 6.56%), with individual accuracies reaching up to 93.40%. These results demonstrate that integrated neurophysiological markers provide a reliable basis for continuous mental workload monitoring. Despite inter-individual variability, the high median performance supports the feasibility of closed-loop neuroadaptive interfaces. These results support continuous neurophysiological workload monitoring and enable adaptive human–AI systems in safety-critical environments.

13:30 – 14:30 **Session 2: Validations and methodological advancements 1**

Frida Heskebeck Class Mean Distance for Early Classification Accuracy Estimation

Motor imagery (MI) based brain-computer interfaces (BCIs) require the use of MI tasks that yield sufficient classification accuracy. However, determining the classification accuracy requires substantial data. In this paper, we investigate whether the distance between Riemannian class means, estimated from a small number of trials, can be used to predict the final classification accuracy achievable with substantially more data. Multiple public MI-BCI datasets are used for analysis. We analyze how the class mean distance relates to classification accuracy and how this relationship changes as data size increases. The results show similar trends across datasets. We also propose two strategies for early estimation of classification accuracy, which can inform early calibration decisions, such as whether to continue data collection or switch MI tasks.

Ricardo Licona Muñoz Local Geometric Consistency for Cross-Subject Riemannian Transfer Learning

The variability of brain signals across users remains a major challenge in brain–computer interfaces (BCIs). Riemannian transfer learning (TL) methods, such as the Riemannian Recentering Transformation (RCT), address this issue by re-centering spatial covariance matrices across domains on the symmetric positive-definite (SPD) manifold. However, covariance matrices are typically treated as independent before re-centering. In this work, we introduce a preprocessing step that enforces local geometric consistency among neighboring covariance matrices prior to RCT. The method is evaluated on a cross-subject binary workload classification task using the Team Metrics dataset under leave-one-subject-out (LOSO) validation. Classification performance is compared with the Minimum Distance to Mean (MDM) classifier and standard RCT. The proposed approach achieved mean accuracies of 77.73% and 73.91% using alpha and theta features, respectively, with moderate inter-subject variability.

Callum Smith Towards Neuroadaptive Mixed Reality: Bioadaptive Triggers for Cognitive Load Mitigation with Multimodal Assessment

Bioadaptive triggers are underexplored in Mixed Reality (MR), enabling closed loop adaptation to live biofeedback. We introduce a Unity based bioadaptive framework that streams electrodermal activity (EDA) via Lab Streaming Layer (LSL) and applies visual and haptic cues (dimming, spotlighting, vibration) when EDA rises above a resting baseline to reduce cognitive load, logging structured time locked LSL event markers to synchronised 16 channel Electroencephalogram (EEG) for multimodal analysis. Participants (N = 26) completed a MR anomaly detection task with scaling difficulty. Outcomes include NASA TLX, Likert ratings, Barratt Impulsivity, and physiological measures of EDA and EEG. EEG analyses show central parietal positivity on error trials at Cz around 200 ms and peaking at 300 to 400 ms, consistent with P300 or error related positivity dynamics. This work provides a closed loop implementation and a multimodal evaluation approach for studying bioadaptive mitigation in MR.

17:00 – 17:45 **Session 3: Validations and methodological advancements 2**

Daniele Germano Toward Reliable passive BCI in Out-Of-The-Labs Environments

The transition of passive Brain-Computer Interfaces (pBCIs) from controlled laboratory settings to real-world applications requires robust systems with built-in self-quality assessment. Covariate shift, often induced by headset displacement, is a critical factor of system failure in real-world applications. This study proposes a two-stage framework for EEG signal management in ecological contexts. First, an Isolation Forest model for unsupervised monitoring, effectively detects anomalies between source and target sessions that correlate with signal quality degradation (r=−0.69). Second, a corrective function based on Riemannian geometry. Experimental results show that this transformation enhances classification performance, achieving AUC values for mental workload detection, that are not significantly different from the source dataset (p<0.05). These findings highlight the framework's potential for maintaining pBCI reliability in non-stationary industrial environments.

Nils Harmening MRI-Free, Artifact-Aware EEG Source Imaging for Mobile Neuroadaptive Systems

Personalized neuroadaptive EEG systems often require accurate EEG source imaging. However, real-world deployment faces significant challenges. Two major obstacles are the unavailability of subject-specific MRI scans and the increased signal contamination from muscle and eye artifacts during natural behavior. We present the individualized HArtMuT framework, which addresses both challenges simultaneously by combining data-driven head model individualization (PCAwarp) with explicit modeling of ocular and muscular source compartments(HArtMuT). Using only digitized electrode positions or photogrammetric scans, our approach reconstructs subject-specific anatomy and enables artifact-aware source localization without MRI. In a simulation study with 15 subjects, we compare the individualized HArtMuT for source localization accuracy with other approaches. This framework provides a scalable, practical pathway to improve the reliability of personalized, everyday neuroadaptive applications.

Talk Sessions Day 2

Thursday, April 23rd

11:30 – 12:30 **Session 4: Deep learning methods**

Yazin Al Musafir — Predicting EEG Seizures Using Graded Spiking Neural Networks

This study presents a novel non-patient-specific epileptic seizure prediction system using graded spiking neural networks (GSNNs) on Intel's Loihi 2 neuromorphic processor. The system achieved 99.14% prediction accuracy on the CHB-MIT dataset with 21.6 EEG segments/second throughput and 25.1 mJ/segment energy consumption. GSNNs demonstrated 6.26× improvement in event sparsity and 3.80× improvement in synaptic communication sparsity versus ANNs, enabling real-time wearable seizure prediction.

Urban Sirca — Assessing Robustness and Interpretability of EEG Foundation Models

EEG foundation models aim to learn general representations from large-scale neural data, yet their robustness and internal mechanisms remain poorly understood. This project studies whether these models remain stable under realistic perturbations such as channel loss, noise, and spatial shifts, and whether their internal features align with known neurophysiology. Several pretrained EEG foundation models are comapred with a supervised baseline across diverse tasks, using linear probing and fine-tuning. Stress tests are applied to measure performance degradation and calibration under noise and montage changes. Attribution, activation patching, and representation analysis are used to identify features that drive robustness or failure. The goal is to move beyond accuracy and assess whether EEG foundation models support reliable and interpretable neural decoding for real-world deployment.

Fawzi Babtain — Deep Learning Hybrid CNN-LSTM to Differentiating Mesial vs Neocortical Temporal Lobe Epilepsy (TLE)

Temporal Lobe Epilepsy (TLE) is the most prevalent focal epilepsy. However, rapid seizure propagation and overlapping semiology make it challenging to differentiate Mesial (mTLE) from Neocortical Temporal Lobe Epilepsy (nTLE). To address this, we proposed a CNN-LSTM model automating the classification of mTLE vs. nTLE using scalp EEG. We implemented a preprocessing pipeline with 5s pre-ictal and 20s early-propagation windows on a dataset of 660 seizures from 102 patients. The model combines convolutional layers for local feature extraction with stacked LSTM layers for long- term temporal dependencies. We compared it with four models: LSTM, Attention with LSTM, SMOTE with LSTM, and SMOTE combined Attention with LSTM. The proposed model achieved a mean accuracy of 86.67%, F1- score of 90.31%, and AUC of 0.93. These results indicate that Deep Learning (DL) can robustly classify TLE subtypes, offering potential for precise diagnosis.

13:30 – 14:15 **Session 5: User Experience for neuroadaptive technologies**

Lea Rabe Why 'userless' neuroadaptive technology is a problem and how to solve it

Real-world applications of neuroadaptive technologies (NATs) have previously been described as imminent or technically mature. However, much of NAT research remains confined to controlled laboratory settings, with limited translation into everyday contexts. In this talk, we seek to stimulate discussion on user-centred design approaches in NAT research and introduce co-production as a structured framework that may support more meaningful stakeholder involvement. We outline how co-production could be applied within our field to help move NATs beyond the laboratory and toward sustainable real-world implementation.

Aida Ponce Del Castillo Workplace neuroadaptive systems under EU law: GDPR, the AI Act and the Charter of Fundamental Rights

Neuroadaptive systems that estimate cognitive workload, stress, or affective states are increasingly proposed for workplace use. This article examines how they are regulated under EU law through the combined application of the GDPR, the AI Act, and the Charter of Fundamental Rights. It makes three contributions. First, it shows that neural signals linked to identifiable workers constitute personal data and, where processing reveals information about mental or physical health, fall within Art 9 GDPR, making reliance on consent structurally fragile in hierarchical employment relationships. Second, it clarifies that under the AI Act, the prohibition of emotion recognition and high-risk classification depend on the functional integration of neural outputs into monitoring or decision-making processes in employment, with limited scope for derogation under Art 6(3). Third, it demonstrates that proportionality under Art 52(1) of the Charter operates as an additional constitutional constraint.

Poster Presentations

Wednesday, April 22nd
15:00 – 17:00

#1 *Andrey Vlasov* Computational Consciousness as a Neuroadaptive Phase Transition

Imagine if your computer could not only respond to commands but also anticipate your needs by understanding its own role in shaping the shared human-machine experience. Our study proposes a novel framework that defines computational consciousness in neuroadaptive agents as a phase transition triggered by specific conditions: high internal complexity, robust bidirectional communication between human and AI, and consistent representation maintenance over time. By leveraging concepts from active inference, mutual information, and dynamical systems theory, we provide a rigorous foundation for identifying and experimentally validating emergent signs of artificial self-awareness. This approach opens new possibilities for exploring nascent forms of Artificial General Intelligence (AGI) within explicitly constrained human-in-the-loop settings.

#2 *Andrey Vlasov* Breaking the Coping Trap: A Neuroadaptive Multi-Agent Model of Human–AI Symbiosis

Imagine an AI collaborator that doesn’t just follow instructions—it helps you overcome mental blocks and unlock creative insights. Our study reveals a novel framework blending neuroadaptive multi-agent model with symbiotic intelligence. We define 'coping traps' as maladaptive patterns in human–AI interactions, creating persistent inefficiencies. To counteract these traps, we engineer a symbiotic agent that dynamically alters goals and environments, encouraging cognitive flexibility and collaboration. Agent-based simulations confirm the efficacy of this approach, leading to significantly shorter periods spent in coping traps and greater overall synergy. This work marks a crucial milestone in developing next-generation neuroadaptive systems, uniting psychology, engineering, and artificial intelligence.

#3 *Aleksei Gorin* VR Inclusion: Clinician-Controlled VR Biofeedback System for Reducing Anxiety in Pediatric Medical Procedures

Needle-related procedures (e.g., venipuncture or vaccination) are among the most frequent invasive events in pediatric care and are a major source of pain, fear, and anxiety, with downstream effects on procedure duration, staff workload, and family satisfaction. Systematic reviews and meta-analyses [1, 2] indicate that immersive Virtual reality (VR) can reduce pediatric procedural pain, fear, and anxiety [3, 4], yet translation into routine outpatient workflows remains uneven. A practical gap is that many solutions are “standalone distraction” with limited clinician control, limited integration with procedure timing, and limited physiological grounding for measurement and personalization.

#4 *Lucija Mihić Zidar* Decoding Workload and Agreement From EEG in Spoken Human-AI Interaction

Passive brain–computer interfaces (pBCIs) offer a promising avenue for aligning Large Language Models (LLMs) via implicit feedback. We introduce an end-to-end pipeline that aligns continuous pBCI predictions for mental workload and implicit agreement with word-level conversational events. Our pilot study demonstrates that a workload classifier successfully generalized to a spoken-dialogue task, showing interpretable trends. However, the implicit agreement classifier, while technically feasible to deploy continuously, faced challenges in identifying discrete evaluative events when clear event labels were not available. These results establish the initial feasibility and boundary conditions for integrating pBCI into conversational AI.

#5 *Michael Leitner* Sex-specific EEG features during mental stress tasks for online usage

Mental stress detection using electroencephalography and the neurophysiological mechanisms underlying graded stress responses and potential sex-specific differences remain insufficiently understood. We analyzed spatial and non-linear EEG features across multiple stress levels with a focus on sex-dependent effects. We used EEG data from 32 females and 29 males performing a mental arithmetic task under time pressure and negative feedback. Band power features (frontal asymmetry, band power values and ratios) and non-linear features, were extracted from artifact-corrected epochs. Independent t-tests compared baseline, moderate, and high stress. Females showed significant frontal beta asymmetry and non-linear trends in frontal alpha asymmetry, whereas males exhibited widespread stress-related changes in various features and regions. These findings highlight the value of interpretable, low-complexity EEG features for sex-aware stress characterization in neuro-adaptive systems.

#6 *Michael Wimmer* Toward hybrid BCIs for augmented reality: Integrating EEG and eye tracking

Augmented reality (AR) can provide digital information about real-world entities within a user's physical environment. However, this information may conflict with user expectations due to objective inaccuracies or cognitive biases, potentially impairing trust and user experience. To address this, we investigate the feasibility of detecting mismatches between physical objects and digital information using a hybrid brain-computer interface. In an interactive paradigm, we measured incongruity-related changes in brain signals by linking neural activity to users' visual focus via eye-tracking (ET). Electroencephalographic (EEG) results revealed an N400 effect associated with semantic mismatch following visual fixation on incongruent information. Beyond its use as a temporal marker for EEG analysis, we employed ET to study gaze behavior, with no significant differences observed between conditions. Overall, our findings provide evidence that detecting AR incongruity is in principle feasible.

#7 *Alexandra Moringen* — Microgenetic and embodiment-based optimization of motor learning in dyads

Learning dexterous motor skills, as required in medical training or rehabilitation demands extensive practice and is therefore time-consuming. One way to accelerate this process is dyad learning, where two learners share their learning experiences. This can be done by alternating between performance and observational practice while discussing their strategies and findings. Here we build on recent work that poses the questions, such as, how to best align learners in a dyad, for dyad motor learning to be most effective. The contribution of this work is a simulation framework that models dyad practice using
reinforcement learning (RL) agents. Our framework offers a computational foundation that should enable us to mine, model and optimize both the relevant embodiment features and microgenetic strategies that make dyad learning so effective. For real-world studies, we will use kinematic and audio measurements, as well as fNIRS signal recorded during the learning process.

#8 *Andreea-Luiza Marin* — EyeZen: A Neuroadaptive Stress-Relief Intervention Combining Gaze-Controlled Communication with EEG-Guided Adaptive Breathing and Multimodal Relaxation

Patients with severe motor impairments face two interconnected challenges: communication barriers and emotional dysregulation. Current assistive technologies address these separately, fragmenting care. We propose EyeZen, a neuroadaptive BCI that unifies both functions in a single gaze-controlled interface. For communication, LLM-powered response generation enables flexible expression using only eye movements. For stress management, real-time EEG assesses the user's state and automatically selects an appropriate breathing technique, delivered through synchronized haptic, visual, and auditory channels. While designed for motor-impaired patients, EyeZen is also suitable for healthy users; therefore, we present a research plan for a feasibility pilot study with healthy participants (N = 5) to evaluate stress-reduction efficacy, laying the groundwork for future clinical deployment.

#9 *Anoushka Jain* — UnitRefine: A Community Toolbox for Automated Spike Sorting Curation

High-density electrophysiology enables recording from hundreds of neurons, but isolating single units still relies on slow, subjective manual curation, limiting scalability. We developed UnitRefine, a machine-learning toolbox that automates curation using expert annotations. Integrated into the SpikeInterface ecosystem, it combines quality metrics, cascading classification, and hyperparameter optimization. UnitRefine achieves performance comparable to expert annotations across diverse datasets, increasing single-unit yield while maintaining quality and improving behavioral decoding. Beyond offline analysis, UnitRefine is well suited for real-time BCI pipelines as an adaptive post–spike-sorting layer operating outside the latency-critical loop. By refining unit quality in the background, it stabilizes spike-train representations without added computational overhead, with the potential to reduce decoder drift and improve the reliability of neural control signals across sessions.

#10 *Yanzhao Pan* — Neuroadaptive VR Gaming Through Passive BCI-Based Interaction Intent Decoding

Neuroadaptive technologies utilize real-time neurophysiological signals to dynamically model users' cognitive states and enable adaptive system behavior. We present a virtual reality (VR) gaming system that combines eye gaze for spatial targeting with a passive EEG-based brain–computer interface (BCI) to decode interaction intent and binary action decisions. Nineteen participants completed calibration and online gameplay sessions. Classifiers trained from calibration data achieved accuracies of 0.6587 ± 0.0105 for binary action decisions and 0.8531 ± 0.0075 for interaction intent, both significantly above chance. During real-time gameplay, mean classification accuracy reached 69.64% ± 1.20%. Questionnaire results indicated that BCI interaction was experienced as engaging and more fun than controller input supporting the feasibility of BCI-based intent decoding for neuroadaptive VR interaction.

#11 *Inbal Pearl* — EEG-Based Classification of Spontaneous Hand-Selection Intentions in a BCI-VR Rehabilitation Framework

We present NeuroSpace, an EEG-based BCI-VR rehabilitation platform targeting learned nonuse following unilateral upper limb impairment. Unlike conventional motor imagery paradigms, NeuroSpace decodes spontaneous intention to use the more-affected versus less-affected hand, aiming to modulate hand selection bias. EEG was recorded from 84 healthy and seven hemiparetic participants during gamified VR tasks. Pre-movement analysis revealed pronounced differences in cortical motor preparation between groups, particularly for the more-affected hand. Riemannian geometry features with ridge regression achieved best intra-subject decoding in healthy (71.23 ± 14.44%) and clinical (73.24 ± 22.50%) participants. A transfer learning pipeline with model-similarity-based subject selection improved clinical performance (78.89 ± 25.06%) while minimizing calibration demands. These findings support the feasibility of low-calibration, transfer-based EEG decoding for clinical rehabilitation.

#12 *Nico Henschel* — Mapping Hugs: Two Hug Barrels Mediate Hug Interactions

Currently, robotic systems or multimodal interfaces that are squeezable with the torso that transmit light and heat are rare and do not incorporate a method that creates continuous maps of an individual arm's pulling force field. These two deformable, human-sized, light-coupled spring core cylinders are designed to encourage mediated and repeated squeeze interactions among strangers with torso contact levels as input, heat and light as output. Our approach measures EEG/fNIRS head leaning levels and a motion trace to track the sequential beginnig of the hug interaction. We pursue hypothesis testing from the collected human-robotic system hug data, such as contact time and touch patterns on the barrel in order to map hug patterns and measure responses to longer-as-usual, and interrupted hug interactions sent between two people.

#13 *Juliette Meunier* Toward studying collaborative coupling with hyperscanning

Workspace awareness is the real-time understanding of how other individuals interact within a shared workspace. While existing tools can track users' observable actions, the underlying cognitive processes involved in collaboration are harder to capture, particularly across different degrees of collaborative coupling, defined as the manner in which collaborators are involved with each other. Understanding this coupling is crucial, as a coupling breakdown can lead to miscommunication and misalignment and, at the end, a poor performance for the collaborative task. To investigate these processes, this study proposes hyperscanning, which enables the simultaneous recording of multiple brains and highlights inter-brain synchrony. We aim to examine how collaborative coupling and its breakdown affect inter-brain synchrony using a task inspired by the board game "Saboteurs," where four participants cooperatively build paths toward a shared goal while one secretly receives conflicting objectives.

#14 *Sourav Bhattacharjee* Understanding Passive BCI Self-Tracking Practices in Everyday Life

Passive brain-computer interfaces (BCIs) can extend wellbeing self-tracking by offering a continuous, low-effort system for monitoring cognitive and affective states, such as stress and mental overload. Yet in HCI/BCI research, progress is still often judged by technical performance, while we know much less about what happens once people try to live with these devices: when they trust them, ignore them, reinterpret them, or stop tracking altogether. This PhD uses personal informatics theory to study passive BCI wellbeing tracking as an everyday practice, how people decide to start, how they make sense of ambiguous readings, what leads to lapses, and how (or whether) they resume. Using a multi-phase mixed-methods study centred on stress and mental-overload monitoring, the research will produce empirically grounded design guidance for supporting monitoring under uncertainty, with a focus on resumption after breaks and on turning "unclear" data into workable reflections and actions.

#15 *Prathu* Mechanistic Cognitive State Decoding from fNIRS Using Dynamic Systems Theory

Functional Near-Infrared Spectroscopy (fNIRS) offers a portable platform for real-world BrainComputer Interfaces (BCIs). However, current machine learning approaches suffer from poor crosssubject generalization and a lack of mechanistic interpretability. We introduce a Dynamic Systems Theory
(DST) framework using state-space identification, Dynamic Causal Modelling, and Recurrence Quantification Analysis to decode cognitive states from bilateral prefrontal fNIRS. This mechanistic approach aims to enable anticipatory neuroadaptive interventions by tracking cognitive trajectories toward vulnerable states, addressing critical limitations in data efficiency and cross-subject transfer that plague current black-box approaches.

#16 *Selina Wriessnegger* Inside your ear, but also inside your head? Correlation patterns between In-Ear and Scalp EEG

In-ear electroencephalography (in-ear EEG) offers a non-invasive approach for long-term neural monitoring, but its correspondence with scalp EEG remains unclear. This study assessed the spatial relationship between single-channel in-ear EEG and 32-channel scalp EEG during an N-back task in 20 participants. Band-power features (theta, alpha, beta, gamma) were computed using Welch's method, and Spearman correlations were calculated between in-ear and scalp signals. The strongest correlations were observed in the alpha band ($r \approx 0.54$, $p < 0.001$) over lateral centro-parietal regions, with additional frontal effects ($r \approx 0.40$, $p < 0.001$). Other bands showed weaker but significant correlations. Spatial patterns matched expected sensitivity profiles and increased slightly with cognitive load. These findings suggest in-ear EEG provides a coarse approximation of scalp activity, particularly for alpha rhythms, supporting its use in real-world monitoring.

#17 *Praneel Bhatia* Neuroadaptive Robotic Control: Integrating Synthetic Neural Signal and Embodied Reasoning for a VLA Policy

This system description paper presents a modular system for online neuroadaptive support in robotic manipulation tasks, modeled as an "Actor-Reasoner-Interpreter" loop. Our system integrates (i) an Actor module that runs a Vision-Language-Action (VLA) model controlling a robot in simulation; (ii) a Reasoner module that queries a Vision-Language-Model (VLM), fine-tuned for embodied and spatial reasoning, to produce a narration of the robot's perceived ongoing action and reasoning; and (iii) an Interpreter module monitoring passive neural feedback of a human observer (error potentials, agreement, surprise, workload) to trigger live, language-based corrective prompts for the Actor. We demonstrate the system's capacity for real-time VLA support without pausing the robot's execution using synthetic neural signals. The architecture provides a reusable blueprint for studying closed-loop, neural-based VLA support without retraining the underlying robot policy.

#18 *Aleksandr Groznykh* Closed-Form Neural Cellular Automata for Learned Feature Visualization

We introduce ClosedFormNCA, a neural cellular automaton whose update rule admits a closed-form solution across continuous time. By parameterising the latent dynamics as a separable linear operator — an orthogonal channel mixer composed with a depthwise convolution diagonalised in the Fourier domain — the full T-step rollout of the automaton reduces to a single matrix exponential evaluated pointwise in frequency space. A learned non-linear lift/project pair restores expressivity, while a marginal-stability constraint on the spectrum guarantees bounded trajectories for arbitrary t. We use this construction as a new differentiable image parameterisation for feature visualisation: rather than optimising pixels, we optimise the NCA rule so that rolling it out from fresh Gaussian noise to any $t \in [t_{min}, t_{max}]$ yields a CLIP-channel-maximising image. The approach inherits the local, self-organising inductive bias of NCAs, as well as the sub-linear inference cost of structured state-space models.