

Dr. Alexander von Lühmann



Biomedical Engineering
& Neurotechnology



CONTACT

- Berlin
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EDUCATION

Dr.-Ing. with highest distinction
Neurotechnology & Machine Learning
Berlin Institute of Technology
2014 – 2018

M. Sc. & B. Sc. (both theses 1,0/A+)
Electrical Engineering & Inf. Tech.,
Karlsruhe Institute of Technology
2011 – 2014

COMPETENCIES

Research & Development

- Data Science / Machine Learning
(*Matlab, Python*)
- Bio-signal Acquisition & Analysis
- Mixed-Circuit Electronics Design
(*Eagle, Pulsonix, Altium*)
- Microcontrollers & Embedded
Programming (C, C++)
- CAD design & Rapid Prototyping
(*SolidWorks, SiemensNX, Blender3D*)
- Neuroscience & Physiology

Management

- Line Management
- Project Management
- Research Grant Acquisition &
Management
- Product & Process Development

WORK ETHICS

Outstanding results depend on passion, continuous learning, and commitment – and a great team. It is crucial for me to contribute to a trust- and truthful environment, in which good communication, open mindedness and integrity are highly valued. As a specialist for bio signal acquisition and -processing, combining hardware architecture engineering and data science, I work with an interdisciplinary focus to drive science and innovation.

WORK EXPERIENCE

For a complete list of my experience and projects visit my [lab's website](#) and [my personal website](#).

Technische Universität Berlin - Machine Learning Dept. | BIFOLD Research Group Lead IBS-Lab 11.2022 - present

The "*Intelligent Biomedical Sensing (IBS) Lab*" is an Independent Research Group at *BIFOLD* / Machine Learning Department, TU Berlin. The IBS Lab develops machine learning methods and wearable instruments for comprehensive brain-body monitoring of the embodied brain in the everyday world.

- Development and lead of group (3,5 researchers and 3 students)
- *Biomedical Electrical Engineering*: wearable, unobtrusive multimodal neurotechnology and biosensors for functional Near-Infrared Spectroscopy (fNIRS), diffuse optical tomography (DOT) and Oximetry, Electroencephalography (EEG), Electro -myo-, -oculo-, -cardiography (ExG).
- *Machine Learning*: methods for the extraction of multivariate biomarkers from complex bio signals. Physiological modeling and physiological transfer functions considering non-stationary and non-instantaneous relationships, context sensitivity, and automatic data annotation.

NIRx Medizintechnik GmbH/LLC

Chief Scientific Officer	11.2022 - present
Scientific Director R&D	11.2020 - 10.2022
Senior Scientist	08.2020 - 11.2020

Scientific lead advisor on and science and technology strategy and roadmap.
Previously: Line and Project Management of Research & Development Division

- *Harvard Business School – Economics for Managers Course + Certificate*
- Grew the R&D team from 6 to 15 (Software, ProductDesign, OptoElectronics)
- Ownership and expansion of NIRx' product portfolio and tech-strategy.
- Acquisition, management, and execution of research grants
- Lead design, research, & system architecture of fNIRS research instruments
- Product and process management, implementation of project management, requirements management, SOPs and development processes



MEMBERSHIPS

- **ISO/IEC** JWG "Oximeters" and **DIN**, expert for fNIRS standard 80601-2-71
- **OPTICA** (formerly OSA) – Optical Society of America
- fNIRS Society (**sfNIRS**)
- **VDI** Germany

AWARDS & SCHOLARSHIPS

- **Early Investigator Award** 2022 by the fNIRS Society
- **BIMoS PhD Award** 2019: best dissertation in data science at TU Berlin
- German Society for Biomedical Engineering (**DGBMT**) **Klee-Award** 2018 (3rd)
- **IEEE TBME** 64(2) 2017 **Cover Article + Special Feature**
- **Scholarship + Research fellowship** at BIMoS Graduate School TU Berlin 2014-2018
- **Research scholarships** by Machine Learning Department TU Berlin, 2014-2018
- **Winner Innovation Academy Biotechnology** (BMBF) 2012

Gallup StrengthsFinder

- ★ Achiever
- ★ Learner
- ★ Input
- ★ Empathy
- ★ Communication

WORK EXPERIENCE (CONTINUED)

Boston University & Harvard Medical School

Visiting Researcher 07.2020 - present
Postdoctoral Researcher 01.2019 - 06.2020

Development of Hard- and Software infrastructure and data driven methods for wearable everyday Brain-Imaging using fNIRS and EEG.

- Project and development lead of a hybrid real-time EEG-fNIRS brain decoding pipeline (Matlab). Human study and paradigm design.
- Development of a novel multimodal data driven unsupervised extension of the gold standard General Linear Model for fNIRS (see publications [4,5])
- www.openfnirs.org: lead development of flexible individualized 3D printed head caps (ninjaCap) and support ninjaNIRS hardware development.

Crely Healthcare Pte. Ltd. (Singapore & US)

Chief Technology Officer 11.2018 - 08.2020

Development of an AI-based warning system for the prediction of Surgical Site Infections (SSI) with a non-invasive, wearable smart dressing

- System and hardware architecture development and supervision
- Consultation in animal and clinical study

Technische Universität Berlin - Machine Learning Dept.

Visiting Researcher 01.2019 - 10.2022
PhD Researcher 08.2014 - 08.2018

Dissertation 2018: "*Multimodal Instrumentation and Methods for Neurotechnology out of the Lab*". Development of...

- multimodal miniaturized wearable EEG-fNIRS hardware (publication + patent [1]), Founder of the open source fNIRS project (openfnirs.org), see [2].
- novel multimodal machine learning & blind source separation for fNIRS [3].
- Brain Computer Interface experimental paradigm design & execution: [9,10]

Karlsruhe Institute of Technology - Biomedical Engineering Dept.

Research Project Manager 05.2013 - 01.2014

- Concept and grant design, application, project management and execution (BMBF project # 031A236) for multimodal wearable vigilance assessment

REFERENCES

Prof. Dr. Klaus-Robert Müller
Machine Learning Department,
TU Berlin

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Prof. Dr. Benjamin Blankertz
Neurotechnology Department,
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Prof. David Boas, PhD
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University & Harvard Medical School

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Prof. Dr. Olaf Dössel
Institute of Biomed. Engineering,
Karlsruhe Institute of Technology

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LATEST INVITED TALKS

See ibs-lab.com/media-talks for all talks

- Fraunhofer IAO, D, '22
- fNIRS Conference, 2x, USA, '22
- University of Rhode Island, USA, '22
- Instituto Santos Dumont, Brasil Virtual, '22
- fNIRS Society Virtual, '21
- fNIRS Summer School, Tübingen University, D, '21
- fNIRS Society Educational Tutorial Series, virtual, '21
- OSA Optics and the Brain Conference, USA, '20
- Neurophotonics Symposium, Boston University, '20

EDITING

- **Frontiers in Neuroergonomics**, Associate Editor for Physical Neuroergonomics

REVIEWING (EXCERPT)

- Science Advances
- OSA Biomedical Optics Express
- SPIE Neurophotonics
- PLOS One
- IEEE TNSRE. (Neur. Sys.)
IEEE TBME (Biomed. Eng.)
- Frontiers in Human Neuroscience
- IOP Journal of Neural Eng.
- AIP Rev. of Sci. Instruments
- MDPI Sensors, MDPI Photonics

11 PUBLICATIONS (SELECTION)

39 publications (13 peer-reviewed journal articles, 5 patents, 20 conference publications). Citations: >760, h-index = 11, i10 index = 11. A complete list of publications is available on the [IBS-labs' website](https://ibs-lab.com) and [google scholar](https://scholar.google.com).

Hardware Development

- [1] von Lühmann, Wabnitz, Sander and Müller, „M3BA: A Mobile, Modular, Multimodal Biosignal Acquisition architecture for miniaturized EEG-NIRS based hybrid BCI and monitoring”, **IEEE Trans. on Biomedical Engineering**, vol. 64, no. 6, pp. 1199-1210, 2017 (**special feature and front cover article IEEE TBME**)
- [2] von Lühmann, Herff, Heger, and Schultz, “Towards a wireless open-source instrument: functional near-infrared spectroscopy in mobile neuroergonomics and BCI applications”, **Frontiers in Human Neuroscience**, vol. 9, no. 617, 2015

Data Science

- [3] von Lühmann, Boukouvalas, Müller and Adali “A new blind source separation framework for signal analysis and artifact rejection in functional Near-Infrared Spectroscopy”, **NeuroImage**, vol. 200, pp. 72-88, 2019
- [4] von Lühmann, Li, Müller, Boas, and Yücel, “Improved physiological noise regression in fNIRS: A multimodal extension of the General Linear Model using temporally embedded Canonical Correlation Analysis”, **NeuroImage**, vol. 208, 2020
- [5] von Lühmann, Martinez, Boas and Yücel, “Using the General Linear Model to Improve Performance in fNIRS Single Trial Analysis and Classification: A Perspective”, **Frontiers in Human Neuroscience**, 2020

Consensus, Review, Opinion Paper

- [6] von Lühmann, Zheng, Martinez, Kiran, Somers, Cronin-Golomb, Awad, Ellis, Boas and Yücel, “Towards Neuroscience of the Everyday World (NEW) using functional Near Infrared Spectroscopy.” **Current opinion in biomedical engineering**, pp. 100272., 2021
- [7] Yücel*, von Lühmann*, et al. “Best practices for fNIRS publications.” **Neurophotonics**, vol. 8 no. 1, pp. 012101, 2021 | *joint first-authorship
- [8] Soekadar, Kohl, Masahito and von Lühmann, “Optical brain imaging and its application to neurofeedback.” **NeuroImage: Clinical** vol. 30, pp 102577, 2021

Multimodal Neuroimaging Datasets

- [9] Shin, von Lühmann, Blankertz, Kim, Hwang and Müller, „Open Access Dataset for EEG+NIRS Single-Trial Classification”, **IEEE Trans. on Neural Systems and Rehabilitation Engineering**, vol. 25, no. 10, pp. 1735-1745, 2017
- [10] Shin, von Lühmann, Kim, Mehnert, Hwang and Müller, “Simultaneous acquisition of EEG and NIRS during cognitive tasks for an open access dataset”, **Nature Scientific Data**, vol. 5, art. No. 180003, doi: 10.1038/sdata.2018.3, 2018
- [11] A. von Lühmann, et al. “Open Access Multimodal fNIRS Resting State Dataset With and Without Synthetic Hemodynamic Responses.” **Frontiers in neuroscience** 14, 2020.

PATENTS (EXCERPT)

- [1] A. von Lühmann and K.-R. Müller, “Biosignal acquisition device and system, method for acquisition of biosignals”, **US Patent # US10799161B2**, granted in EU & US, CN, CA, 2016
- [2] A. von Lühmann, “NIRS device and method”, EU Patent **#EP20217768.9A1** (filed), 2021
- [3] A. von Lühmann, “Capacitive sensor system for measurement of electromagnetic bio-signals” **DE Patent # DE102012014219A1**, 2013