

Raul C. Sîmpetru, M. Sc.

raul.simpetru@fau.de |  orcid.org/0000-0003-0455-0168

Neural Interfaces, Motor-Intent Decoding, and BCI Systems

[Google Scholar](#)

ACADEMIC PROFILE

Neuroengineer working at the intersection of neural interfaces, computational motor control, machine learning, and real-time assistive systems. My research develops methods to decode motor intent and movement manifolds from neural and neuromuscular signals, connects them to closed-loop devices, and complements data-driven interfaces with biophysical simulation. Current work spans surface EMG, motor-unit activity, wearable interfaces, neuromuscular digital models, and the systems questions required for robust long-term brain-computer interfaces.

ACADEMIC APPOINTMENTS

Invited Professor / Course Leader, Computer Science Kutaisi International University (KIU)	2025 - Ongoing <i>Kutaisi, Georgia</i>
International teaching in computer science and neurotechnology; course leadership in Neurocomputing, Robotics, Deep Learning, and Digital Signal Processing. Contributed to development of a new master's-level curriculum.	
Research Associate / Doctoral Researcher Neuromuscular Physiology and Neural Interfacing (n-squared) Lab, FAU	12.2023 - Ongoing <i>Erlangen, Germany</i>
Research on neural interfaces and neurorehabilitation, including motor-intent decoding, movement manifolds, real-time assistive control, wearable EMG systems, and neuromuscular simulation.	
Research and Teaching Assistant Neuromuscular Physiology and Neural Interfacing (n-squared) Lab, FAU	06.2022 - 09.2023 <i>Erlangen, Germany</i>
Research on hand motor control and high-density EMG; teaching in neural control of movement and related seminars.	
Research Assistant Fraunhofer Institute for Integrated Circuits (IIS)	10.2021 - 02.2022 <i>Erlangen, Germany</i>
Integrated a few-shot cancer-detection pipeline into an existing research system while preserving performance.	
Teaching and Student Assistant Machine Learning and Data Analytics Lab, FAU	11.2020 - 08.2021 <i>Erlangen, Germany</i>
Weekly exercises for Algorithms and Data Structures for Medical Engineers; development of gait-analysis and algorithm-benchmarking tools.	

EDUCATION

Dr.-Ing. (= Ph.D. in Engineering), Artificial Intelligence in Biomedical Engineering <i>Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU)</i>	12.2023 - 12.2026 <i>Germany</i>
Status Dissertation submitted; defense expected December 2026.	
Dissertation	<i>Restoration of Hand Function through Decoding of Motor Intent and Movement Manifolds from Neural Interfaces.</i>
Supervisor	Prof. Alessandro Del Vecchio
M.Sc. Medical Engineering <i>Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU)</i>	06.2022 - 10.2023 <i>Germany</i>
Thesis	<i>Predicting Hand Movements from Spared Motor Units after Cervical Spinal Cord Injury through an Artificial Intelligence System.</i>
Supervisors	Prof. Alessandro Del Vecchio and Dr. Matthias Ponfick
B.Sc. Medical Engineering <i>Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU)</i>	10.2019 - 10.2022 <i>Germany</i>
Thesis	<i>Robust Prediction of Hand Kinematics from Surface Electromyography using Convolutional Neural Networks and Machine Vision.</i>
Supervisors	Prof. Alessandro Del Vecchio and Prof. Andreas Arkudas

SELECTED RESEARCH PROJECTS AND COLLABORATIONS

BIONIK - Bidirectional Interface between Neuroorthoses and Users for Interactive Control BMFTR START-Interaktiv, FAU	04.2026 - Ongoing
Bidirectional neuroorthosis control with FAPS: neural-intent decoding, shared autonomy, and vibrotactile sensory feedback.	

GRASPAGAIN - A Direct Sensorimotor Connection with the Spared Neural Code of Movement to Regain Motor Function	01.2024 - Ongoing
ERC Starting Grant, FAU	
Peripheral neural interfaces for decoding spared spinal motor output after paralysis; my work includes movement-manifold analysis, real-time decoding, and MyoGestic.	
GraspAgain - Restoring Hand Function with Neuromuscular Restrictions using an Intelligent Neuroorthosis	12.2023 - 05.2026
Medical Valley Award / StMWi, FAU	
Developed and tested EMG decoding and real-time neuroorthosis control in participant studies, forming part of the clinical MyoGestic work.	
International collaborations: TUM / MIRMI: Joint pilot with Prof. Cristina Piazza mapping sEMG-derived human control manifolds to a prosthetic hand for individual finger control. University of Campinas, Brazil: Co-development of MyoGen with Profs. Ricardo G. Molinari, Renato N. Watanabe, and Leonardo A. Elias.	

TEACHING AND SUPERVISION

Applied Programming	04.2025 - 07.2025
B.Sc. Artificial Intelligence, FAU	
Course teaching in programming and computational problem solving.	
MindMove; Movement Neuroscience; Interfacing the Neuromuscular System	2023 - Ongoing
FAU	
Seminar and project-based teaching spanning motor neuroscience, neural interfaces, biosignal processing, and real-time myoelectric interaction.	
Neurocomputing; Robotics; Deep Learning; Digital Signal Processing	2025 - Ongoing
Kutaisi International University	
Course leader / invited faculty in an international computer-science curriculum.	
Supervision	Supervision of bachelor's and master's theses, student research projects, and research assistants in neural interfaces, EMG decoding, representation learning, real-time systems, and assistive control.
Pedagogical training	FAU Certificate for Teacher Assistants, Continuing Education Centre for University Teaching (FBZHL), 2020.

ACADEMIC SERVICE AND LEADERSHIP

Organizing Committee Member	09.2026
2026 IEEE International Conference on Cyborg and Bionic Systems (CBS 2026)	
<i>Munich, Germany</i>	
Conference organization for the IEEE Robotics and Automation Society meeting on cyborg and bionic systems.	
Session Chair - Medical Robotics	09.2026
IEEE CBS 2026	
<i>Munich, Germany</i>	
Chaired the Medical Robotics session.	
Professional memberships	IEEE; The Physiological Society; Fraunhofer Alumni Network.

OPEN-SOURCE RESEARCH SOFTWARE

MyoGestic	Co-creator and core developer of an open-source real-time biosignal interfacing framework for recording, processing, machine-learning inference, and closed-loop control. MyoGestic 2.0 was released in 2026 following a ground-up redesign; the clinical framework was published in <i>Science Advances</i> . GitHub · Documentation · Zenodo .
MyoGen	Author and maintainer of an open-source biophysical simulation framework linking cortical drive, spinal motor-neuron dynamics, proprioceptive feedback, muscletendon mechanics, and surface/intramuscular EMG. Current release: v0.11.0 (2026). The associated manuscript is under review at <i>Nature Communications</i> . GitHub · Documentation · Preprint .

AWARDS AND DISTINCTIONS

Co-author of Best Student Paper Award-winning contribution, IEEE CBS 2026	09.2026
<i>MyoKin3X</i>	
IEEE TBME Featured Article	12.2024
<i>Learning a Hand Model from Dynamic Movements Using High-Density EMG and Convolutional Neural Networks</i>	
DMEA Young Talent Award - 3rd Prize	04.2023
German Health IT Association (bvitg e.V.)	

INVITED AND SELECTED PRESENTATIONS

Invited Symposium Talk

24.06.2026

International Society of Electrophysiology and Kinesiology Congress (ISEK 2026)

Jyväskylä, Finland

MyoGestic: Real-time closed-loop control of preserved motor intent using wearable HD-EMG and deep learning.

Rapid-Fire Presentation and Posters

08.07.2025

14th International Motoneuron Society Meeting

St. John's, Canada

Presented MyoGestic and MyoGen; posters on real-time EMG interfacing and biophysical neuromuscular simulation.

Oral Presentation

26.06.2024

ISEK 2024

Uncertainty-aware hand posture classification for better assistive devices in spinal cord injury patients.

Selected Oral Presentation

13.12.2023

Neurophysiological Bases of Human Movement, The Physiological Society

Can we use AI to find the unharmed motor dimensions and give them back to the patient? One of eight oral presentations.

PEER-REVIEWED PUBLICATIONS

- 09.2026 Tillaeva, M., Braun, H., **Sîmpetru, R.C.**, Kadereit, L., Castellini, C., Del Vecchio, A. *Co-located Ultrasound and Tattoo-Electrode sEMG for Hand Gesture Decoding*. **2026 IEEE International Conference on Cyborg and Bionic Systems (CBS 2026)**, in press.
- 09.2026 Rohleder, C., **Sîmpetru, R.C.**, Wünsch, A., Del Vecchio, A. *MyoKin3X: A myoelectric framework for full-hand 3D force recording*. **2026 IEEE International Conference on Cyborg and Bionic Systems (CBS 2026)**, in press.
- 05.2026 Rahimi, F., Badamchizadeh, M.A., **Sîmpetru, R.C.**, Ghaemi, S., Eskofier, B.M., Del Vecchio, A. *Simultaneous control of human hand joint positions and grip force via HD-sEMG and deep learning*. **IEEE Access**. [doi:10.1109/ACCESS.2026.3692583](https://doi.org/10.1109/ACCESS.2026.3692583).
- 04.2026 Haller, D., Beermann, F., **Sîmpetru, R.C.**, Hofbeck, L., Enoka, R.M., Del Vecchio, A. *Voluntary dissociation of motor unit activity in the vastii muscles*. **Journal of Neuroscience**. [doi:10.1523/JNEUROSCI.1982-25.2026](https://doi.org/10.1523/JNEUROSCI.1982-25.2026).
- 04.2025 **Sîmpetru, R.C.**, Braun, D.I., Simon, A.U., März, M., Cnejevici, V., Souza de Oliveira, D., Weber, N., Walter, J., Franke, J., Höglinger, D., Prahm, C., Ponfick, M., Del Vecchio, A. *MyoGestic: EMG interfacing framework for decoding multiple spared motor dimensions in individuals with neural lesions*. **Science Advances** 11, eads9150. [doi:10.1126/sciadv.ads9150](https://doi.org/10.1126/sciadv.ads9150).
- 10.2024 **Sîmpetru, R.C.**, Souza de Oliveira, D., Ponfick, M., Del Vecchio, A. *Identification of Spared and Proportionally Controllable Hand Motor Dimensions in Motor Complete Spinal Cord Injuries Using Latent Manifold Analysis*. **IEEE Transactions on Neural Systems and Rehabilitation Engineering** 32, 3741-3750. [doi:10.1109/TNSRE.2024.3472063](https://doi.org/10.1109/TNSRE.2024.3472063).
- 07.2024 **Sîmpetru, R.C.**, Arkudas, A., Braun, D.I., Osswald, M., Souza de Oliveira, D., Eskofier, B.M., Kinfe, T.M., Del Vecchio, A. *Learning a Hand Model from Dynamic Movements Using High-Density EMG and Convolutional Neural Networks*. **IEEE Transactions on Biomedical Engineering** 71(12), 3556-3568. [doi:10.1109/TBME.2024.3432800](https://doi.org/10.1109/TBME.2024.3432800).
- 07.2024 Tsay, J., Steadman, N., Fleming, M., Gann, M., Di Giulio, I., Graef, C., Han, J., Jayasinghe, K., Mitchell, M., Chen, R., Raheel, K., Semedo, E., **Sîmpetru, R.**, Utami, K.P., Williams, A., Zhu, Z., Stagg, C., Haar, S. *Bridging the gap between experimental control and ecological validity in human sensorimotor science*. **Journal of Physiology**. [doi:10.1113/JP287037](https://doi.org/10.1113/JP287037).
- 06.2024 Pfenning, S., **Sîmpetru, R.C.**, Pollak, N., Del Vecchio, A., Fey, D. *Analysis of embedded GPU architectures for AI in neuromuscular applications*. **IADIS International Journal on Computer Science and Information Systems** 19, 1-14.
- 03.2024 **Sîmpetru, R.C.**, Cnejevici, V., Farina, D., Del Vecchio, A. *Influence of spatio-temporal filtering on hand kinematics estimation from high-density EMG signals*. **Journal of Neural Engineering** 21. [doi:10.1088/1741-2552/ad3498](https://doi.org/10.1088/1741-2552/ad3498).
- 01.2024 Küderle, A., Ullrich, M., Roth, N., Ollenschläger, M., Ibrahim, A.A., Moradi, H., Richer, R., Seifer, A.-K., Zürl, M., **Sîmpetru, R.C.**, et al. *Gaitmap - An Open Ecosystem for IMU-Based Human Gait Analysis and Algorithm Benchmarking*. **IEEE Open Journal of Engineering in Medicine and Biology** 5, 163-172. [doi:10.1109/OJEMB.2024.3356791](https://doi.org/10.1109/OJEMB.2024.3356791).
- 10.2023 Pfenning, S., **Sîmpetru, R.C.**, Pollak, N., Del Vecchio, A., Fey, D. *Evaluation of GPU-Centric Embedded Architectures in the Field of Neuromuscular EMG-Based AI*. **Proceedings of the International Conferences on Applied Computing 2023 / WWW/Internet 2023**, 39-46. [doi:10.33965/ICWI_AC_2023_202307L005](https://doi.org/10.33965/ICWI_AC_2023_202307L005).
- 07.2023 **Sîmpetru, R.C.**, März, M., Del Vecchio, A. *Proportional and Simultaneous Real-Time Control of the Full Human Hand From High-Density Electromyography*. **IEEE Transactions on Neural Systems and Rehabilitation Engineering** 31, 3118-3131. [doi:10.1109/TNSRE.2023.3295060](https://doi.org/10.1109/TNSRE.2023.3295060).

- 02.2023 Küderle, A., Richer, R., **Șîmpetru, R.C.**, Eskofier, B.M. *tcp: Tiny Pipelines for Complex Problems - A set of framework-independent helpers for algorithm development and evaluation*. **Journal of Open Source Software** 8, 4953. [doi:10.21105/joss.04953](https://doi.org/10.21105/joss.04953).
- 07.2022 **Șîmpetru, R.C.**, Osswald, M., Braun, D.I., Souza de Oliveira, D., Cakici, A.L., Del Vecchio, A. *Accurate Continuous Prediction of 14 Degrees of Freedom of the Hand from Myoelectrical Signals through Convolutional Deep Learning*. **IEEE EMBC 2022**, 702-706. [doi:10.1109/EMBC48229.2022.9870937](https://doi.org/10.1109/EMBC48229.2022.9870937).
- 07.2022 Cakici, A.L., Osswald, M., Souza de Oliveira, D., Braun, D.I., **Șîmpetru, R.C.**, Kinfe, T.M., Eskofier, B.M., Del Vecchio, A. *A Generalized Framework for the Study of Spinal Motor Neurons Controlling the Human Hand During Dynamic Movements*. **IEEE EMBC 2022**, 4115-4118. [doi:10.1109/EMBC48229.2022.9870914](https://doi.org/10.1109/EMBC48229.2022.9870914).

PREPRINTS AND MANUSCRIPTS

- 06.2026 Rohlf, D.R., **Șîmpetru, R.C.**, Braun, D.I., Souza de Oliveira, D., Ponfick, M., Del Vecchio, A. *Physiological and pathological motor unit phenotypes coexist within single motor pools after cervical SCI*. Preprint. [doi:10.64898/2026.06.04.730075](https://doi.org/10.64898/2026.06.04.730075).
- 01.2026 **Șîmpetru, R.C.**, Molinari, R.G., Rohlf, D.R., Batichotti, R.L., Watanabe, R.N., Elias, L.A., Del Vecchio, A. *MyoGen: Unified Biophysical Modeling of Human Neuromotor Activity and Resulting Signals*. bioRxiv. **Under review at Nature Communications**. [doi:10.64898/2026.01.01.697284](https://doi.org/10.64898/2026.01.01.697284).
- 06.2025 Cnejevici, V., Ponfick, M., Fey, D., **Șîmpetru, R.C.**, Del Vecchio, A. *Closed-loop Neuroprosthetic Control through Spared Neural Activity Enables Proportional Foot Movements after Spinal Cord Injury*. arXiv:2506.16468. [arXiv:2506.16468](https://arxiv.org/abs/2506.16468).

PUBLIC ENGAGEMENT AND OUTREACH

Public Talk	07.2025
AI Camp, Nuremberg Digital Festival	Nuremberg, Germany
EMG-based hand control and neurorehabilitation.	
Public Talk	05.2025
Pint of Science	Nuremberg, Germany
Introduction to EMG-based hand control for a general audience.	
Public Demonstration	10.2024
Consumenta	Nuremberg, Germany
Demonstration of an intelligent neuroorthosis for restoring hand movement in people with neuromuscular impairments.	

TECHNICAL EXPERTISE

Neural interfaces	High-density surface EMG, intramuscular EMG, motor-unit analysis, biosignal acquisition, motor-intent decoding, movement manifolds, uncertainty-aware control, closed-loop myocontrol.
Machine learning	PyTorch, deep learning, representation learning, computer vision, real-time inference, model evaluation, HPC, CUDA, Triton, TensorRT.
Systems and software	Python, C/Cython, MATLAB, JavaScript, Git, multithreading, gRPC, LSL, BLE systems, embedded/on-device inference, scientific software engineering.
Simulation	NEURON, biophysical motor-neuron and motor-unit modelling, muscletendon and electrophysiological simulation.
Languages	Romanian (native); German (fluent); English (fluent).