TOMAS ROS DIGITAL CURRICULUM VITAE

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EDUCATION

Higher Education

2006- 2010 Goldsmiths, University of London, UK
Doctorate in Psychology (PhD) [*Awarded* : 31/12/2010]

2001- 2003 Louis Pasteur University, Strasbourg, France
Masters in Neuroscience (MSc)

1997-2000 Imperial College of Science, Technology and Medicine, London, UK
Bachelors in Physics (BSc)

PAST AND PRESENT RESEARCH POSITIONS

2024- Senior Lecturer
Department of Clinical Neuroscience, **University of Geneva**, Switzerland

2019- 2024 Scientific Collaborator
Department of Neuroscience, **University of Geneva**, Switzerland

2016 -2018 Research Associate
Department of Neurology, **Geneva University Hospitals**, Switzerland

2012-2015 Marie-Curie Research Fellow
Department of Neuroscience, **University of Geneva**, Switzerland

2010-2011 Postdoctoral Researcher
Department of Psychiatry, **University of Western Ontario**, Canada

Honors & Awards

2014 **Brain Star Award**
Canadian Institutes of Health Research

2011 **Best Scientific Paper Award**
Self-regulation of functional MRI connectivity via EEG neurofeedback
Psychiatry Academic Research Day, UWO, Canada

2010 **Best Publication Award**
Endogenous control of waking brain rhythms induces neuroplasticity
Foundation for Neurofeedback and Applied Neuroscience, CA, USA

2009 **Best Student Paper Award**
Neuroplastic effects of endogenously entrained brain rhythms
International Society for Neurofeedback, Indianapolis, USA

2008 **Best Student Paper Award**
Optimising Microsurgical Skills with EEG Neurofeedback
International Society for Neurofeedback, San Antonio, USA

Language Skills

English: Fluent
French: Fluent
Italian: Mother tongue
Croatian: Mother tongue

Reseach Statement

My career has been focused on applications of real-time electroencephalogram (EEG) signal processing, and how brain-computer interfaces (BCI) and neurofeedback may be used to modulate the brain and behavior. My interdisciplinary background in physics, neuroscience and psychology has driven my interest for combining multiple modalities with human EEG recordings (e.g. EEG-TMS, EEG-fMRI, EEG-PET). During my PhD, I used transcranial magnetic stimulation (TMS) to probe for the effects of neurofeedback, showing for the first time neuroplastic changes in cortical excitability directly after a training session (Ros et al, 2010). During my postdoc at Western University in Canada, I developed a neurofeedback protocol for reducing mind-wandering, which in parallel modulated functional connectivity in fMRI salience/default-mode networks (Ros et al 2013). This led to the first translational study investigating the impact of this protocol on patients with post-traumatic stress disorder (PTSD), revealing a positive effect on their symptoms and large-scale brain networks (Ros et al, 2014, 2017). During my postdoc at the University of Geneva, I worked on several EEG projects for the rehabilitation of visuospatial attention in stroke patients (Ros et al, 2017), demonstrating network disruptions of EEG source connectivity (Ros et al, 2022). Following this, I have acted as principal investigator via the NCCR-Synapsy showing that alpha-rhythm neurofeedback can enhance executive functions in ADHD (Deiber et al, 2020, 2021). I collaborated with the UNIGE Functional Brain Mapping Lab in the advancement of spectral methods of EEG microstate analysis (Ferat et 2022) and clinical applications of machine learning (Terpou et al 2022).

Research Outputs

Significant Publications

Ros T, Munneke MA, Ruge D, Gruzelier JH, Rothwell JC.
Endogenous control of waking brain rhythms induces neuroplasticity
European Journal of Neuroscience (2010); 31(4): 770-778
DOI: 10.1111/j.1460-9568.2010.07100.x
Open access: https://www.tomasros.com/publications
A single 30-min session of EEG-neurofeedback induced a lasting and activity-dependent (EEG-correlated) increase in cortical excitability of up to 150%. This was comparable to excitability increases following noninvasive brain stimulation techniques such as rTMS and tDCS. The findings were the first to show a direct neuroplastic change induced by neurofeedback.

Ros T, Theberge J, Frewen PA, Kluetsch R, Densmore M, Calhoun VD Lanius R.
Mind over chatter: Plastic up-regulation of the fMRI salience network directly after EEG neurofeedback
NeuroImage (2013); 65: 324—335
DOI: 10.1016/j.neuroimage.2012.09.046
Open access: https://archive-ouverte.unige.ch/unige:26206
Using multimodal EEG and fMRI, and compared to a sham group, EEG-neurofeedback led to plastic changes in coupling within salience and default-mode fMRI networks, predicting decreased mind-wandering during an attention task 30 minutes later. This suggests a basis for treating disorders with excessive levels of thought intrusion (e.g. ADHD, depression).

Ros T, Kluetsch R, Theberge J, Frewen P, Candrian G, Mueller A, Vuilleumier P, Lanius R
Neurofeedback Tunes Scale-Free Dynamics in Spontaneous Brain Activity
Cerebral Cortex (2017); 27(10):4911-4922.
DOI: 10.1093/cercor/bhw285
Open access: https://archive-ouverte.unige.ch/unige:90238
Validating a theoretical framework based on critical brain dynamics, EEG-neurofeedback training induced significant decreases in hyperarousal symptoms in patients with post-traumatic stress disorder (PTSD), that were associated with a normalization of scale-free dynamics of spontaneous EEG activity (LRTCs: long-range temporal correlations).

Deiber MP, Hasler R, Colin J, Dayer A, Aubry JM, Baggio S, Perroud N, Ros T
Linking alpha oscillations, attention & inhibitory control in ADHD with EEG neurofeedback.
Neuroimage Clinical (2020); 25:102145.
DOI: 10.1016/j.nicl.2019.102145
Open access: https://archive-ouverte.unige.ch/unige:144381
At baseline, significantly attenuated alpha oscillations in adult ADHD patients compared to neurotypical controls revealed a signature of cortical hyper-activation. Neurofeedback training led to alpha normalization during a continuous performance task and correlated with individual improvements in motor inhibition (i.e. reduced commission errors) only in the ADHD group.

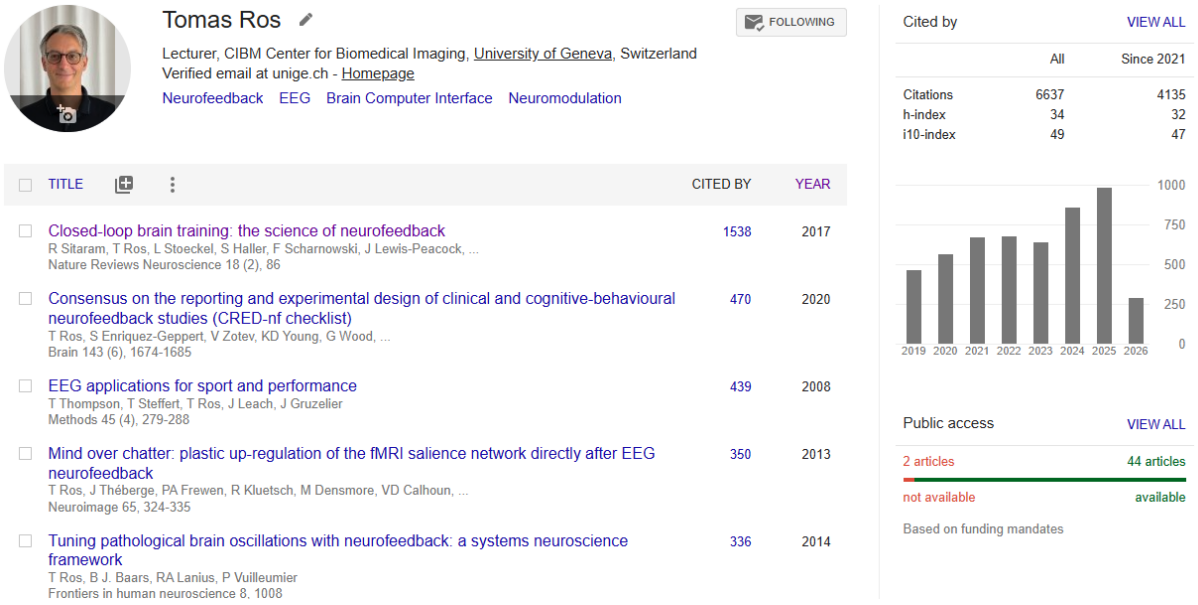
Ferat V, Arns M, Deiber MP, Hasler R, Perroud N, Michel CM, Ros T
EEG Microstates as Novel Functional Biomarkers for Adult ADHD
Biological Psychiatry: CNN (2021) S2451-9022(21)00319-0.
DOI: 10.1016/j.bpsc.2021.11.006.

Open access: https://archive-ouverte.unige.ch/unige:156996
The first study using brain (micro)state dynamics to decompose the spontaneous EEG in patients with attention-deficit hyperactivity disorder (ADHD). A replicable microstate biomarker was found across two independent datasets (depite no evident differences in spectral power) that correlated with sleep disturbance.

SIGNIFICANT METHODS

Ferat V, Seeber M, Michel CM, **Ros T**
Beyond broadband: Towards a spectral decomposition of EEG microstates
Human Brain Mapping (2022)
DOI: 10.1002/hbm.25834
Open access: https://onlinelibrary.wiley.com/doi/full/10.1002/hbm.25834
The first study to show that despite similar microstate (MS) topographies, MS temporal sequences have informational independence between classical EEG bands. Importantly, a narrow-band MS taxonomy (e.g., θA and αC) predicted different behavioral states more accurately compared to traditional broadband MS measures.

Ros T, Kwiek J, Andriot T, Michela A, Vuilleumier P, Garibotto V, Ginovart N.
PET Imaging of Dopamine Neurotransmission During EEG Neurofeedback.
Frontiers in Physiology (2021) 11:590503.
DOI: 10.3389/fphys.2020.590503
Open access: https://archive-ouverte.unige.ch/unige:149326
With the HUG Nuclear Medicine division, we pioneered a simultaneous EEG-PET experiment while participants performed EEG neurofeedback inside a PET scanner. This involved dynamic PET brain imaging using the unique dopamine receptor radiotracer Fallypride, which allows imaging of endogenous dopamine release on a minute-by-minute temporal resolution.



H-index: 34
Total number of citations: > 6600
Total number of publications: 65

Scientific Planning

Currently important questions remain on the electrophysiological (e.g. amplitude, frequency, connectivity) and anatomical (e.g. regions, networks) domains that underpin human behaviors such as attention, language and memory. My plan is to harness the dynamic signals from EEG-based brain-computer interfaces to manipulate specific EEG features and more accurately determine whether their involvement in behavior is causal, rather than simply correlative. In light of the improved anatomical specificity and spatial resolution of source-based EEG measures, this would also involve developing an EEG inverse-source localization toolbox for real-time neurofeedback training using network-based parameters (e.g. source-based microstates, dynamic functional connectivity). In the context of the significant heterogeneity of brain disorders, this approach would be deployed along with deep (longitudinal tracking of subjects) and wide (big data across subjects) phenotyping that could be harnessed by machine learning algorithms (e.g. SVM or deep neural networks) to identify candidate biomarkers for neurorehabilitation, whether in psychiatry (e.g. ADHD, schizophrenia, ageing) or neurology (e.g. epilepsy, stroke).

Research Collaborations

Prof. Ruth Lanius (Department of Psychiatry, Western University, Canada)
I have a long-standing (> 10 years) collaboration with Prof. Lanius, who is head of the Post-traumatic Stress Disorder (PTSD) Unit. We have collaborated extensively on EEG/fMRI correlates of PTSD and its clinically-significant treatment with neurofeedback. Currently, we have co-authored 8 peer-reviewed papers together (e.g. Ros et al 2017, Nicholson et al 2020).

Prof. Nader Perroud (Department of Psychiatry, HUG, Switzerland)
In the last 4 years I have collaborated with Prof. Perroud, head of the Geneva University Hospitals adult attention-deficit hyperactivity disorder (ADHD) Unit. Our collaboration initially began via the NCCR-Synapsy program, but we are continuing to work together and have thus far published 1 paper on EEG microstate biomarkers of ADHD (Ferat et al 2021) and 2 papers on alpha-rhythm neurofeedback for ADHD (Deiber et al 2020, 2021).

Prof. Nathalie Ginovart (Department of Neuroscience, UNIGE, Switzerland)
My first collaboration with Prof. Nathalie Ginovart, who is an expert in PET imaging, involved developing the first simultaneous EEG-PET protocol to image neuromodulator release dynamically during neurofeedback (Ros et al 2021). Then, with the support of the Louis Jeantet Foundation, we embarked on a clinical study investigating the EEG and PET signatures of chronic Cannabis Use Disorder (CUD) as well as Internet Gaming Disorder. The first results of this study are in press (Andriot et al 2022).

Prof. Dimitri Van De Ville (Bioengineering at EPFL and University of Geneva, Switzerland)
My collaboration with Prof. Van De Ville started through the Leenards Project that investigated the EEG/fMRI correlates of visuospatial neglect in stroke patients (Ros et al 2017). I am currently acting as an adviser for the Wyss-Center NeuroTin project (where Prof. Van De Ville is a collaborator), which is examining the benefit of EEG- and fMRI-based neurofeedback on patients with tinnitus disorder.

Research Funding and Grants

2023 Ros T
Innovating neurofeedback therapy for ADHD: training real-time brain (micro)states
Swiss National Science Foundation Project Grant. 760,000 CHF

2017 Ginovart N, Khaazal Y, Ros T
Neurofeedback for Cannabis Use Disorder: A pilot study on clinical effects and possible relationship with brain dopamine function
Louis Jeantet Foundation and Geneva University Hospitals. 500,000 CHF

2016 Saj A, De Ville D, Serino A, Ros T, Vuilleumier P
Rehabilitation of attentional disorders after stroke using neurofeedback
Leenards Foundation, Lausanne. 430,000 CHF

2015 Ros T, Ginovart N
Neurochemical Substrates of Neurofeedback
BIAL Foundation, Portugal. 50,000 EUR

Research Supervision and Mentoring

I had the opportunity to mentor several scientists over the years with the goal of sharing my knowledge of online/offline EEG processing, biostatistics and cognitive neuroscience.

Starting from 2018, I have acted as principal investigator within a research group that formed around the Synapsy EEG neurofeedback project for ADHD, which included Prof. Nader Perroud, Roland Hasler, and Dr. Marie-Pierre Deiber. Given my expertise in the field, I trained Dr. Deiber to perform online EEG neurofeedback successfully in psychiatric patients and I have similarly supervised the offline EEG analyses (Deiber et al 2020, 2021).

More recently, I have acted as direct supervisor of Victor Ferat, a PhD student in the Functional Brain Mapping Lab who successfully defended his thesis in December 2023. So far, we have published two papers where I have featured as principal investigator, that were focused on EEG microstate analyses (Ferat et al 2021, 2022). In 2021, based on this work, Victor won the Best Poster Prize at the Basic Clinical and Multimodal Imaging (BaCI) Conference.

In the meantime, I have also supervised the Masters thesis projects of Dr. Abele Michela (former PhD student at Radboud University Nijmegen), Mr. Theo Andriot (now a PhD student at Sorbonne University, Paris) and Ms. Sara Djambazovska (now at Google).

Other Scientific Activities

2022 Real-Time Functional Neuroimaging Conference (Yale University, USA)
Program Committee member

2021 Recent innovations in M/EEG microstate analysis, BaCI Conference 2021
Symposium Chair

2020 Neurofeedback as a tool for targeting the correlates of brain disorders
Department of Neurology, Geneva University Hospitals, Switzerland
Invited speaker

2016-2018 NEWROFEEDBACK Multicentre Clinical Trial on Childhood ADHD
Scientific Committee member

Journal Reviewer for (selected journals): **Elife, Neuron, Nature Communications, Cerebral Cortex, Journal of Neural Engineering, Brain Topography, Human Brain Mapping, NeuroImage, IEEE**

CONTRIBUTIONS TO OPEN SCIENCE

In this context, I have a GitHub repository for sharing code (e.g. eCAPs toolbox) and software for signal processing. I also created a personal webpage which allows others free access to all my publications, as well as a number of scientific presentations (please see below). I am a strong believer in sharing written up results as pre-prints, in order to minimize the delay between discovery and peer-reviewed publication. In the same vein, I have made it a habit to upload all copies of officially published papers to the Geneva Open Archive.

GitHub repository : https://github.com/tomasros
Academic Webpage : https://www.tomasros.com/

SCIENTIFIC OUTREACH

2021 *Therapie mit Neurofeedback: «Noch sehr viel Forschung nötig»*
Beobachter magazine article, Switzerland

2020 Public lecture & demonstration of a live EEG recording to school children
Ecole Internationale, Geneva, Switzerland

2018 *Le neuro-feedback ou comment mieux faire fonctionner son cerveau*
Radio Television Suisse podcast, Switzerland

2015 *Plastic modulation of PTSD resting-state networks by EEG neurofeedback*
appeared in magazines **Le Nouvel Observateur**:
Cerveau: le meilleur des ondes & **Le Monde de L'Intelligence**: Mind-Mirror

2013 *Mind over Chatter* was covered in **Le Monde** newspaper
Pirates du Cerveau by Yves Eudes

TEACHING EXPERIENCE

I have more than 15 years of teaching experience at the university level, having taught classes on EEG BCI/neurofeedback at the Masters and PhD level at the Faculties of Medicine and Psychology of University of Geneva (e.g. Techniques for Investigating Cerebral Functions, Clinical and Experimental Neuropsychology). My teaching essentially covered the potential causal relationships that can be revealed between changes in brain activity and behavior induced by closed-loop brain training (e.g. EEG synchronization measures, BOLD regression analyses, network functional connectivity), and how to design experiments to appropriately disentangle such effects. Given my experience with different processing pipelines of brain signals and interdisciplinary background, I like to expose students to research evidence collected from a wide range of tools available to cognitive neuroscience, such as multimodal functional neuroimaging including EEG/MEG/fMRI and transcranial magnetic stimulation. In

terms of the official student evaluation (ADEVEN) of my module within the course Techniques for Investigating Cerebral Functions, I have recently received a global score of 3.8 out of 4 (i.e. > 95%) on average.

Extra-murally, I was invited in the last year to take part in an EEG practicum at the University of Lausanne, where students were shown how to implement their own closed-loop recording for real-time EEG processing.

Finally, in the capacity as research staff scientist of the Center for Biomedical Imaging (CIBM), I have given two online seminars (CIBM Breakfast & Science Seminars) covering the topics of EEG microstates and machine learning methods for clinical populations.

Academic Teaching

2014-2026 BRAIN-COMPUTER INTERFACES & NEUROFEEDBACK
Advanced PhD course in EEG recording and analysis
PhD in Neuroscience, Faculty of Medicine, University of Geneva

2014-2026 FMRI & EEG NEUROFEEDBACK
Techniques for Investigating Cerebral Functions
Master in Neuroscience, Faculty of Medicine, University of Geneva

2018-2026 EEG AND NEUROFEEDBACK IN PSYCHIATRY
Fundamentals of neuropsychiatry
Department of Psychiatry, Belle Idee Campus, University of Geneva

2021 EEG II - EEG METHODS : AN OVERVIEW
PhD course on research with EEG, including practical demonstration
Faculty of Psychology, University of Lausanne

2016 -2019 NEUROFEEDBACK: THE BRAIN UNDER SELF-CONTROL
Clinical and Experimental Neuropsychology
Master in Clinical Psychology, Faculty of Psychology, University of Geneva

Development of Teaching Tools and Activities

As leading co-author, in 2020 I headed a community effort to produce the first paper providing consensus guidelines for more rigorous reporting and experimental design of clinical and behavioural neurofeedback studies. This document was an interdisciplinary effort uniting more than 80 researchers and/or clinicians in the fields of EEG and fMRI neurofeedback. The guidelines have been published open-access in the journal *Brain* as well as through a dedicated app available freely on the internet.

CRED-nf checklist application:
https://crednf.shinyapps.io/CREDnf/

Consensus on the reporting and experimental design of clinical and cognitive-behavioural neurofeedback studies (CRED-nf checklist)
Ros T., Enriquez-Geppert S., *(see online for full author list)*
BRAIN (2020); 143(6):1674-1