

Thibault Roumengous, PhD
Research Scientist/Engineer
Richmond, Virginia

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PROFESSIONAL EXPERIENCE

Lead Scientist, Wearable physiological sensing technology, medical device development Jan 2022-Present
NIRSense Inc., Richmond, VA, USA

- ◆ Serving as Principal Investigator on several DoD R&D contracts, including a direct-to-phase II SBIR funded by the US air force research lab (AFRL) for the development of a novel flight-compatible multimodal (EEG+fNIRS+tECS) cerebral monitoring and neuromodulation wearable system
- ◆ Leading scientific research activities within the company (internal R&D) and broader research projects (external) such as clinical and pre-clinical studies with many (> 10 CRADAs) industry and military collaborators
- ◆ Contributing to design and development of several sensors, including helmet-compatible, ultra-thin fNIRS wearable device for fighter jet pilots (NAVAIR) for real-time tracking of physiological events (G-LOC, desaturation events). Published work in relevant peer-reviewed scientific journals
- ◆ Developing algorithms to expand capabilities of current near-infrared spectroscopy (NIRS) system such as real-time oxygen saturation (SpO₂), pulse-rate, respiratory rate, blood pressure, cognitive workload, and more
- ◆ Conducting in-person research and designing experimental protocols and procedures in human and animal studies for applications of NIRSense wearable devices in the fields of hemorrhage and trauma monitoring (510k FDA clinical trial), physical performance and health, cognitive and sleep monitoring
- ◆ Co-developed and authored several patents including:
 - ◆ NEUROFEEDBACK APPLICATION OF MULTIMODAL NEUROIMAGING WEARABLE (US patent No. 63/389,282, pending)
 - ◆ SYSTEMS AND METHODS FOR DETECTING NEUROPHYSIOLOGICAL PARAMETERS (US patent No. 63/356,740, pending)
 - ◆ SYSTEMS AND METHODS FOR DETECTING BIOMETRIC PARAMETERS (US patent No. 63/351,237, pending)
- ◆ Recruited and managed a multi-disciplinary team of scientists, engineers and clinical researchers
- ◆ Attending/presenting at military research symposiums and related events to maintain and expand relationships with sponsors and program managers, customers and research collaborators within and outside the Department of Defense

R&D Engineer, Signal processing and analysis, device development 2019-2021
Bionica Labs LLC, Richmond, VA, USA

- ◆ Implemented state-of-the-art functional near-infrared spectroscopy (fNIRS) signal processing pipeline (SSR filtering, offline classification) for internal research and military applications
- ◆ Developed and maintained a centralized data processing platform on a secure remote server (Google Colab)
- ◆ Participated in 3D design and rapid prototyping of nylon parts of custom sensor patch
- ◆ Collaborated with consultants and engineers on statistical analyses, experimental design, data processing
- ◆ Developed cognitive workload testing program (n-back) from open-source python codebase
- ◆ Debugging, assembling, conducting human experiments and standardized tests with custom fNIRS device

Research Assistant, Rehabilitation Engineering to Advance Ability (REALab) 2017-2021
College of Engineering, Virginia Commonwealth University, Richmond, VA, USA

- ◆ Designed procedures using non-invasive brain and nerve stimulation (TMS, PNS) integrated with electromyography (EMG), electroencephalogram (EEG), kinematics and force/moment recordings as a novel method for monitoring neurorehabilitation of patients with chronic spinal cord injury (SCI)

- ◆ Conducted recruitment and testing of human subjects to develop diagnostic criteria and evaluate the reliability of novel TMS-based methods, data processed and analyzed with linear mixed effect (LME) modeling
- ◆ Mentored 10+ undergraduate and graduate students on independent projects relating to brain-computer interfaces and TMS research as a program mentor for the Deans Undergraduate and Early Research Initiative (DURI/DERI) with most resulting in conference presentations
- ◆ Implemented and tested low-cost navigated TMS system using motion tracking and open-source software (Unity) with performance on par with commercial systems and reduced cost by 85%
- ◆ Held a graduate teaching assistantship for Advanced Biomedical Signal Processing course for two years (EGRB 308, 2018-2020)

Research Assistant, Rehabilitation with Insight from Robotics and Engineering (Rewire Lab) 2016
Department of Mechanical Engineering, the University of Texas at Austin, TX, USA

- ◆ Engineered MRI-compatible force sensors and keyboards (using SLS 3D printing) for fine motor relearning evaluation of post-stroke patients
- ◆ Investigated impaired motor control and neurofeedback protocols (operant conditioning) using neuroimaging techniques such as functional magnetic resonance imaging (fMRI), fNIRS, and electrocorticography (ECoG)
- ◆ Led a human subject study with post-stroke and epilepsy patients and independently operated MRI scans
- ◆ Utilized machine learning algorithms including multi-voxel pattern analysis (MVPA) for data processing and analysis of large data sets to identify key findings

Research Assistant, Human Performance Physiology (LAMHESS Lab) 2014-2015
Université de Nice, France

- ◆ Collaborated with other R&D engineers to identify materials and integrate skin conductance and temperature sensors for the design of self-cooling smart clothing
- ◆ Assessed voluntary activation of the knee flexors in athletes by interpolating twitch technique of PNS responses to identify strength and neuromuscular fatigue differences among the population
- ◆ Managed and analyzed athlete human subject experiments and evaluated data for the presentation of results and future device design ideas to improve athlete performance

Physical Therapist Assistant, Hopital Renée Sabran 2013-2014
Hospices Civiles de Lyon, Physical Rehabilitation Department, France

- ◆ Worked alongside a licensed physical therapist with TBI, stroke, and COPD patients through their recovery conducting spirometry testing and electrostimulation
- ◆ Directly interacted with patients following therapy to answer questions and evaluate at home therapy

EDUCATION

- ◆ **Doctor of Philosophy (Ph.D.), Biomedical Engineering and Bioengineering** 2017-2021
VCU College of Engineering, Virginia Commonwealth University, Richmond, VA, USA
- ◆ **Master of Science (M.S.), Bioengineering (with high honors)** 2015-2016
Faculté des Sciences AMU, Luminy, Université Aix-Marseille, Marseille, France
- ◆ **Master (Maîtrise) of Science, Human Movement and Biomechanics (with honors)** 2014-2015
Faculté des Sciences, Université de Toulon, Toulon, France
- ◆ **Bachelor (Licence) of Science, Human Physiology and Rehabilitation** 2011-2014
Faculté des Sciences, Université de Toulon, Toulon, France

SKILLS

- ◆ **Coding Languages:** Python (Anaconda, Colab), MATLAB, R, Basic, C, C#. WebDev: HTML, CSS, JS, PHP
- ◆ **Operating Systems:** Windows, Ubuntu/Debian
- ◆ **Machine learning algorithms programming** (Tensorflow, SciPy), **Data mining, Statistical analysis** (LME models)
- ◆ **Expert in multimodal biological signal processing and analysis (e.g. optical, electrical, impedance-based)**
- ◆ **Translational clinical research**
- ◆ **Prototyping using 3D printing** (SLA, SLS, RAISE3D, Lulzbot)
- ◆ **Software:** Monday.com, CED Spike 2, RedCap, FreeSurfer, Microsoft Office suite, Statistica, Prism, Rstudio, Adobe
- ◆ **Mechanical design and FEA analysis** (SolidWorks Suite)
- ◆ Designing and implementation of **IRB approved human subject experiments**
- ◆ **Languages:** Fluent in French (native) and English, Intermediary level in Spanish and Japanese

PEER-REVIEWED PUBLICATIONS

- ◆ **T. Roumengous**, A. B. Reutter, and C. L. Peterson, "Effect of low-cost transcranial magnetic stimulation navigation on hotspot targeting and motor evoked potential variability in the biceps brachii" *Restorative Neurology and Neuroscience*, DOI: 10.3233/RNN-211207.
- ◆ C. S. Lynch, **T. Roumengous**, N. Mittal, and C. L. Peterson, "Effects of Stimulus Waveform on Transcranial Magnetic Stimulation Metrics in Proximal and Distal Arm Muscles" *Neurophysiologie Clinique*, DOI:10.1016/j.neucli.2022.07.002.
- ◆ **T. Roumengous** and C. L. Peterson, "Assessment of Biceps Voluntary Activation with Transcranial Magnetic Stimulation in Individuals with Tetraplegia" *Restorative Neurology and Neuroscience*, DOI:10.3233/RNN-221254.
- ◆ **T. Roumengous**, B. Thakkar, and C. L. Peterson, "Paired Pulse TMS in the Assessment of Biceps Voluntary Activation in Individuals with Tetraplegia" *Frontiers in Human Neuroscience*, DOI: 10.3389/fnhum.2022.976014
- ◆ **T. Roumengous**, Y. Zeineddine, Y. Cho, and C. L. Peterson, "Motor Evoked Potential Input-Output Curves Indicate Neuroplasticity of the Biceps Brachii after Cervical Spinal Cord Injury". *IEEE 11th EMBS Conference on Neural Engineering*.
- ◆ **T. Roumengous**, S. Critcher, T. Songkakul, R. C. Boutwell, J. Strohmaier, J. Allen. B. Morse, J. Beer, P. Sherman. "Cerebral Oxygenation Kinetics Monitoring of Military Aircrew at High G using Novel fNIRS Wearable System". *Frontiers in Neuroergonomics, Advances in Mobile Optical Brain Activity Monitoring*.

CONFERENCE PRESENTATIONS AND PROCEEDINGS

- ◆ **T. Roumengous**, R. C. Boutwell, J. Strohmaier, B. Morse, J. Beer, P. Sherman, L. Potter, C. Dooley. "Cerebral Hemodynamics Monitoring of Military Aircrew at High G: Towards In-Flight Event Detection". *Military Health System Research Symposium*, August 2023.
- ◆ R. C. Boutwell, J. Strohmaier, J. Allen, **T. Roumengous**, T. Songkakul, S. Critcher, B. Goldbach, K. Koradiya, S. Stewart, D. Rodenhaver, N. Marotta. "The NIRSense Argus Oximetry System, Wearable Brain and Muscle Monitoring for Performance Optimization and Casualty Care". *Military Health System Research Symposium*, August 2023.
- ◆ T. Songkakul, **T. Roumengous**, R. C. Boutwell, J. Strohmaier. "Wearable, Deep Tissue Oxygenation Tracking with a Flexible Patch for Casualty Monitoring". *Military Health System Research Symposium*, August 2023.
- ◆ S. Critcher, T. Songkakul, R. C. Boutwell1, J. Strohmaier, J. Allen, **T. Roumengous**. "Wearable Multimodal System for Aircrew Monitoring and Augmentation". *Military Health System Research Symposium*, August 2023.
- ◆ **T. Roumengous**, Invited Speaker and Panelist, "Maximizing Cognitive Performance". *VERTEX, Human Performance*, Austin, TX, December 7-8, 2022.

- ◆ R. C. Boutwell, N. Marotta, J. Allen, B. Goldbach, **T. Roumengous**, J. Strohmaier, M. Tenan, E. Friedrich, S. Stuart. “Wearable Near-Infrared Spectroscopy-based Physiological Monitoring during Hemorrhage”. Military Health System Research Symposium, Orlando, FL. September 13, 2022.
- ◆ **T. Roumengous**, R. C. Boutwell, J. Strohmaier, L. A. Hawthorn, W. D. Smith. “Flight Environment Compatible Wearable fNIRS for Real-Time Monitoring of Aircrew Cognitive Workload”. Invited Speaker at International Conference on Applied Human Factors and Ergonomics (AHFE 2023), NYC, July 25, 2022.
- ◆ **T. Roumengous**, R. C. Boutwell, J. Strohmaier, L. A. Hawthorn, W. D. Smith. “Flight Environment Compatible Wearable fNIRS for Real-Time Monitoring of Aircrew Cognitive Workload”. Invited Speaker and Panelist at SEMICON West, Smart MedTech, San Francisco, CA, July 12, 2022.
- ◆ **T. Roumengous**, Y. Zeineddine, C. L. Peterson. “Motor Evoked Potential Input-Output Curves Indicate Neuroplasticity after Spinal Cord Injury”. Summer Biomechanics, Bioengineering and Biotransport Conference (SB3C), June 14-18, 2021.
- ◆ C. S. Lynch, **T. Roumengous**, C. L. Peterson. “Effect of Stimulus Waveform on Transcranial Magnetic Stimulation Metrics in Proximal and Distal Arm Muscles”. Summer Biomechanics, Bioengineering and Biotransport Conference (SB3C), June 14-18, 2021.
- ◆ A. Reutter, **T. Roumengous**, C. L. Peterson. “Evaluation of a Low-Cost Navigation Technique for Transcranial Magnetic Stimulation”. Biomedical Engineering Society annual conference, Philadelphia, PA, October 16-19th, 2019.
- ◆ Y. Zeineddine, **T. Roumengous**, C. L. Peterson. “Motor Evoked Potential Recruitment Curves Indicate Neuroplasticity after Spinal Cord Injury”. Biomedical Engineering Society annual conference, Philadelphia, PA, October 16-19th, 2019.
- ◆ **T. Roumengous**, P. A. Howell, C. L. Peterson. "Voluntary Drive Amplifies Effects of Paired-pulse TMS and Arm Posture on Biceps Corticomotor Excitability". International Biomechanics Society Annual Meeting, Calgary, CANADA, August 4th, 2019.
- ◆ P. A. Howell, **T. Roumengous**, C. L. Peterson. "Increased Elbow Angle to Improve Measurement of Cortical Voluntary Activation of the Elbow Flexors". International Biomechanics Society Annual Meeting, Calgary, CANADA, August 4th, 2019.
- ◆ **T. Roumengous**, P. A. Howell, C. L. Peterson. “Biceps Voluntary Activation: Method To Calculate Pre-Stimulus Moment Affects Magnitude But Not Reproducibility”. Summer Biomechanics, Bioengineering, and Biotransport Conference, Seven Springs, PA, June 27th, 2019.
- ◆ **T. Roumengous**, C. L. Peterson. “Voluntary Drive Increases Detectability of Changes in Corticomotor Excitability”. Invited Speaker at the 2019 Virginia Academy of Science Annual Meeting, Norfolk, VA, May 23th, 2019.
- ◆ P. A. Howell, **T. Roumengous**, C. L. Peterson. "Innovative Methodologies to Reliably Assess Voluntary Activation of the Elbow Flexors". Central Virginia Society for Neuroscience annual symposium, Richmond, VA, March 24th, 2018.
- ◆ P. A. Howell, **T. Roumengous**, C. L. Peterson. "Cutaneous Stimulation and Arm Posture to Modulate Biceps Responses to Transcranial Magnetic Stimulation". Biomedical Engineering Society annual conference, Atlanta, GA, October 17-20th, 2018.

AWARDS/ACCOMPLISHMENTS/OTHERS

- ◆ National Center for Adaptive Neurotechnologies program (3 weeks of in-person training, 1 of 24 selected) funded by the National Institute of Health
- ◆ Reviewer for scientific journals:
 - ◆ Frontiers in Human Neuroscience (2021-present)
 - ◆ Brain Research (2022-present)
- ◆ Biomedical Engineering Society member (2017-2022)
- ◆ Society for functional Near Infrared Spectroscopy member (2022-present)
- ◆ Scientific Advisory Board Member, Applied Human Factor and Ergonomics Society (2023-present)
- ◆ Interdisciplinary Collaboration committee chair, Biomedical Engineering Graduate Student Council (2018-2019)
- ◆ French government scholarship to study abroad (2016)
- ◆ Volunteer tennis coach with Sportable.org for individuals with motor impairments
- ◆ Volunteer host of educational sessions on science with REALab (National Biomechanics Day 2020, 2019, 2018)
- ◆ Therapeutic Patient Education Certification (2015)