Curriculum vitae

1. Personal details

Name: Samu Taulu
Email: staulu@uw.edu
ORCID: 0000-0001-6164-3366
Date of CV: September 19, 2023

2. Degrees

- Doctor of Science (Tech.), Department of Technical Physics, Helsinki University of Technology, Finland (date of award: October 14, 2008)
  - Title of Ph.D thesis: "Processing of Weak Magnetic Multichannel Signals: The Signal Space Separation Method"
  - Ph.D advisor: Dr. Juha Simola
- Master of Science, Department of Technical Physics, Helsinki University of Technology, Finland (date of award: April 11, 2000)

3. Current employment

- Associate Professor (tenure-track), Department of Physics, University of Washington, Seattle, WA, USA (09/01/2018-)
- Director of I-LABS MEG Brain Imaging Center, Institute for Learning and Brain Sciences, University of Washington, Seattle, WA, USA (09/25/2014-)
- Consultant, Sigma 3SP (https://sigma3sp.com/)

4. Previous work experience

- Research Associate Professor, University of Washington, Seattle, USA (09/25/2014 - 08/30/2018)
- Senior Clinical Applications Scientist, Elekta Oy, Helsinki, Finland (2012 - 2014)
- Senior Researcher, Elekta Neuromag Oy, Helsinki, Finland (2006-2012)
- Researcher, Elekta Neuromag Oy, Helsinki, Finland (2003 - 2006)
- Method development engineer, Neuromag Oy / 4D Neuroimaging, Helsinki, Finland (2000 - 2003)
- Master's thesis student for Neuromag Oy (private company) and Low Temperature Laboratory at Helsinki University of Technology, Finland (1999 - 2000)
- Research Assistant, Low Temperature Laboratory at Helsinki University of Technology, Finland (1997 - 1998)

5. Research funding and grants

- $400,000 NIH R21 funding for the development of mathematical methodology aiming at improvement of the precision of inverse models in MEG. I am the Principal Investigator (PI) of the project and I will be applying the vector spherical harmonic expansion, QR pivoting, and global optimization on multi-channel MEG data. The grant number is R21EB033577-01 and it is for period 7/6/2022 – 3/31/2025.
- $40,845 funding for the of mapping magnetic field and tissue parameters using the elliptical signal model of balanced steady state free precession MRI. I am the PI of the project and the purpose of the grant is to support UW physics graduate student Yiyun Dong in collaboration with University of California San Francisco. I am the faculty mentor for Yiyun. The grant is for period 9/16/2022 – 9/15/2023.
- $1,105,000 NIH R01 funding for method development and implementation in MNE Python in the role of a co-PI. This is a renewal of grant number R01NS104585-01A1 mentioned below. The PI of the whole project is Dr. Matti Hämäläinen at Massachusetts General Hospital, Harvard University, who has recently moved to Aalto University. The grant number R01NS104585-01A1 and it is for the time period July 2022 - June, 2027
- $519,215 NIH U01 funding for the development of optically pumped magnetometer (OPM) sensor arrays. I have the main responsibility for one of the three specific aims of the project, which is focused on modeling and calibration of OPM sensor signals. My role in the application is co-PI. The PI of the whole project is Dr. Peter Schwindt at Sandia National Laboratories. The grant number is 1U01EB028656-01 and it is for the time period March 4, 2020 - February 4, 2025.
- $1,163,611 NIH R01 funding for method development and implementation in MNE Python in the role of a co-PI. The PI of the whole project is Dr. Matti Hämäläinen at Massachusetts General Hospital. The grant number R01NS104585-01A1 and it is for the time period August 1, 2018 - May 31, 2022 (expired).
- $46,911 NIH R01 bridge funding for the development of calibration and analysis methods of a new MEG system consisting of optically pumped magnetometer sensors in the role of a co-PI. The PI of the whole project is Peter Schwindt at Sandia National Laboratories. The project has been completed.
- Co-Investigator in an NIH R21 grant funded at $434,710 for the investigation of biological origins of literacy. The PI of the project is Jason Yeatman at the UW. The grant number is R21HD092771-01A1 and it is for the time period July 1, 2018 - June 30, 2021 (expired).

6. Research output

- Total number of peer-reviewed publications as of September 19, 2023: **55**
- Total number of citations, according to Google Scholar as of September 19, 2023: **5778**
- Ten most cited papers, according to Google Scholar as of September 19, 2023:
    1. **Taulu S** and Simola J, "Spatiotemporal signal space separation algorithm for rejecting nearby interference in MEG measurements, Phys. Med. Biol. 2006; 51(7):1759. **Total number of citations: 1335**.
    2. **Taulu S**, Kajola M, and Simola J, "Suppression of interference and artifacts by the signal space separation method", Brain Topography. 2004; 16(4):269-275. **Total number of citations: 544.**
    3. **Taulu S**, Simola J, and Kajola M, "Applications of the signal space separation method", IEEE Trans. Sign. Proc. 2005; 53(9):3359-3372. **Total number of citations: 536.**
    4. **Taulu S** and Kajola M, "Presentation of electromagnetic multichannel data: the signal space separation method", J. Appl. Phys. 2005; 97(12):124905. **Total number of citations: 389.**
    5. **Taulu S** and Hari R, "Removal of magnetoencephalographic artifacts with temporal signal-space separation: Demonstration with single-trial auditory-evoked responses", Hum. Brain Mapp. 2009; 30(5):1524-1534. **Total number of citations: 336.**
    6. Imada T, Zhang Y, Cheour M, **Taulu S**, Ahonen A, and Kuhl P, "Infant speech perception activates Broca's area: a developmental magnetoencephalography study", Neuroreport. 2006; 17(10):957-962. **Total number of citations: 298.**
    7. Ramirez F, Ramirez R, Clarke M, **Taulu S**, and Kuhl P, "Speech discrimination in 11-month-old bilingual and monolingual infants: a magnetoencephalography study", Dev. Sci. 2017; 20(1), e12427. **Total number of citations: 167.**
    8. Huotilainen M, Kujala A, Hotakainen M, Parkkonen L, **Taulu S**, Simola J, Nenonen J, Karjalainen M, and Näätänen R, "Short-term memory functions of the human fetus recorded with magnetoencephalography", Neuroreport. 2005; 16(1):81-84. **Total number of citations: 149.**
    9. Uutela K, **Taulu S**, Hämäläinen M, "Detecting and correcting for head movements in neuromagnetic measurements", Neuroimage. 2001; 14(6):1424-1431. **Total number of citations: 134.**
    10. Hari R, Baillet S, Barnes G, Burgess R, Forss N, Gross J, Hamalainen M, Jensen O, Kakigi R, Mauguiere, F, Nakasato N,

Puce A, Romani G-L, Schnitzler A, and **Taulu S**, "IFCN-endorsed practical guidelines for clinical magnetoencephalography (MEG)", 2018; Clin. Neurophys., 129(8): 1720-1747. **Total number of citations: 125.**

- Main methods and tools developed:
    - Main developer and inventor of the Signal Space Separation methodology (SSS/tSSS) that is widely used for interference suppression, data standardization, and movement compensation in MEG. This methodology contains several algorithmic variants of the basic idea.
    - Main contributor to the application of the vector spherical harmonic (VSH) expansion in the modeling of multi-channel whole-head MEG data. This approach has been extensively used, besides SSS, in interpretation of the information and sampling considerations of novel MEG sensor arrangements.
    - Inventor of the Oversampled Temporal Projection method (OTP) that is used for the suppression of random sensor noise and channel artifacts. This is helping neuroscientists, e.g., in the detection of brainstem and high-frequency oscillation signals in MEG.
    - Supervision of some of the major contributors of the MNE Python open-source toolbox to enhance signal processing of MEG data of various vendors.
    - Main contributor of the standardized workflow leading from data acquisition to inverse modeling in infant MEG. The workflow and guidelines have been published in Human Brain Mapping.
    - Major role in the design of the active compensation methodology that made light magnetically shielded rooms available.
    - Major role in the calibration and cross-talk correction of multichannel MEG instruments.
    - Major role in developing algorithms for clinical MEG workflows especially in the case of epilepsy and Parkinson's disease.
    - Inventor of the mathematical idea to improve MEG signal detection and processing quality by breaking the near-spherical symmetry of multichannel MEG recordings. The idea was published in (Nurminen et al. 2013). As a result, a unique 360-channel MEG system was designed and built.

- 13 patents or patent applications in the field of MEG instrumentation, signal processing, and data analysis.

7. Teaching

- Teacher at the introductory and advanced customer training courses for Elekta Oy, Finland.
- Guest lecturer at several graduate-level physics courses at Helsinki University of Technology, Finland.
- Instructor of the Master's thesis of Liisa Helle (completed in 2009), Department of Technical Physics, Aalto University, Espoo, Finland.
- PhD advisor for Jussi Nurminen, Department of Technical Physics, Aalto University, Espoo, Finland. Nurminen received the Doctoral degree in 2014.
- PhD advisor for Wan Jin Yeo, Department of Physics, University of Washington. Yeo received the doctoral degree in 2022.
- Currently PhD advisor for Aalto University graduate student Liisa Helle.
- Currently PhD advisor for UW Physics graduate student Alexandria McPherson.
- Currently faculty mentor for Yiyun Dong, a UW Physics graduate student
- Currently research advisor for three UW Physics undergraduate students and one graduate student who is working as an hourly research assistant.
- Instructor of the undergraduate course PHYS 122 (Electromagnetism) at the Department of Physics, University of Washington, in the following quarters: Fall 2018, Winter 2019, Spring 2022, Winter 2023.
- Instructor of PHYS 427 / 576 (Applications of Physics) in the spring quarter of 2020 at the University of Washington. The course was held on-line due to COVID.
- Instructor of PHYS 321 (Electromagnetism I) in the autumn quarter of 2020 (on-line) and in the spring quarter of 2023 (in person) at the University of Washington.
- Instructor of PHYS 322 (Electromagnetism II) in the winter quarter of 2021 at the university of Washington. The course was held on-line due to COVID.

8. Academic service

- Member of the Graduate Admissions committee at the Department of Physics, University of Washington in subsequent years 2019-2023.
- Member of the Undergraduate Advising committee at the Department of Physics, University of Washington, in 2022 and 2023.
- Member of the PhD reading committee for UW Physics graduate student Zeeshawn Kazi.
- Member of the PhD committee for UW Physics graduate student John Ferre.

- Member of the PhD committee for UW Speech and Hearing graduate student Maggie Clarke.
- Member of the advisory PhD committee for Joonas Haakana at Aalto University, Espoo, Finland.

9. Awards and honors

- Excellence Award at the 2005 MEG Applications Conference (Xylocastro, Greece)
- Outstanding Reviewer Award, Journal of Neuroscience Methods, Nov. 2015

10. Other key academic merits and appointments

- Official opponent of Dr. Julio Hernandez-Pavon's doctoral thesis entitled: "Transcranial magnetic stimulation and EEG in studies of brain functions", Aalto University, School of Science, Espoo, Finland, August 13, 2015.
- Preliminary examiner of Dr. Antti Mäkinen's doctoral thesis entitled "Applications of magnetic-field modeling for hybrid MEG and MRI", Aalto University, School of Science, Espoo, Finland. Examination completed on October 5, 2020.
- Associate Editor for *Frontiers in Neuroscience*, special section on Brain Imaging Methods
- Guest Editor for special issue on MEG/EEG source reconstruction for *Brain Sciences*
- Guest Editor for special issue on Neural engineering informatics for *IEEE Access*
- Reviewer of over 70 manuscripts for peer-reviewed journals
- Reviewer of 3 grant proposals
- More than 10 invited international talks, the most recent one given on August 25, 2022, at the University of Cambridge, UK. The title of the talk was "Extending the SSS and SSP approaches for enhanced processing of MEG/EEG signals".