

Silvia F. Storti

Curriculum Vitae

Position Associate Professor
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Brief Bio

Silvia Storti is Associate Professor in Bioengineering at the Dept. of Engineering for Innovation Medicine, University of Verona. She received the Master's degree in Electronic Engineering from the University of Padova and the Ph.D. degree in Neuroscience from the University of Verona, Italy. Her academic career began in 2008 at the Dept. of Neurological and Movement Sciences, University of Verona, when she joined the *Clinical Neurophysiology and Functional Neuroimaging Unit*, led by Prof. Paolo Manganotti, as Research Associate first and then as PhD Student in Neuroscience. After completing her Ph.D. degree, she continued working as Post-doctoral Researcher in the same group until 2014. In 2014, she joined the *Neuroimaging Lab*, led by Prof. Gloria Menegaz, at the Dept. of Computer Science, where she continued her research as Post-doctoral Researcher until 2018. In 2018 she became Assistant Professor (tenure-track position, senior researcher RTDb) and later in Nov 2021 achieved a promotion to the position of Associate Professor at the same Department. From March 2023 she moved to the Dept. of Engineering and Innovation Medicine at University of Verona.

Her primary research interests lie in the field of **Neuroengineering**, with a specific focus on integrating *multimodal functional neuroimaging data*, inferring *brain functional connectivity*, and analyzing *brain networks*. Currently, she is actively involved in developing innovative methods for estimating brain functional connectivity from non-invasive brain imaging recordings, such as electroencephalography (EEG)/high-density EEG, functional magnetic resonance imaging (fMRI), and arterial spin labeling (ASL) data. Her research aims to develop brain connectivity techniques that can estimate cortical activity, characterize temporal dynamics, and decode functional connectivity patterns across brain regions, with a focus on improving health and clinical applications. She is also interested in extracting novel measures of brain network characteristics and integrating them with information derived from multiple imaging modalities, including microstructural diffusion MRI.

More recently, her focus has been on developing both active and passive brain-computer interfaces (BCI). This work has involved developing innovative techniques that leverage signal processing, brain connectivity, and machine learning to integrate brain signals with computer systems. Her goal has been to enhance the usability and effectiveness of these interfaces, with a particular focus on improving their performance on real-world applications. Since 2012, Prof. Storti has collaborated with the Italian Navy on a study exploring alterations in source and connectivity EEG patterns

during hyperbaric oxygen breathing in professional divers under simulated deep-sea conditions. She has co-authored **64 publications on International Peer-Reviewed Journals**, covering a wide range of topics in bioengineering and neurophysiology and more than 90 contributions to conferences. Prof. Storti holds prominent editorial roles, including **Associate Editor** for BioMedical Engineering OnLine (Springer Nature), IEEE Journal of Biomedical and Health Informatics (J-BHI), as well as **Editorial Board Member** of Scientific Report (Nature Portfolio).

Bibliometric Parameters

ORCID <http://orcid.org/0000-0002-8605-803X>
Scopus ID 24339432600
Researcher ID K-3142-2016
H-index 22 - Scopus
Citations 1375 - Scopus

Scientific Production Summary

- 64 Papers on international peer-reviewed journals
- 18 Short-papers (proceedings) on international conferences
- 4 Short-papers (proceedings) on national conferences
- 68 International and national conference abstracts
- 1 National book chapter

Education

- Nov. 2007 **Master Degree in Electronic Engineering - curriculum Biomedical Engineering** (*University of Padova, Italy*)
Thesis: "Metodi e modelli per la generazione di mappe di attivazione fMRI"
Supervisor: Prof. Gianna M. Toffolo.
- Jan. 2009– **Ph.D. Degree in Neuroscience** (*University of Verona, Italy*)
- Dec. 2011 Graduate School of Sciences Engineering Medicine, PhD degree in Neuroscience (XXIV cycle).
Dissertation: "Multimodal imaging approach for quantitative assessment of epilepsy".
Supervisor: Prof. Paolo Manganotti, Reviewer: Prof. Michel M. Christoph (University of Genève) - *Note*: winner of PhD fellowship.

Current Academic Position

- Nov. 2021– **Associate Professor** (*University of Verona, Italy*)
present Dept. of Engineering for Innovation Medicine, Dept. of Computer Science (2021-2023), University of Verona, S.S.D. ING-INF/06.

Previous Academic Positions

Mar. 2008– **Research Fellow** (*University di Verona, Italy*)

Dec. 2008 Research activity on "Vascular changes and neuroinflammation in the experimental and human epilepsy: identification of new drug targets. EEG-fMRI coregistrations". Supervisor: Prof. Paolo Manganotti; Dept. of Neurological and Vision Sciences, University of Verona. Research fellowship funded by the Cariverona Foundation (Fondazione Cassa di Risparmio di Verona Vicenza Belluno e Ancona), S.S.D. MED26.

Jan. 2012– **Post-Doctoral Research Fellow - Two years** (*University of Verona, Italy*)

Dec. 2013 Research activity on "Multimodal approach to the study of dementia and mild cognitive impairment". Supervisor: Prof. Paolo Manganotti; Dept. of Neurological and Movement Sciences, University of Verona. Two-year scholarship funded by the Cariverona Foundation (Fondazione Cassa di Risparmio di Verona Vicenza Belluno e Ancona), S.S.D. MED26.

Apr. 2014– **Post-Doctoral Research Fellow - Two years** (*University of Verona, Italy*)

Sep. 2016 Research activity on "Assessment of functional connectivity in motor tasks and investigation of its relation with DTI-derived structural pathways". Supervisor: Prof. Gloria Menegaz, Dept. of Computer Science, University of Verona, S.S.D. INF01.

Oct. 2016– **Post-Doctoral Research Fellow** (*University of Verona, Italy*)

Sep. 2017 Research activity on "Study, implementation and validation of interfaces for robotic systems". Supervisor: Prof. Gloria Menegaz, Dept. of Computer Science, University of Verona, S.S.D. INF01, FSE 2014-2020.

Oct. 2017– **Post-Doctoral Research Fellow** (*University of Verona, Italy*)

Oct. 2018 Research activity on "Brain microstructural modeling for improved TMS anchoring". Supervisor: Prof. Gloria Menegaz, Dept. of Computer Science, University of Verona, S.S.D. INF01, Project "BrAnch" - Joint Projects 2015.

Nov. 2018– **Assistant Professor (RTDb)** (*University of Verona, Italy*)

Oct. 2021 Dept. of Computer Science, University of Verona, S.S.D. ING-INF/06

Research and consulting assignments

Jan. 2008 **Research contract** (*University of Padova, Italy*)

Description: statistical analysis of biomedical signals. Supervisor: Prof. Gianna M. Toffolo, Dept. of Information Engineering, University of Padova.

Nov. 2012– **Research contract** (*EB Neuro Spa, Florence, Italy*)

- Jun. 2013 Description: quantitative analysis of electroencephalographic data of healthy and oxygen-sensitive subjects acquired during the breathing of air at 0 msw, oxygen at 18 msw and air after the decompression phase at 0 msw in a hyperbaric chamber (Italian Navy divers, Italian Navy Medical Service CONSUBIN Varignano, Le Grazie, La Spezia).
- Jul. 2014– **Research contract** (*EB Neuro Spa, Florence, Italy*)
- Aug. 2014 Description: quantitative analysis of electroencephalographic data of students (not experienced divers) acquired during the breathing of air and oxygen at normobaric pressure; breathing air at 0 msw, oxygen at 18 msw and breathing air at 0 msw after the decompression phase in a hyperbaric chamber (Italian Navy divers, Italian Navy Medical Service CONSUBIN Varignano, Le Grazie, La Spezia).

Research Projects

Principal Investigator of Research Projects

- 2019 **Post-doc grant funded by the Dept. of Computer Science, UniVR**
 "Modeling of brain microstructure informed-connectomics for improved transcranial magnetic stimulation anchoring". Role: PI of the project, duration: 12 months, €23.8K, co-funded, [AdR3309/19].
- 2020 **Post-doc grant funded by the Dept. of Computer Science, UniVR**
 "BCIConnect: EEG-based connectivity for BCI in robotic device control". Role: PI of the project, duration: 12 months, €23.8K, [AdR3554/20].
- 2023-24 **RiBa2022 funded by UniVR for positively evaluated PRIN2022 projects**
 "Brain-connectivity based computer interfaces: An enhanced technology for restoring motor function in stroke survivors (Brain-RESTORE)". This research was supported by the funding initiative of the University of Verona, Ricerca di Base 2022, for projects positively evaluated in the Prin call but not funded: Prin2022 - score 94/100, Project code: 2022K4EJRM. Role: PI of the project, duration: 1 year (Nov.2023-Nov.2024), €38.9K.
- 2023-26 **PhD grant funded by NRRP D.M.118**
 "Development of EEG-TMS systems based on brain connectomics for personalized treatment of epilepsy" funded by National Recovery and Resilience Plan (NRRP) D.M.118 of 02.03.2023, Role: PI of the Project and supervisor of the PhD student (cycle XXXIX), duration: 3 years (Oct. 2023-Sep. 2026).

Task Leader of Research Projects

- 2022-25 **MNESYS funded by MIUR - NRRP**

"A multiscale integrated approach to the study of the nervous system in health and disease (MNESYS) (DN. 1553 11.10.2022)" supported by #NEXTGENERATIONEU (NGEU) and funded by the Ministry of University and Research (MUR), National Recovery and Resilience Plan (NRRP). Duration: 36 months (Nov 2022-Oct 2025). Task leader for UniVR in Work Package 4 - T4.5. Neural dynamics and plasticity. Responsible for Deliverable - D4.1. Framework for multi-layer connectome analysis and automated extraction of neuronal connectivity features. Funding of €24K received and allocated for the acquisition of equipment, as well as funding for AdR initiatives, over which I have been and continue to be the supervisor [AdR4227/23 and AdR4492/23].

Proposer of Research Projects

2022-24 **AI4Health funded by MIUR D.M. 737/2021**

"AI4Health: empowering neurosciences with eXplainable AI methods". Storti S.F. is one of the proposers of the project, duration: 36 months. Budget received for one RTDa position (ING-INF/06) and two 1-year AdR fellowships (ING/INF05 e INF01). PI: Prof. G. Menegaz. Role: proposer and supervisor of one AdR "AI4Health: integration of neuroimaging and neurophysiology data through eXplainable AI for pre-surgical planning and prediction of surgical outcome" [AdR3850/21].

Scientific Participation in Research Projects funded by Public Organizations

2009-10 **Ricerca Sanitaria Finalizzata – Regione Veneto (VE, VR, TV, VI).**

"Studio sull'uso della Stimolazione Magnetica Transcranica e della Stimolazione Elettrica Diretta Continua Transcranica, per migliorare la diagnosi e la prognosi e per proporre un approccio terapeutico innovativo nei pazienti in stato vegetativo" (PI: Dr. S. Casson), duration: 24 months, €170K.

2012-13 **Joint Project 2011 - UniVR and ATES MEDICA Device s.r.l.**

"Highly reliable image-guided multimodal neuronavigation for motor cortex stimulation - JP 2011". PI: Prof. P. Manganotti, partner: ATES MEDICA Device s.r.l. (Verona, Italy), duration: 24 months, €30.45K.

2013-14 **Joint Project 2012 - UniVR and EBNeuro s.r.l.**

"AHeAD, Automatic Human behavior Analysis in neurological Diseases: the case of epilepsy - JP 2012". PI: Prof. G. Menegaz, partner: EB Neuro Spa (Firenze, Italy), duration: 24 months, €20K.

2015-16 **Joint Project 2014 - UniVR and EBNeuro s.r.l.**

"BRAINCO, Investigation of structural and functional brain connectivity from multimodal data - JP 2014". PI: Prof. G. Menegaz, partner: EB Neuro Spa (Firenze, Italy), duration: 24 months, €31.86K.

2016-17 **Joint Project 2015 - UniVR and EBNeuro s.r.l.**

"BrAnch, Brain microstructural modeling for improved TMS anchoring - JP 2015".
PI: Prof. G. Menegaz, partner: EB Neuro Spa (Firenze, Italy), duration: 24 months,
€27.3K.

Scientific Participation in Research Projects funded by Private Organizations

2007-08 **Project funded by Fondazione Cariverona**

"Vascular changes and neuroinflammation in experimental and human epilepsy: identification of new drug targets", PI: Dr. B. Dalla Bernardina, Dept. of Neurological and Vision Sciences (University of Verona), duration: 24 months, €449.66K.

2011-13 **Project funded by Fondazione Cariverona**

"Disabilità cognitiva e comportamentale nelle demenze e nelle psicosi", PI: Prof. N. Rizzuto. Dept. of Neurological and Movement Sciences (University of Verona), duration: 36 months, €73.63K for the unit.

2016 **Project funded by Verona Brain Research Foundation**

"Mapping functional connectivity patterns in neurological and neurosurgical diseases with Arterial Spin Labeling and Blood Oxygenation Level Dependent MRI", PIs: Prof. G. Menegaz - Dr. F.B. Pizzini, University Hospital Verona and Dept. of Computer Science (University of Verona), duration: 12 months, €16K.

2017 **Project funded by Verona Brain Research Foundation**

"Brain connectivity underlying physiological and pathological patterns in action tremor", PIs: Prof. G. Menegaz - Dr. F.B. Pizzini. University Hospital Verona and Department of Computer Science (University of Verona), duration: 12 months, €23.7K.

2020-22 **EDIPO funded by Fondazione Cariverona**

"A computational solution for bringing neuroimaging genetic into translational research (EDIPO)", PI: Prof. G. Menegaz. Department of Computer Science (University of Verona), duration: 36 months, €180K. Other organizations involved: Imaging Genetics Center (IGC) of the University of Southern California (USC), French National Institute of Research in Informatics and Automation (INRIA).

2021-22 **OPERA funded by Fondazione Cariverona**

"Osservazione dei processi lavorativi, con garanzie oggettive di tutela della Privacy, per la prevenzione di Errori e situazioni di Rischio in maniera Automatica ai tempi di Industria 4.0 (OPERA 4.0)", PI: Prof. D. Quaglia. Department of Computer Science (University of Verona), duration: 24 months, €100K. Role: participant - Work Package: MA2 Intelligent systems.

Visiting Programs

- Oct-Dec 2023 Winner of the Visiting Call for applications, Internationalization Program cat. B – 2022 edition, granted to host Dr. Marco Pizzolato from the Technical University of Denmark, Denmark, as a visiting researcher at the Dept. of Engineering for Innovation Medicine. Received a stipend of €1.5K.
- 2024 Winner of the Visiting Call for applications, Internationalization Program cat. B – 2023 edition, granted to host Prof. Sergey Plis from Georgia State University (USA) as a visiting researcher at the Dept. of Engineering for Innovation Medicine. Received a stipend of €1.7K.

Chair/Moderator Activity for, Organizer of International Events

Chair Activity

- May 2021 **Chair of the session entitled: Podium Session 1: Brain-Computer/Machine Interface**, May 4, 2021, at *International IEEE EMBC Conference on Neural Engineering*, Virtual Conference.

Organization of International Conferences/Workshops

- Jan 2008 **International Workshop on: "Dense Array EEG and Epilepsy"**, Jan 26, 2008, Policlinico Universitario G.B.Rossi, Verona, Italy. Member of the Local Organizing Committee.
- May 2008 **International Workshop on: "Coregistration EEG-fMRI and epilepsy"**, May 30, 2008, Policlinico Universitario G.B.Rossi, Verona, Italy. Member of the Local Organizing Committee.
- Mar 2012 **International Workshop on: "Multimodal Brain Imaging in Epilepsy"**, Mar 23, 2012, Dept. Neurosciences, Biomedicine and Movement Sciences, University of Verona, Italy. Member of the Local Organizing Committee.
- Sep 2016 **"2016 Summer School on Brain Connectomics - 1st Edition"**. Sponsored by PhD School in Natural Sciences and Engineering and Dept. of Computer Science University of Verona, Fondazione Bruno Kessler, MICCAI, ISMRM Italian Chapter, AINR, University of Trieste. Sep 19-22, 2016, Dept. of Computer Science, University of Verona, Italy. Member of the Organizing Committee and Tutor for the lab session on Functional Imaging. <http://brainconnectomics.org/archive/2016/index.html>
- Oct 2017 **"2017 IEEE SPS Winter School on Brain Connectomics - 2nd Edition"**, sponsored by PhD School in Natural Sciences and Engineering and Dept. of Computer Science University of Verona, IEEE Signal Processing Society, MICCAI, Brain Research Foundation. Oct 09-13, 2017, Dept. of Computer Science, University of Verona, Italy. Co-president of the Scientific and Organizing Committee. <http://brainconnectomics.org/archive/2017/index.html>

Sep 2019 **"2019 Winter School on Brain Connectomics - 3rd Edition"**, sponsored by PhD School in Natural Sciences and Engineering and Dept. of Computer Science University of Verona, MICCAI, Brain Research Foundation. Sep 23-27, 2019, Dept. of Computer Science, University of Verona, Italy. Co-president of the Scientific and Organizing Committee. <http://brainconnectomics.org>

Editorial Responsibilities

- 2017-ongoing **Associate Editor** for *BioMedical Engineering OnLine* (Springer Nature)
IF2022: 3.8
<https://biomedical-engineering-online.biomedcentral.com/about/editorial-board>
- 2022-ongoing **Associate Editor** for *IEEE Journal of Biomedical and Health Informatics J-BHI* - (IEEE), IF2022: 7.7
<https://www.embs.org/jbhi/associate-editors/>
- 2023-ongoing **Editorial Board Member** for *Scientific Report* (Springer Nature), IF2022: 4.9
https://www.nature.com/srep/about/editors#engineering_section
- 2012-13 **Guest Editor** for *Frontiers in Neurology - Epilepsy*
Co-editor of the Research Topic "The role of neuroimaging in the pre-surgical evaluation of the epileptic patient".
<https://www.frontiersin.org/research-topics/1300/the-role-of-neuroimaging-in-the-pre-surgical-evaluation-of-the-epileptic-patient>
- 2020-21 **Lead Guest Editor** for *Electronics* (MDPI)
Co-editor of the Special Issue "Machine Learning applied to Medical Image Analysis".
https://www.mdpi.com/journal/electronics/special_issues/Medical_Image
- 2022-23 **Guest Editor** for *Frontiers in Neuroscience-Brain Imaging Methods*
Co-editor of the Research Topic "Chasing Brain Dynamics at Their Speed: What Can Time-Varying Functional Connectivity Tell Us About Brain Function?". The following Editorial has been written to accompany the research topic: [IE1-2023].
<https://www.frontiersin.org/research-topics/34359/chasing-brain-dynamics-at-their-speed-what-can-time-varying-functional-connectivity-tell-us-about-brain-function>
- 2022-23 **Lead Guest Editor** for *Frontiers in Human Neuroscience*
Co-editor of the Research Topic "Brain-Connectivity - Based Computer Interfaces". The following Editorial has been written to accompany the research topic: [IE2-2023].
<https://www.frontiersin.org/research-topics/32047/brain-connectivity-based-computer-interfaces>
- 2020-21 **Lead Guest Editor** for *Sensors* (MDPI)
Co-editor of the Special Issue "Brain Computer Interface for Biomedical Applications".

https://www.mdpi.com/journal/sensors/special_issues/1P9YC6R70K

- 2017 **Editorial Board Member** for *BioMedical Engineering OnLine* (Springer Nature)
- 2017-ongoing **Review Board Member** for *Brain Topography* (Springer Nature), IF2022: 3.4
<https://link.springer.com/journal/10548/editors>
- 2021 **Conference Program Committee** "International Conference on Image Processing and Vision Engineering" - IMPROVE 2021
<https://improve.scitevents.org/ProgramCommittee.aspx=2021>
- 2023 **Member of Scientific Committee** "VII National Congress of Bioengineering" - Padova, June 21-23 2023.
<http://gnb2023.it/scientific.html>

Reviewing

Reviewer for international grants

- 2018 Swiss National Science Foundation (SNF).

Referee activity

- Since 2010 Referee for several international peer-reviewed journals, including Journal of Neuroscience Methods, Journal of Neuroengineering and Rehabilitation, Experimental Brain Research, IEEE Transactions on Biomedical Engineering, PloS One, Brain Topography, Biomedical Signal Processing and Control, EURASIP Journal on Image and Video Processing, IEEE Journal of Biomedical and Health Informatics, BioMedical Engineering OnLine.
- Since 2014 Referee for several international and national conferences, including Annual International Conference of the IEEE Engineering in Medicine and Biology Society, EMBC; International Workshop on Pattern Recognition in Neuroimaging, PRNI; International Conference on Biological Information and Biomedical Engineering, BIBE; International Symposium on Biomedical Imaging, ISBI, Gruppo Nazionale Bioingegneria (GNB).

Awards

- 2008 Oral Presentation Award "Continuous EEG-fMRI study in patients with partial epilepsy and focal interictal slow-rate discharges on EEG", at the 13th European Congress of Clinical Neurophysiology, May 9, 2008, Istanbul, Turkey.
- 2012 Paul Durst Prize awarded by the National Group of Bioengineering for the best Italian Ph.D. Thesis in Bioengineering.

- 2018 Best Poster Award "Vector graphs could reveal functional polymorphism of brain regions" at the 2nd International Workshop on Connectomics in NeuroImaging (CNI) held in conjunction with MICCAI 2018, September 20th, 2018, Granada, Spain.
- 2019 Best Paper Award: "EEG-Based Workload Index as a Taxonomic Tool to Evaluate the Similarity of Different Robot-Assisted Surgery Systems" at the 3rd International Symposium on Human Mental Workload: Models and Applications, H-WORKLOAD 2019, Nov 14-15, Rome, Italy. <http://hworkload.org/2019/awards/>

Teaching

AY2020-21-
today **Teacher** for the Doctoral School on Natural and Engineering Sciences, "**Brain Computer Interfaces**" (University of Verona, Italy) (2 CFU: 8h - AY2020-21; 3 CFU: 12h - AY2021-22; 2 CFU: 8h - AY2022-23)

This course aims to provide an introduction to the fundamentals of Brain Computer Interfaces (BCI) with a focus on analyzing oscillatory EEG activity from a signal processing perspective. Students learn about the key methods for processing brain activity data in real-time and converting it into control signals for BCI systems. The course is divided into two parts. The first part covers topics including the BCI model, different types of BCI systems and their associated signal processing techniques, performance evaluation of these systems, limitations of current BCI paradigms, and a wide range of BCI applications. The second part focuses on practical aspects involving hands-on BCI design and implementation, along with an introduction to real-time processing of EEG recordings.

AY2019-20
today **Teacher** for the Bachelor's course in Computer Science, "**Biomedical Data and Signal Processing**" (University of Verona, Italy) (6 CFU: 32h theory; 29h lab - AY2019-20; 32h theory; 24h lab - AY2020-21; AY2021-22; AY2022-23; AY2023-24)

AY2018-19-
today **Teacher** for the Bachelor's course in Computer Science and Bachelor's course in Bioinformatics, "**Probability and Statistics**" (University of Verona, Italy) (AY2018-19: 8 CFU: 32h theory; 48h lab; AY2019-20: 6 CFU: 33h theory; 26h lab; AY2020-21, AY2021-22: 6 CFU: 32h theory and 24h lab). Teacher for the Bachelor's course in Bioinformatics (AY2022-23, and AY2023-24: 6 CFU: 32h theory; 24h lab)

AY2023-24-
today **Teacher** for the Bachelor's course in Human Centered Medical System Engineering, "**Modeling and Analysis of Biological Systems**" (University of Verona, Italy) (AY2023-24: 3 CFU: 16h theory; 12h lab)

From
AY2008-09 to
AY2017-18 **Teaching Assistant** for Master's course in Bioengineering (University of Padova, Italy), Master's course in Bioinformatics and Medical Biotechnology, Master's course in Computer Science and Engineering, and Bachelor's course in Bioinformatics (University of Verona, Italy), Master's course in Mathematics (University of Trento, Italy), Post-Degree Graduate Course, 1st level, in Information Elaboration of Biomedical data and Telecontrol in medicine (University of Verona, Italy).

Advising

Ongoing - PhD Students

- Oct 2023 - **Supervisor of a PhD Student** (Edoardo Paolini - XXXIX cycle - PhD in Computer Science - University of Verona) with a research project on "Development of EEG-TMS systems based on connectomics for personalized treatment of epilepsy" - DM118-PNNR.
- Oct 2022 - **Supervisor of a PhD Student** (Ettore Cinquetti - XXXVIII cycle - PhD in Computer Science - University of Verona) with a research project on "Enhanced safety in Industry 5.0: Development of passive BCI with deep learning architectures for vigilance prediction".
- Jan 2022 - **Co-supervisor of a PhD Student** (Ilaria Siviero - XXXVII cycle - PhD in Computer Science - University of Verona) with a research project on "AI4Health: empowering Telemedicine through explainable AI methods for personalized diagnosis, monitoring and treatment" (PON Ricerca e Innovazione).

Ongoing - Postdoc Researchers

- Feb 2023 - **Supervisor of a Post-doc Scholar - AdR4492/23** (Nicola Valè - Dept. of Engineering for Innovation Medicine - University of Verona) with a research project on "Modeling brain dynamics, connectivity, and plasticity with eXplainable AI", SSD ING-INF/06 (funded by #NextGenerationEU - MNESYS Project, Spoke2).

Completed - Postdoc Researchers

- Ago 2023 - **Supervisor of a Post-doc Scholar - AdR4227/23** (Ilaria Boscolo Galazzo - Dept. of Computer Science - University of Verona) with a research project on "eXplainable AI-based integration and modeling of multimodal data and brain connectomics for precision medicine", SSD ING-INF/06 (funded by #NextGenerationEU - MNESYS Project, Spoke2).
- Jan 2023 - **Supervisor of a Post-doc Scholar - AdR3850/21** (Federica Cruciani - Dept. of Computer Science - University of Verona) with a research project on "AI4Health: integrazione e modellazione di dati di neuroimaging multimodali mediante eXplainable AI in ambito clinico", SSD ING-INF/05 (funded by MIUR D.M. 737/2021, University of Verona).
- Sep 2020 - **Supervisor of a Post-doc Scholar - AdR3554/20** (Francesca Stival - Dept. of Computer Science - University of Verona) with a research project on "BCIConnect: EEG-based connectivity for BCI in robotic device control", SSD ING-INF/06 (funded by Dept. of Computer Science, University of Verona).
- Ago 2019 - **Supervisor of a Post-doc Scholar - AdR3309/19** (Lorenza Brusini - Dept. of Computer Science - University of Verona) with a research project on "Modeling of brain microstructure informed-connectomics for improved transcranial magnetic stimulation anchoring", SSD ING-INF/06 and INF01 (funded by Dept. of Computer Science, University of Verona).

Completed - Research Fellows

- Apr 2023 - **Supervisor of a Graduate Student - BO07/23** (Edoardo Paolini - Dept. of
Sep 2023 Computer Science - University of Verona) with a research project on "Sviluppo di algoritmi di apprendimento automatico per il monitoraggio e la predizione di dati biomedici per la sicurezza sul lavoro nell'industria 4.0" (funded by OPERA 4.0, University of Verona).
- Apr 2022 - **Supervisor of a Graduate Student - AdR3916/22** (Ettore Cinquetti - Dept. of
Sep 2022 Computer Science - University of Verona) with a research project on "Passive BCI for the user mental workload assessment during work processes in Industry 4.0", SSD ING-INF/06 (funded by OPERA 4.0, University of Verona).

Completed - Bachelor/Master Students

Summary	Undergraduate	Master
Thesis Advisor	20	3
Thesis Co-Advisor	4	9
Stage Co-Advisor	5	13
Academic Stage Advisor	8	3
Company Stage Advisor	20	0

Institutional Duties

Ongoing

- Apr 2019 - Member of Council of the PhD School in Computer Science (Collegio Docenti del ongoing Dottorato in Informatica) - Doctoral School on Natural and Engineering Sciences.
- AY2020-21 - Professor Tutor, Bachelor's course in Computer Science, University of Verona (Italy), ongoing <https://www.universitaly.it/index.php/scheda/sua/554903>
- Jun 2023 - Internationalization Commission Member (Referente per l'internazionalizzazione) - ongoing Dept. of Engineering for Innovation Medicine, UniVR.

Past

- Jul 2020 - Teaching Staff-Student Joint Committee (Membro della Commissione Paritetica
Dec 2023 Docenti-Studenti Scienze-Ingegneria CPDS) - Dept. of Computer Science, UniVR.

Membership of Scientific Societies

- 2019-ongoing National Group of Bioengineering (Gruppo Nazionale di Bioingegneria, GNB)
- 2019-ongoing IEEE and IEEE Signal Processing Society
- 2009,10,13,16 Organization for Human Brain Mapping (OHBM)
- 2014 International Society for Magnetic Resonance in Medicine (ISMRM)
- 2016 Italian Society of Clinical Neurophysiology (SINC)

Main Research Activity

Dynamics and Brain Connectivity

The main research activity consists in the development of new approaches for modeling the brain functional connectivity in the healthy and pathological brain. The brain is a complex system in which neurons or brain regions organize themselves into different dynamic connectivity patterns based on functional needs. The main purpose is to demonstrate the existence of an integrated functional activity of different brain areas and determine when the connections between the areas (and, therefore, the network) show altered functional patterns. To support this, the graph theory, applied to non-invasive brain data such as electroencephalogram (EEG) / high-density EEG, functional magnetic resonance imaging (fMRI), and arterial spin labeling (ASL), allows characterizing temporal dynamics and decoding the functional connectivity patterns of the brain. The goal is to extract the most significant characteristics of the network organization under normal conditions, mainly related to real motor functions or imagined and in neurological diseases, integrating the information deriving from multiple neuroimaging modalities such as EEG, EEG-TMS, fMRI, ASL, and diffusion MRI.

■ [brAln] Models of brain dynamics, connectivity, and plasticity based on AI

2019-ongoing *(Principali collaborazioni relative a MNESYS e DM737: Perception and Awareness (PandA) Lab, UniVR - Prof.ssa Silvia Savazzi, Dott.ssa Chiara Mazzi; Fondazione Don Carlo Gnocchi Milano - Dott.ssa Francesca Baglio, Dott.ssa Valeria Blasi e Università degli Studi della Campania Luigi Vanvitelli - Prof. Fabrizio Esposito, responsabile WP4 progetto MNESYS; Prof. Marialuisa Gandolfi, Cognitive Rehabilitation Research Center, UniVR.)*

The research focuses on improving our understanding of the brain using AI methods. We explore how the brain works in both healthy and diseased states, with particular emphasis placed on understanding neural dynamics and plasticity. In addition, we combine neuroimaging and physiological data to better plan surgeries and predict their outcomes. Key focus areas include the development of frameworks for multi-layer connectome analysis and automated extraction of neuronal connectivity features using AI methods. By doing this, a deeper comprehension of brain function and pathology is pursued, with the goal of advancing medical interventions and treatment strategies.

■ [Multi4Epilepsy] Multimodality, Connectomics, and Functional Dynamics in Epilepsy

2007-ongoing A major problem in pre-surgical patient selection is the correct identification of the epileptogenic zone, especially in patients with negative MRI. Standard pre-surgical workup includes long-term EEG recording, video-EEG, MRI, and neuropsychological evaluation. When localization of the epileptic focus is uncertain, further techniques may include positron emission tomography (PET), ictal and interictal single-photon emission computed tomography (SPECT), EEG-functional MRI (fMRI), high-density EEG, and invasive EEG recording. EEG-fMRI can provide information on the hemodynamic changes as a consequence of the abnormal neural activity generating IEDs. Differently, the source analysis estimates the current density of the source that generates a measured electric potential, and it yields a plausible dipole localization of irritative regions. Source analysis involves numerous scalp electrodes, high-density EEG, and realistic head models derived from structural MRI. EEG-fMRI coregistration and high-density EEG can be combined to map noninvasively abnormal brain activation elicited by epileptic processes. The aim is to identify by means of multimodal, noninvasive assessment the epileptogenic zone to be resected. Advanced methods for modeling ictal and interictal activity combine and integrate high-density EEG, EEG-fMRI, and other imaging data as arterial spin labeling (ASL), and PET data. The second aim is to validate the aforementioned multimodal investigation approach with the stereo-EEG results in each patient, given that stereo-EEG remains the only reliable method to define the epileptogenic zone (the gold standard). The use of noninvasive methods to identify the epileptic zone could reduce the need for more expensive stereo-EEG investigations while providing a better diagnostic definition of patients with complex epilepsy. The main national and international collaborations (*Prof. P. Manganotti, University of Trieste; Dr. R. Mai, Ospedale Cà Granda Niguarda, Milan; Prof. M.C. Michel, Functional Brain Mapping Laboratory, University of Geneva*) have led to numerous scientific publications on the topic. The recent collaboration with *Harvard Medical School (Prof. Eleonora Tamlia and Prof. Alexander Rotenberg)* promises to further consolidate the research developed over the years and to extend it to the pediatric context as well.

■ [DeepBrain] Study of brain activity for the prevention of oxygen toxicity during immersion.

2012-ongoing (*in collaboration with the Italian Navy, COMSUBIN, Le Grazie, La Spezia, Italy; University La Sapienza - Prof. L. Pastena; Dept. of Neuroscience, Section of Rehabilitation - University of Padova - Dr. E. Formaggio*)

Oxygen toxicity is a problem in diving, with potentially fatal consequences for the diver in the water. When divers use a closed-circuit oxygen rebreathing apparatus, they are breathing O_2 100% and are exposed to hyperoxide conditions. In this scenario, the body could be affected differently depending on the exposure type. The electrical activity of the brain is sensitive to its oxygen supply. In this project, we study the source and functional connectivity through brain sources to evaluate the physiological effects of oxygen breathing and to delineate different diving profiles, providing indications on the potential risk of a dive. The project targets the acquisition and processing of signals from distributed wearable body sensors in extreme conditions, that is during under-water training and operation of divers of the ComSubIn. Even though this could be considered a niche project, it would provide the unique opportunity to investigate the modulation of the physiological and neurophysiological activity in such critical scenarios unveiling mechanisms that could not be observed in normal laboratory conditions and opening new perspectives in neural modulation. This is not only unique but also poses an outside-the-norm technical challenge.

Brain Computer Interfaces

This project intends to fill the gap between the human brain and external devices in the framework of motor-imagery (MI)-based brain computer interfaces (BCIs) technologies. The BCI is a system able to read voluntary changes in brain activity and then translate neural signals into a message or a computational command in real-time. Among the various types of systems, a non-invasive BCI based on EEG and MI transforms neuroelectric signals derived from motor regions into command outputs for external effectors. The success of translating the signal in messages depends on several methodological contributing factors, i.e., decoding algorithms, calibrated on the motor regions using a suitable representation of the data that simplifies the classification or detection of specific brain patterns. The state-of-the-art devices provide good performance albeit limited, particularly when few EEG electrodes are used, calling for novel approaches. In answer to this call, we propose new methods for extracting discriminative features to distinguish different mental movements within a multivariate and deep learning framework. The system is trained to decode the brain activity during MI tasks using the coupling information or causal influence between signals.

■ [Brain-RESTORE] Development of Brain Computer Interfaces for Rehabilitative Purposes.

2020-ongoing *(in collaboration with University of Tübingen, RamosLab, Prof. Ander Ramos Murguialday; Prof. Marialuisa Gandolfi, Neuromotor and Cognitive Rehabilitation Research Center (CRRNC), UniVR)*

The recent collaboration with Prof. Ramos and his team provides us with the opportunity to address challenges in motor rehabilitation, especially in uncontrolled settings, such as at home. In these real-world scenarios, signals like EMG, EEG from portable devices and inertial measurement unit (IMU) data are crucial for decoding continuous human actions and decrypting the related neural activity. Classical modeling methods, such as linear, adaptive, or static filters, lack the capacity to capture complex relationships between surface EMG and kinematics, as well as generalizability across subjects. We propose deep learning models for the continuous decoding of hand motion. Our approaches enhances wrist kinematics decoding providing a generalized model based on data captured with wearable devices. The findings hold potential for innovative home-based telemedicine solutions in motor rehabilitation.

■ [PassiveBCI] Development of passive BCIs through AI architectures for mental state prediction in Industry 5.0

2016-ongoing *(in collaboration with BrainSigns, spin-off of the University Sapienza, Rome - Prof. F. Babiloni)*

Passive BCI allows the monitoring of a subject's mental state, without the need of any active input. It has applications in fields where operator mistakes may cause severe accidents, such as air traffic control, plant surveillance, or driving. The first studies conducted between 2016 and 2019 in collaboration with Prof. Babiloni and his team aimed to assess the level of brain engagement during tasks assigned to surgical apprentices at UniVR, using both the "Da Vinci" system and the Actaeon simulator (BBZ s.r.l., UniVR). This approach allowed us to measure the cognitive reserve. Subsequently, starting from 2022, we explored the possibility of using passive BCI also in an industrial context, specifically by monitoring an operator's level of vigilance, which can be defined as the capacity to sustain one's attention during the realization of a task, and their mental workload, that is the effort furnished to respond to the task's demands. Both vigilance and mental workload fluctuations can be observed over time by analyzing the EEG, since they are associated with specific behaviors. The goal of the project is to create a deep learning pipeline for monitoring an operator's mental state in real-time, during the execution of prolonged activities and for predicting vigilance degradation during repetitive tasks. The model needs to alert operators by audio or video cues, should they become too tired to work without endangering themselves or the assembly procedure.

Other Research Activities

Imaging-Genetics

2020-ongoing **Imaging-Genetics** *(in collaboration with UCL (UK) - Dept. of Med Phys and Biomedical Eng, Faculty of Engineering Science - Dr. A. Altmann; INRIA Sophia Antipolis (FR) Universite Cote d'Azur - Dr. M. Lorenzi)*

Imaging genetics (IG) aims at decrypting the genetic underpinning of brain structure and function, which is one of the most prominent enabling technologies for precision medicine. With this project, we aim to open a glimpse on the scene by focusing on a specific case: modeling the association between neuro-image-derived endophenotypes (IDPs) and genetic variants, called determinants (GDs) focusing on brain aging in both healthy and diseased conditions, with the aim of decoupling the effect of physiological degeneration processes, acting as a baseline, from disease-induced modulations.

Scientific Production

Papers on International Peer-Reviewed Journals

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