Michele Svanera

michelesvanera.org
rockNroll87q
rockNroll87q
michele-svanera

Research Interests

At the core of my research interests there is a question: Will we ever be able to replicate (a part of) the brain? I do not have an answer, only more questions. How does the human vision work? Can current Artificial Intelligence models explain brain activity? Can we create an artificial network that mimics some brain functions? How can we advance brain imaging methods? Wandering across Cognitive Neuroscience and Artificial Intelligence (specifically Deep Learning), I address the goal of understanding human vision conducting behavioural, f/MRI, and computational modelling studies. For more insights on my research, please visit my personal website.

Experience

2022

Lecturer, *School of Psychology & Neuroscience*, University of Glasgow (UK).

⋄ Application of recent deep learning methods to develop the first DL-based cortical thickness estimation on human brain MRI. A fast and reliable extraction of cortical thickness distributions will unlock the ability to derive population trajectories for thousands of healthy subjects' and patients with Alzheimer's symptoms, creating an atlas with cortical thickness distributions for different brain areas.

⋄ Development of a novel Artificial Intelligence Method for inferencing impaired cognition trajectories from MRI data in patients with Alzheimer's dementia. Artificial intelligence tools have attempted to diagnose MR images into simple labels like 'disease' vs 'no-disease'. However, this approach fails to capture the cognitive impact of the disease on the patient. This project aims to link cognitive impairments to anatomical variations and track changes in symptoms over time.

⋄ Development of a new tool for brain MRI analysis at 3T, working with scans from any site in the world. The method produces state-of-the-art results, consistent across internal and external sites, robust to anatomical variations. Portable for use in various healthcare settings, patient populations, and imaging tech. More on the project website.

2019
2021

Research Associate, *School of Psychology & Neuroscience*, University of Glasgow (UK).

⋄ Application of recent methods on correlation analysis to test predictive coding theories on the functional connectivity organisation of early visual cortex activation elicited by watching movies.

⋄ Novel approach for early visual cortex modelling. Challenging DL models and the human brain to solve same (visual) tasks, I obtained a new promising way to compare DL with brain data. More on the project website.

⋄ Development of new tools for brain MRI analysis at 3T and 7T; focusing on segmentation, I developed a tool that performs better and faster than any automatic method available and it has been approved by experts. More on the project website.

2019
2017

Research Assistant, *Institute of Neuroscience and Psychology*, University of Glasgow (UK).

I addressed the goal to understand the brain activities (fMRI) in relation with movie stimulus applying recent advances in machine learning. Duties included: Development of experimental procedures, design and programming of behavioural and f/MRI experiments (3 and 7 Tesla), recording and analysing of the results, developing new multivariate-analysis procedures, review of current literature in relevant fields, presenting at conferences, and participating in the writing up of the results.

Education

2017
2014

Doctoral program (Ph.D.), Department of Information Engineering, University of Brescia (Italy).

During my Ph.D., I tried to combine three great passions of mine: AI, neuroscience, and movies. The result of this long journey allowed me to exploit movie representations as *trait d'union* to study AI and Neuroscience. The thesis, titled *"Movies and the brain: learning video content representation for cinema studies and neuroscience"* shows how representation learning can help find suitable numerical representations to use in fMRI data analysis and cinema studies.

International experiences

Visiting PhD
Functional Brain Center, Sourasky center, Tel Aviv (Israel): I spent few months in Israel opening a new line of research on Deep Learning approaches for fMRI analysis, in collaboration with prof. Talma Hendler. In the meantime, I taught more than 20 hours of Introduction to Deep Learning to the entire department. (2016)

Visiting PhD
Maastricht Brain Imaging Centre, Maastricht (Netherlands): These six months, in collaboration with prof. Rainer Goebel, gave me my first immersion in the field of Neuroscience. We worked together on the reconstruction of audio-visual features based on fMRI signal, using one of the biggest fMRI dataset ever collected. (2015)

2013
2011

Master of Science (M.Sc. Eng.),

Telecommunication Engineering, University of Brescia, Italy.

Master thesis: Methods and models for the synthesis and representation of 3D surfaces.
Relevant courses: information theory, digital modulation and channel coding, system identification and data analysis, image processing and visualisation, digital systems for signal processing, multimedia information coding, digital audio processing, remote sensing data analysis.

2011
2006

Bachelor of Science (B.Sc. Eng.),

Electronic Engineering, University of Brescia, Italy.

Bachelor thesis: Development of eye tracking technique software.
Relevant courses: linear algebra, mathematical analysis, analysis of differentiation and integration, statistical methods, probability, multivariable calculus, electromagnetic theory, waves and diffraction, operative systems, informatics, electronic engineering, analogue and digital electronics, communication systems.

Research Support

Two examples of supervisions are:

2022

MRC DTP in Precision Medicine Scholarship, *granted*, £90,000.

PhD Scholarship x4 years - Title "A novel Deep Learning method for estimating Cortical Thickness trajectories in Alzheimer?s patients and healthy population". The goal of this project is to exploit recent achievements in deep learning (DL) segmentation methods for cortical thickness estimation on human brain MRI. The extraction of cortical thickness distributions in a few minutes will unlock the ability to drawn population trajectories for thousands of healthy subjects' data in short time, creating an atlas with different distributions for different brain areas.

2022 **SGSSS Supervisor-led Steers Studentship Competition**, *submitted*, £50,000.

PhD Scholarship x4 years - Title "A novel Artificial Intelligence Method for inferencing impaired cognition trajectories from MRI data in patients with Alzheimer's dementia". First selection passed, waiting for the second. In this project, we will exploit recent achievements in Artificial Intelligence for inferring symptoms from brain MRI images of patients with AD. Several studies have shown that AD correlates with anatomical changes, such as a decrease in white matter volume or an increase in ventricle size. However, how single AD symptoms (i.e., cognitive impairments) produce anatomical changes is yet to be discovered. Here, we want the student to relate cognitive impairments to anatomical changes, drawing symptom trajectories changes over time.

2022 **Carnegie research incentive grants**, *submitted*, £20,000.

Early Career Researcher pump priming funds - Title "A novel Deep Learning method for estimating Cortical Thickness trajectories in Alzheimer's patients and healthy population".

Teaching

2022 **Statistical and Scientific Models (PSYCH4037)**, *Master course*.

Main topic: Deep Learning methods for f/MRI analyses

2017
2014 **Fundamentals of computer graphics**, *Master course*.

Main topics: geometric modelling, rendering and illumination, rasterization, texture mapping, volumetric rendering. Libraries: OpenGL and Unity, in python and C++. SW: Blender.

2015
2014 **Digital image processing**, *Master course*.

Main topics: geometric transformations, filtering, edge detection, image segmentation, morphological operators, feature extraction (ex. SIFT), source coding principles. Libraries: OpenCV in python and C++.

Research Supervision

2022 **Andreas Drakopoulos**, *PhD student*, UofG.

UKRI funded, Social AI CDT program, currently second year, working on "Deep Learning methods for studying lateralisation in Brain Age Prediction". Co-supervision with Professor Monika Harvey and Dr Michele Sevegnani.

2022 **Roberto Scott Luciani**, *PhD student*, UofG.

UKRI funded, Social AI CDT program, currently first year, working on "Towards modelling of biological and artificial perspective taken". Co-supervised with Professor Lars Muckli and Dr Michele Sevegnani.

2022 **Niina Seittenranta**, *PhD student*, UofG.

UKRI funded, Social AI CDT program, currently first year, working on "Deep Learning feature extraction for social interaction prediction in movies and visual cortex". Co-supervised with Professor Lars Muckli and Dr Fani Deligianni.

Two additional examples of supervisions are:

2019 **Deep learning methods for MRI data analysis**, *Master thesis*, UofBrescia.

In this thesis, we adopted a weakly-supervised learning strategy to develop a tool to produce accurate multi-structure segmentation results in only few seconds. The outcome of the work is "CEREBRuM: a fast and fully-volumetric Convolutional Encoder-decodeR for weakly-supervised sEgmentation of BRain strUctures from out-of-the-scanner MRI" published in *Medical Image Analysis*. The former student is now Ph.D. student at Harvard Medical School.

2016

Hair detection, segmentation, and hairstyle classification in the wild, *Master thesis*, UofBrescia.

In this thesis, we tackled the problem of hair analysis (detection, segmentation, and hairstyle classification) from unconstrained view by relying only on textures. The outcomes of the work are "Hair detection, segmentation, and hairstyle classification in the wild" published in: *Image and Vision Computing* and "Figaro, hair detection and segmentation in the wild" presented at *ICIP-2016*. The former student is now Senior AI Algorithm Developer at Huawei Technologies.

Journal Publications

2021

M. Svanera, S. Benini, D. Bontempi, and L. Muckli. "CEREBRUM-7T: Fast and Fully-volumetric Brain Segmentation of 7 Tesla MR Volumes". In: *Human Brain Mapping*. URL: https://rocknroll87q.github.io/cerebrum7t/.

2021

M. Svanera, A.T. Morgan, L.S. Petro, and L. Muckli. "A self-supervised deep neural network for image completion resembles early visual cortex fMRI activity patterns for occluded scenes". In: *Journal of Vision* 21.7, pp. 5–5. DOI: https://doi.org/10.1167/jov.21.7.5.

2020

Bontempi, D., S. Benini, A. Signoroni, L. Muckli*, and **M. Svanera***. "CEREBRUM: a fast and fully-volumetric Convolutional Encoder-decodeR for weakly-supervised sEgmentation of BRain strUctures from out-of-the-scanner MRI". In: *Medical Image Analysis* 62, p. 101688. DOI: https://doi.org/10.1016/j.media.2020.101688.

2019

Bálint, K.A., Gal Raz, Valente G, **M. Svanera**, and S. Benini. "A Robust Neural Fingerprint of Cinematic Shot-Scale". In: *Projections* 13.3, pp. 23 –52. DOI: 10.3167/proj.2019.130303.

2019

Svanera M., S. Benini, G. Raz, T. Hendler, R. Goebel, and G. Valente. "Transfer learning of deep neural network representations for fMRI decoding". In: *Journal of Neuroscience Methods*. DOI: 10.1016/j.jneumeth.2019.108319.

2019

Svanera M., M. Savardi, A. Signoroni, K.A. Bálint, and S. Benini. "Who is the film's director? Automatic style recognition based on shot features". In: *IEEE MultiMedia Magazine*. DOI: 10.1109/MMUL.2019.2940004.

2018

Muhammad, U. R., **M. Svanera**, R. Leonardi, and S. Benini. "Hair detection, segmentation, and hairstyle classification in the wild". In: *Image and Vision Computing* 71, pp. 25 –37. DOI: 10.1016/j.imavis.2018.02.001.

2017

Raz, G., **M. Svanera**, N. Singer, G. Gilam, M. B. Cohen, T. Lin, R. Admon, T. Gonen, A. Thaler, R. Y. Granot, R. Goebel, S. Benini, and G. Valente. "Robust inter-subject audiovisual decoding in functional magnetic resonance imaging using high-dimensional regression". In: *NeuroImage*. DOI: 10.1016/j.neuroimage.2017.09.032.

2016

Benini, S., **M. Svanera**, N. Adami, R. Leonardi, and K.A. Bálint. "Shot Scale Distribution in Art Films". In: *Multimedia Tools and Applications*. DOI: 10.1007/s11042-016-3339-9.

2016

Gordiychuk, A., **M. Svanera**, S. Benini, and P. Poesio. "Size distribution of micro bubbles for a venturi type bubble generator: effect of different parameters on bubble mean size , statistics of the distribution". In: *Experimental Thermal and Fluid Science*. DOI: 10.1016/j.expthermflusci.2015.08.014.

Conference Publications

2019

Bontempi, D., S. Benini, A. Signoroni, L. Muckli*****, and **Svanera M.***. "Fast Brain MRI Segmentation Using a Volumetric Deep Learning Approach". In: *2019 Conference on Cognitive Computational Neuroscience (CCN)*.

2018

Svanera M., A. T. Morgan, L. S. Petro, and L. Muckli. "Unsupervised deep neural network for fMRI feedback modelling". In: *2018 Conference on Cognitive Computational Neuroscience (CCN)*. URL: https://ccneuro.org/2018/proceedings/1055.pdf.

2016

Svanera M., S. Benini, G. Raz, T. Hendler, R. Goebel, and G. Valente. "Deep driven fMRI decoding of visual categories". In: *NIPS Workshop on Representation Learning in Artificial and Biological Neural Networks (MLINI, 2016)*. URL: https://arxiv.org/abs/1701.02133.

2016

Svanera M., U. Riaz Muhammad, R. Leonardi, and S. Benini. "Figaro, hair detection and segmentation in the wild". In: *Proceedings of IEEE International Conference on Image Processing (ICIP, 2016)*. DOI: 10.1109/ICIP.2016.7532494.

2015

Svanera M., S. Benini, N. Adami, R. Leonardi, and K.A. Bálint. "Over-the-Shoulder Shot Detection in Art Films". In: *13th International Workshop on Content-Based Multimedia Indexing (CBMI, 2015)*. DOI: 10.1109/CBMI.2015.7153627.

Certifications

- Build Basic Generative Adversarial Networks (DeepLearning.AI, coursera.org)
- Deep Neural Networks with PyTorch (IBM, coursera.org)
- Deep Learning Specialization (DeepLearning.AI, coursera.org)
- Machine Learning (Stanford, coursera.org)
- Networked Life (University of Pennsylvania, coursera.org)
- Social Network Analysis (University of Michigan, coursera.org)
- Process Mining: Data science in Action (Eindhoven University of Technology, coursera.org)
- Statistical Analysis of fMRI Data (Johns Hopkins University, coursera.org)
- Mining Massive Datasets (Stanford University, coursera.org)
- Applied Regression Analysis (Ohio State University, coursera.org)
- Applied Logistic Regression (Ohio State University, coursera.org)

Languages

Italian	Native speaker	*Mother Tongue*
English	Proficient user	*Daily practice, all work performed in English*

Programming Skills

★ ★ ★ ★ ★
python, bash, 🐧

★ ★ ★ ★ ☆
Matlab, LaTex

★ ★ ★ ☆ ☆
C, C++, Java

★ ★ ☆ ☆ ☆
PHP, HTML, CSS,
MySQL, R

OS experience

GNU/Linux	★ ★ ★ ★ ☆
MacOS	★ ★ ★ ★ ★
Windows	★ ★ ★ ☆ ☆

Interests

Hobby	Reading, cooking, PC strategy games, walking, and homebrewing.
Sport	Football, swimming, running, cycling, yoga, squash, and bouldering.

References

Post-doc PI
Prof. Lars Muckli
Glasgow University, UK
✉ Lars.Muckli@glasgow.ac.uk

Ph.D. Advisor
Prof. Sergio Benini
University of Brescia, Italy
✉ sergio.benini@unibs.it