Adam Gosztolai

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Research interests

Both our brains and AI systems solve computational challenges in a highly distributed manner encoded in the collective activity of neural populations. My research focuses on understanding the dynamical processes underpinning neural computations to derive common algorithmic principles shared by these fundamentally different systems. I am motivated by two synergistic aims: (1) developing novel methods using machine learning, geometry and dynamical systems theory that facilitate discovering better models of how the brain works and (2) reverse-engineering the dynamical processes that underpin complex animal behaviours to develop more advanced AI systems that benefit clinical applications such as brain-machine interfaces

Current position

Apr 2024 - present **Independent Group Leader**, *Dynamics of Neural Systems Laboratory, AI Institute, Medical University of Vienna, AT.*

Jun 2023 - present **Research Affiliate**, *McGovern Institute for Brain Research, MIT, USA.*
Host: Prof. Mehrdad Jazayeri

Previous positions

Jun 2022 - Mar 2024 **Postdoctoral Fellow**, *Signal Processing Laboratory, EPFL, CH.*
Advisor: Prof. Pierre Vandergheynst.

May 2019 - Jun 2022 **HFSP Postdoctoral Fellow**, *Neuroengineering & Biorobotics Laboratories, EPFL, CH.*
Advisors: Prof. Pavan Ramdya and Prof. Auke Ijspeert.

Nov 2018 – Jun 2023 **Honorary Research Fellow**, *Imperial College London, UK.*
Collaborated with haematologists to develop dynamical models of blood platelet regulation.

Mar 2017 – May 2017 **Visiting Graduate Student**, *Prof. Martin Ackermann's lab, EAWAG-ETHZ, CH.*
Developed skillset in microfluidics with fluorescent microscopy for studying bacterial growth.

Jun 2015 **Visiting Graduate Student**, *Prof. Jeff Gore's lab, MIT, USA.*
Collaborated with Christoph Ratzke on modelling quorum sensing in bacterial chemotaxis.

Jul 2011 – Jul 2012 **Engineer in Flight Physics**, *Airbus UK, Bristol, UK.*
Developed models to identify aeroelastic instabilities in airframes from multi-sensor data.

Education

Oct 2014 – Nov 2018 **BBSRC Doctoral Student in Mathematics**, *Imperial College London, UK.*
Advisors: Prof. Mauricio Barahona and Prof. Martin Buck.
Thesis title: 'Dynamical adaptation in biology on multiple scales: from cells to collectives'.

Oct 2013 – Oct 2014 **M.Res. in Systems and Synthetic Biology**, *Imperial College London, UK.*
Distinction.
Thesis title: 'Dynamic regulation of bacterial nitrogen assimilation'.

Oct 2012 – Jun 2013 **M.A.St. (Part III) in Mathematics**, *University of Cambridge, UK.*
Specialisation: graphs and combinatorics, operational research, asymptotic methods.
Advisor: Prof. Jörn Dunkel.
Thesis title: 'Information processing in slime mould networks'.

Sep 2008 – Jun 2011 **B.Eng. in Mechanical Engineering**, *University College London, UK.*
First-class honours with Dean's list (best overall result).

Grants & Awards

Jul 2024 **Europeal Research Council (ERC) Starting grant**, EUR 1.5m.

Oct 2023 **Winner of the Ignite Generative AI Entrepreneurship competition**, annual contest organised by the MIT-IBM Watson Lab to showcase promising startup ideas in the field of generative AI, USD 15,000.

Feb 2022 **Winner of the PIs of Tomorrow competition**, annual competition organised by Life Sciences Switzerland for aspiring early career researchers in all fields of life sciences.

Jun 2019 – Jun 2022 **HFSP Cross-disciplinary Postdoctoral Fellowship**, highly competitive independent grant to fund postdoctoral research. CHF 261,432.

Mar 2017 – May 2017 **EMBO Short-Term Fellowship**, to visit Prof. Martin Ackermann's lab. EUR 18,000.

Jun 2015 **MIT-Imperial Global Fellows programme**, interdisciplinary collaboration and leadership program awarded to 20 PhD students from Imperial and MIT.

2013-2018 **BBSRC doctoral training programme**, to fund M.Res. and Ph.D. studies at Imperial College London, GBP 65,000.

2012 **UK Techmasters award**, awarded to ten students annually in the UK to support their Master's studies in STEM subjects. GBP 5,000.

2011 **Archibald P. Head memorial prize and medal**, for the best overall grade in the Engineering degrees at UCL.

Invited talks

- Oxford Mathematical Neuroscience seminar, University of Oxford (2024)
- COSYNE conference, Lisbon (2024)
- Bernstein conference workshop - Symmetry, Invariance and Neural Representations, Berlin (2023)
- McGovern Institute neuroscience seminar, MIT (2023)
- Cognitive Neuroscience Seminar, École Normale Supérieure (2023)
- YISS seminar, Friedrich Miescher Institute (2022)
- PIs of Tomorrow competition finals, Zürich (2022) - **plenary talk**
- Group meeting, Prof. Sahand Jamal Rahi's lab, EPFL (2022)
- Group meeting, Prof. Andy Oates' lab, EPFL (2022)
- Warwick Complexity seminar, University of Warwick (2021)
- Applied Topology seminar, EPFL (2021)
- Institute of Physics workshop, Machine Learning in Biological Physics, virtual (2021)
- Physics of Living Systems seminar, EPFL (2021)
- Group meeting, Theoretical Neuroscience group, University of Geneva (2019)
- BBSRC-DTP Annual Meeting, London (2019)
- Group meeting, Prof. Roman Stocker's group, ETH Zürich (2017)
- Physics of Living Systems seminar, MIT (2017)

Conference presentations in the past five years

- Networks Neuroscience, Vienna (2023) - *contributed talk*
- Theory across Biology workshop, Bern (2023) - *contributed talk*
- AI4Science day, EPFL, Lausanne (2022) - *contributed talk*
- Applied Machine Learning Days, Lausanne (2022) - *poster*
- LS2 Annual meeting, Zürich (2022) - *contributed talk*
- HFSP Annual meeting, virtual (2021) - *contributed talk*
- CVPR Workshop - CV4Animals, virtual (2021) - *poster*
- Networks2021, virtual (2021) - *contributed talk*
- SFN conference, virtual (2021) - *contributed talk*
- European Brain and Behaviour Society meeting, virtual (2021) - *poster*

- Neuromatch 3.0 conference, virtual (2020) - *contributed talk*
- AMAM conference, Lausanne (2020) - *poster*
- SNF conference, virtual (2019) - *poster*
- COSYNE, Lisbon (2019) - *poster*
- SYSBIO conference, Innsbruck (2018) - *contributed talk*

Major collaborations

- Prof. Gregoire Courtine (EPFL), Robotic foundation model to understand the neural control of primate locomotion. I am currently being supported by primate data from this group.
- Prof. Liset de la Prida (Cajal Institute), The emergnent dynamics of the cognitive map. Currently applying for an HFSP research grant.
- Prof. Mehrdad Jazayeri (MIT), Neural correlates of counterfactual decision-making. One submitted manuscript. I am currently being supported by primate data from this group.
- Prof. Pierre Vandergheynst (EPFL), Geometric deep learning methods to study neural dynamics. Two first-author publications.
- Prof. Pavan Ramdya (EPFL), Data-driven methods to model animal behaviour. Two first-author publications.
- Prof. Nir Grossman (Imperial College London), Analysis of EEG data in Alzheimer's patients using geometric Gaussian processes. One last-author publication.
- Prof. Mauricio Barahona (Imperial College London), Imperial College London, Multiscale methods to study biological collectives. Three first-author publications.
- Prof. José Carrillo (Oxford), Kinetic theory and gradient-flow methods to model population dynamics. One first-author publication.
- Dr. Alexis Arnaudon (EPFL), Geometric methods for dynamical systems. Two first-author publications.
- Prof. Martin Buck (microbiology), One first-author publication.

Teaching & Supervision Experience

Supervision (Medical University of Vienna)

Albert López i Serrano (2024-) — PhD student.
Project: 'A mathematical theory of compositional generalisation in biological and artificial neural networks'.

Student supervision (EPFL)

Danyang Wang (2023) — Master's project, Computational Science and Engineering.
Project: 'Geometric deep learning to study information propagation in temporal networks'.

Sam Jegou (2023) — Semester project, Computational Science and Engineering.
Project: 'Inferring bifurcations in dynamical systems using geometric deep learning'.

Jiri Lhotka (2022) — Semester project, Computer Science, *currently intern at DeepMind*.
Project: 'Adaptive geometric neural networks'.

Louise de Wouters (2022) — Internship.
Project: 'Data-driven analysis of fruit fly movement kinematics'.

Aliaa Diab (2021) — Master's project, Robotics, *currently doctoral student at EPFL*.
Title: 'Software and hardware design for high-throughput closed-loop stimulation'.

Cédric Portmann (2021) — Semester project, Robotics, *currently doctoral student at EMPA, ETH Zürich*.
Title: 'Ball-tracking and closed loop stimulation for tethered *Drosophila*'.

Mahdi Nobar (2020) — Master's project, Mechanical Engineering, *currently a doctoral student at ETH Zürich*.
Title: 'Construction of a 2-prism behavioural arena'.

Marco Abrate (2020) — Master's project, Data Science.
Title: 'Monocular 3D pose estimation in *Drosophila*'.

Teaching assistantship (Imperial College London)

2016-17 Fall/Spring — Geometry and Linear Algebra (M1GLA), *Department of Mathematics*.
Conducted twice-a-week exercise classes to approx. 100 first-year students.

2016-17 Fall/Spring	Multivariable Calculus (M2AA2), *Department of Mathematics*. Conducted twice-a-week exercise classes to approx. 50 second-year students.
2017 Spring	Integrative Systems Biology, *Department of Life Sciences*. Designed exercise and final exam questions for second-year Systems Biology students.
2017 Fall/Spring	Modelling in Biology (MIB), *Department of Bioengineering*. Designed and conducted demonstration classes involving coding-based classroom assignments.

Professional & Outreach Activities

Conference organisation

- Life Sciences Switzerland Annual meeting, Zürich (2023)
- Year of Mathematical Biology Conference, London (2018)
- Imperial SIAM Conference, London (2017)

Journal review

Nature, Physical Review Letters, Nature Communications, eLife, Communications Physics, Scientific Reports, Physical Review Research, Physical Review E

Innovation and creativity

- EPFL Open doors (Portes ouvertes) 2019, *designed real-time experimental demonstration of fruit fly behaviour for high school student event*
- Vice president of Imperial SIAM student society (2017) - *contributed to funding acquisition, and organisation of conferences and departmental seminars*
- Maths Helpdesk - *founder of initiative for connecting mathematicians with other disciplines and industry*
- Junior Applied Mathematics Seminars (JAMS) - *initiated and organised weekly student seminars*

Activities to promote diversity

- EPFL diversity committee (2020-21), *contributed to debates to promote equal opportunities in academic hiring*

Programming skills

- Expert knowledge in Python in diverse scientific problems, including the implementation of machine learning models and numerical schemes.
- Good command of C++ and Fortran in implementing efficient numerical routines.
- Expert knowledge in Matlab for engineering simulations.
- Experienced in several computational fluid mechanics packages (COMSOL, Ansys) to solve fluid dynamic simulations and other CAD packages (AutoCAD, Solidworks).

Languages

English: proficient, **German:** good command, **Hungarian:** native

Hobbies & Interests

Striving for a healthy work-life balance by practising regular sports and playing the piano. A competitive runner, cyclist and tennis player since a young age. Have recently completed the Lausanne Marathon 2023.