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Patrik Reizinger

Summary

I am a doctoral researcher specializing in causal and self-supervised representation learning, affiliated with the IMPRS-IS and ELLIS doctoral programs. My work focuses on grounding the theory of how deep networks generalize into real-world physics. I possess a robust interdisciplinary background in engineering, robotics, and machine learning, complemented by extensive extracurricular training in leadership, exercise physiology, and the psychology of high performance. My research contributions, particularly in representation learning and dynamical systems, have been recognized with an Oral (top 1.8%) and a Spotlight distinction at ICLR 2025, as well as a Spotlight at NeurIPS 2024. I have delivered invited talks at several prestigious institutions, including Mila, LMU Munich, and the University of Waterloo. I actively contribute to the machine learning community by organizing workshops and symposia and by mentoring and supervising talented students.

Education

2021–2026 **Machine Learning Ph.D.**, *International Max Planck Research School for Intelligent Systems/University of Tübingen/ELLIS Institute Tübingen*, Tübingen, Germany
Thesis: Causal Representation Learning
Supervisors: Wieland Brendel, Ferenc Huszár, Matthias Bethge, Bernhard Schölkopf
ELLIS exchange at the University of Cambridge: 2022.10–2023.03.

2019–2021 **Electrical Engineering M.Sc.**, *Budapest University of Technology and Economics*, Budapest, Hungary, GPA 5.0/5.0 (valedictorian)
Thesis: Development of an Attitude Determination and Control System for CubeSats on LEO orbits
Supervisors: Ferenc Vajda, Márton Szemenyei
Extracurricular: iMSc program for talented students

2015–2019 **Electrical Engineering B.Sc.**, *Budapest University of Technology and Economics*, Budapest, Hungary, GPA 5.0/5.0 (valedictorian)
Thesis: Development of a 3D input device for virtual working environments
Supervisors: Ferenc Vajda, Márton Szemenyei
Extracurricular: German language program in cooperation with the Karlsruhe Institute of Technology
Exchange semester at the Karlsruhe Institute of Technology: 2018.10–2019.02.

Experience

2025.10–12. **Visiting Researcher**, *Mila*, Montreal, Canada
Hosted by Dhanya Sridhar and Simon Lacoste-Julien, working on causal representation learning, mechanistic interpretability, LLMs, and optimization

2024.06–09. **Summer Research Intern**, *Vector Institute*, Toronto, Canada
Hosted by Rahul G. Krishnan, working on causal representation learning and self-supervised methods

2020.02–2021.01. **Deep Learning Student Researcher**, *Budapest University of Technology and Economics*, Budapest, Hungary
Analyzed time series data with deep learning

2019.02–2021.02. **Control Engineering Intern**, *C3S Electronics Development LLC*, Budapest, Hungary
Developed and designed a CubeSat attitude determination and control system

2019.01–02. **FPGA Developer Intern**, *Karlsruhe Institute of Technology*, Karlsruhe, Germany
Implemented FPGA time synchronisation with a Python interface

2018.06–08. **Image Processing Intern**, *Fraunhofer Institute for Factory Operation and Automation IFF*, Magdeburg, Germany
Developed an automated visual inspection tool in C++, including a Python wrapper

2017.06–08. **Data Scientist Intern**, *Gravity R&D*, Budapest, Hungary
Analyzed customer data in Python with machine learning

2016.09–2019.01. **Virtual Reality Peripheral Device Developer**, *Budapest University of Technology and Economics*, Budapest, Hungary
Developed the hardware and software for a 3D input device for virtual working environments

Honors and Awards

2023,2024 **Qualcomm Innovation Fellowship Europe**, *Qualcomm*, Finalist, AI/cybersecurity fellowship; finalists present to Qualcomm judges

2021 **Pro Scientia Gold Medal**, *National Scientific Students' Association Hungary*, top 0.03%, Highest national student research distinction for overall scientific excellence

2021 **Hope Badge Special Award to The Most Promising Young Scientist**, *Pro Scientia Gold Medalists' Association*, top 0.003%, Highest national student research distinction at the National Scientific Students' Association Conference

2019, 2021 **1st Prize at National Scientific Students' Association Conference**, *National Scientific Students' Association Hungary*, top 0.3%
- Attention-based curiosity in multi-agent reinforcement learning environments (2021)
- Stochastic weight matrix-based regularization methods for deep neural networks (2019)
- Development of a 3D input device for virtual working environments (2019)

2017–2019 **1st Prize at Scientific Students' Association Conference**, *Budapest University of Technology and Economics*, top 0.3%
- Attention-based curiosity in multi-agent reinforcement learning environments (2019)
- Development of an Attitude Determination and Control System for CubeSats on LEO orbits (2019)
- Stochastic weight matrix-based regularization methods for deep neural networks (2018)
- Development of a 3D input device for virtual working environments (2017)

2018 **Nokia Bell Labs Scholarship for Deep Learning Research**, *Nokia Bell Labs Hungary*, Early research scholarship from a globally recognized industrial lab

2016–2018,2020 **National Higher Education Scholarship**, *Republic of Hungary*, top 0.8%, Highest national student distinction for academic excellence

Grants

2025 **ICLR Scholar Award**, *Conference support for accepted authors*

2022–2023 **ELLIS Travel Grant**, *Travel support from the ELLIS netweork for my exchange at the University of Cambridge*

2022 **NeurIPS Scholar Award**, *Conference support for accepted authors/participants*

2016,2018 **New National Excellence Program Research Grant**, *Ministry of Innovation and Technology Hungary*, top 0.3%, Competitive research grant for university students

References

[1] **Patrik Reizinger***, Bálint Mucsányi*, Siyuan Guo*, Benjamin Eysenbach, Bernhard Schölkopf†, and Wieland Brendel†. *Skill Learning via Policy Diversity Yields Identifiable Representations for Reinforcement Learning*. 2025. arXiv: 2507.14748 [cs.LG].

[2] **Patrik Reizinger***, Randall Balestriero, David Klindt, and Wieland Brendel. "Position: An Empirically Grounded Identifiability Theory Will Accelerate Self-Supervised Learning Research". In: *The 42nd International Conference on Machine Learning*. 2025.

[3] Szilvia Ujváry, Anna Mészáros, Wieland Brendel, **Patrik Reizinger**†, and Ferenc Huszár†. "Transcending Bayesian Inference: Transformers Extrapolate Rules Compositionally Under Model Misspecification". In: *7th Symposium on Advances in Approximate Bayesian Inference – Workshop Track*. 2025.

[4] David Klindt, Charles O'Neill, **Patrik Reizinger**, Harald Maurer, and Nina Miolane. *From superposition to sparse codes: interpretable representations in neural networks*. 2025. arXiv: 2503.01824 [cs.LG].

[5] **Patrik Reizinger***, Alice Bizeul*, Attila Juhos*, Julia E Vogt, Randall Balestriero, Wieland Brendel, and David Klindt. "Cross-Entropy Is All You Need To Invert the Data Generating Process". In: *The Thirteenth International Conference on Learning Representations*. Oral (top 1.8%). 2025.

[6] **Patrik Reizinger***, Siyuan Guo*, Ferenc Huszár, Bernhard Schölkopf, and Wieland Brendel. "Identifiable Exchangeable Mechanisms for Causal Structure and Representation Learning". In: *The Thirteenth International Conference on Learning Representations*. Spotlight (top 5.1%). 2025.

[7] Evgenia Rusak*, **Patrik Reizinger***, Attila Juhos*, Oliver Bringmann, Roland S. Zimmermann, and Wieland Brendel. "InfoNCE: Identifying the Gap Between Theory and Practice". In: *The 28th International Conference on Artificial Intelligence and Statistics*. 2025.

[8] **Patrik Reizinger** and Rahul G. Krishnan. "Exploring A Bayesian View On Compositional and Counterfactual Generalization". In: *NeurIPS 2024 Workshop on Compositional Learning: Perspectives, Methods, and Paths Forward*. 2024.

[9] Anna Mészáros, Szilvia Ujváry, Wieland Brendel, **Patrik Reizinger**†, and Ferenc Huszár†. "Rule Extrapolation in Language Modeling: A Study of Compositional Generalization on OOD Prompts". In: *The Thirty-eighth Annual Conference on Neural Information Processing Systems*. Spotlight. 2024.

[10] **Patrik Reizinger***, Szilvia Ujváry*, Anna Mészáros*, Anna Kerekes*, Wieland Brendel, and Ferenc Huszár. "Position: Understanding LLMs Requires More Than Statistical Generalization". In: *Forty-first International Conference on Machine Learning*. Spotlight (top 3.5%). 2024.

[11] Goutham Rajendran*, **Patrik Reizinger***, Wieland Brendel, and Pradeep Kumar Ravikumar. "An Interventional Perspective on Identifiability in Gaussian LTI Systems with Independent Component Analysis". In: *3rd Conference on Causal Learning and Reasoning (CLeaR)*. Oral. 2024.

[12] **Patrik Reizinger***, Han-Bo* Li, Aditya* Ravuri, Ferenc Huszár, and Neil D Lawrence. "Independent Mechanism Analysis in GPLVMs". In: *Fifth Symposium on Advances in Approximate Bayesian Inference*. 2023.

[13] **Patrik Reizinger** and Ferenc Huszár. "SAMBA: Regularized Autoencoders perform Sharpness-Aware Minimization". In: *Fifth Symposium on Advances in Approximate Bayesian Inference*. 2023.

[14] Hamza Keurti*, **Patrik Reizinger***, Bernhard Schölkopf, and Wieland Brendel. "Desiderata for Representation Learning from Identifiability, Disentanglement, and Group-Structuredness". In: *ICML 2023 Workshop 2nd Annual TAG in Machine Learning*. 2023.

[15] **Patrik Reizinger** and Ferenc Vajda. "CubeSat Attitude Determination with Decomposed Kalman Filters". In: *Journal of the Brazilian Society of Mechanical Sciences and Engineering* 45.2 (2023), p. 126.

[16] **Patrik Reizinger**. "The Falsificationist View of Machine Learning". In: *Information Society/Információs Társadalom (InfTars)* 23.2 (2023).

[17] **Patrik Reizinger**, Yash Sharma, Matthias Bethge, Bernhard Schölkopf, Ferenc Huszár, and Wieland Brendel. "Jacobian-based Causal Discovery with Nonlinear ICA". In: *Transactions on Machine Learning Research* (2023). ISSN: 2835-8856.

[18] Evgenia Rusak*, **Patrik Reizinger***, Roland S. Zimmermann*, Oliver Bringmann, and Wieland Brendel. " Content Suppresses Style in Dimensionality Collapse in Contrastive Learning ". In: *NeurIPS 2022 Workshop on Self-Supervised Learning–Theory and Practice*. 2022.

[19] **Patrik Reizinger***, Luigi Gresele*, Jack Brady*, Julius von Kügelgen, Dominik Zietlow, Bernhard Schölkopf, Georg Martius, Wieland Brendel, and Michel Besserve. "Embrace the Gap: VAEs Perform Independent Mechanism Analysis". In: *NeurIPS2022*. 2022.

[20] **Patrik Reizinger***, Yash Sharma, Matthias Bethge, Bernhard Schölkopf, Ferenc Huszár, and Wieland Brendel. "Multivariable Causal Discovery with General Nonlinear Relationships". In: *UAI 2022 Workshop on Causal Representation Learning*. Oral. 2022.

[21] Márton Szemenyei and **Patrik Reizinger**. "Handling Realistic Noise in Multi-Agent Systems with Self-Supervised Learning and Curiosity". In: *Journal of Artificial Intelligence and Soft Computing Research* 12.2 (2021), pp. 135–148.

[22] **Patrik Reizinger**, Péter Huszár, Dorottya Milánkovich, and Alexandra Széll. "Kisműholdak fejlesztése a sokoldalúság és a könnyű reprodukálhatóság tükrében". In: *Repüléstudományi Közlemények* 32.2 (2020), pp. 81–95.

[23] Márton Szemenyei and **Patrik Reizinger**. "Learning to Play Robot Soccer from Partial Observations". In: *2020 23rd International Symposium on Measurement and Control in Robotics (ISMCR)*. IEEE. 2020, pp. 1–6.

[24] **Patrik Reizinger** and Márton Szemenyei. "Attention-based curiosity-driven exploration in deep reinforcement learning". In: *ICASSP 2020-2020 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)*. IEEE. 2020, pp. 3542–3546.

[25] Marton Szemenyei and **Patrik Reizinger**. "Attention-based curiosity in multi-agent reinforcement learning environments". In: *2019 International Conference on Control, Artificial Intelligence, Robotics & Optimization (ICCAIRO)*. IEEE. 2019, pp. 176–181.

[26] **Patrik Reizinger** and Bálint Gyires-Tóth. "Stochastic weight matrix-based regularization methods for deep neural networks". In: *International Conference on Machine Learning, Optimization, and Data Science*. Springer, Cham. 2019, pp. 45–57.

[27] **Patrik Reizinger** and Ferenc Vajda. *Concept of a mobile, cameraless VR-controller framework for working environments*. 2018.

* denotes joint first, † joint senior authorship.

Talks

2025.10. **Identifiable Exchangeable Mechanisms** , *Symposium on Mathematical Foundations of Trustworthy Learning*, Ascona, Switzerland

2025.09. **Identifiable Exchangeable Mechanisms**, *Centre Suisse d'Electronique et de Microtechnique*, Alpnach, Switzerland, Invited

2025.09. **Causal Representation Learning**, *Laboratory of Cryptography and System Security*, Budapest, Hungary, Invited

2025.08. **Identifiable Exchangeable Mechanisms**, *Hungarian Machine Learning Days, Artificial Intelligence National Laboratory*, Budapest, Hungary, Invited

2025.08. **Estimating Treatment Effects with Independent Component Analysis**, *4th MCML Workshop on Causal Machine Learning, MCML*, München, Germany, Invited

2025.02. **Causality and OOD generalization in Foundation Models**, *Bellairs Workshop on Causality, Bellairs Research Institute*, Barbados, Invited

2024.09. **Identifiable Exchangeable Mechanisms**, *Mila tea talk series, Mila*, Montréal, Canada, Invited

2024.07. **Embrace the Gap: VAEs Perform Independent Mechanism Analysis**, *Critical ML Lab, University of Waterloo*, Waterloo, Canada, Invited

2023.12. **Embrace the Gap: VAEs Perform Independent Mechanism Analysis**, *Central European University Representation Learning Reading Group*, Budapest, Hungary, Invited

2023.02. **Popper meets machine learning—How falsificationism can guide the design of AI solutions**, *Darwin College*, Cambridge, UK

2023.01. **Multivariable Causal Discovery for General Nonlinear Functions**, *AstraZeneca Seminar*, online, Invited

2022.12. **Multivariable Causal Discovery for General Nonlinear Functions**, *Learning on Graphs Cambridge Meetup*, Cambridge, UK

2022.10. **Embrace the Gap: VAEs Perform Independent Mechanism Analysis**, *University of Warsaw Machine Learning Seminar*, online, Invited

2022.08. **Multivariable Causal Discovery for General Nonlinear Functions**, *UAI 2022 Workshop on Causal Representation Learning*, Eindhoven, Netherlands

Outreach & Community Service

2024 **Organizer**, *CALM: First Workshop on Causality and Large Models*, NeurIPS 2024

2023,2024 **Organizer**, *IMPRS-IS Bootcamp*, International Max Planck Research School for Intelligent Systems

2022,2023 **Organizer**, *ELLIS Doctoral Symposium*, ELLIS

2022–ongoing **Academic Knowledge Transfer**, *The Path to PhD blog*, path2phd.substack.com

2021–ongoing **Thesis committee member**, *Budapest University of Technology and Economics*

2020–ongoing **Coordinator**, *Machine Learning Journal Club for Hungarian Students*

2020 **Program Committee Member**, *6th International Conference on Machine Learning, Optimization, and Data Science*

2016 **E-learning Developer**, *EduBase*
Video series for the Digital Design I. university course

Mentoring

2025–ongoing **Hsun-Yu Kuo**, *M.Sc. at EPFL*

2025–ongoing **Samuel Innes**, *B.Sc. at Heidelberg→ M.Sc. at the University of Cambridge*

2023–ongoing **Bálint Mucsányi**, *M.Sc.→ Ph.D. at the University of Tübingen*

2023–ongoing **Szilvia Ujváry**, *M.Sc.→ Ph.D. at the University of Cambridge*

2023–ongoing **Anna Mészáros**, *M.Sc.→ Ph.D. at the University of Cambridge*

2022–ongoing **Boglárka Ecsedi**, *B.Sc. at GeorgiaTech→Ph.D. at the University of Toronto*

Reviewing

ICML 2025 position paper track, ICLR 2025/2026, NeurIPS 2024/2025, CLeaR 2024/2025, AISTATS 2026, NeurIPS 2023/2024 workshops, Infocommunications Journal

Teaching

Fall 2020/21 **Teaching Assistant**, *Budapest University of Technology and Economics*, Budapest, Hungary
Image Processing Laboratory I., Computer Vision Systems, Deep Learning in Visual Computing

Fall 2017/18 **Teaching Assistant**, *Budapest University of Technology and Economics*, Budapest, Hungary
Digital Design I. laboratory

Extracurriculars & Coursework

2024.07–ongoing **Performance Psychology, Leadership**, *The Growth Equation Academy*, online

2023.11–ongoing **Coaching, Exercise Physiology, Biomechanics**, *The Scholar Program*, online

2023.12. **CI/CD for Machine Learning certification**, *Weights and Biases*, online

2022.07. **ELLIS Cambridge Unit Machine Learning Summer School**, *ELLIS Cambridge Unit*, Cambridge, UK

2022.07. **Machine Learning Summer School**, *ML in PL*, Krakow, Poland

2021.04. **A Young Leader's Guide to Risk**, *McChrystal Group*, Budapest, Hungary

2020.09. **Ladybird Guide to Spacecraft Operations Workshop**, *European Space Agency*, online

2020.07. **Eastern European Machine Learning Summer School**, *ML in PL*, online

2019.07. **International Summer School on Deep Learning**, *IRDTA*, Warsaw, Poland

2019.01. **Concurrent Design Workshop**, *European Space Agency*, ESEC-Galaxia, Redu, Belgium

2018–2020 **Leadership Academy**, *Mathias Corvinus Collegium*, Budapest, Hungary

2018.11. **Traction Europe Case Studies for Outstanding Engineering Students**, *Boston Consulting Group*, Paris, France

2016–2018 **Business and Economics Specialization**, *Mathias Corvinus Collegium*, Budapest, Hungary

2015–2016 **University Junior Program**, *Mathias Corvinus Collegium*, Budapest, Hungary

Competencies

Soft skills Leadership, Scientific writing, Project management, Assertive communication, Storytelling

Languages English (C2), German (C2), Hungarian (native), Italian (A2), French (A1),

Tübingen, 19th October, 2025