

List of Publications

Journal Articles

1. Bley F, **Lapuschkin S**, Samek W and Montavon G (2025).
“Explaining Predictive Uncertainty by Exposing Second-Order Effects”.
In: *Pattern Recognition* 160:111171.
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2. Vielhaben J, **Lapuschkin S**, Montavon G and Samek W (2024).
“Explainable AI for Time Series via Virtual Inspection Layers”.
In: *Pattern Recognition* 150:110309.
<https://github.com/jvielhaben/DFT-LRP>
3. Becker S, Vielhaben J, Ackermann M, Müller K-R, **Lapuschkin S** and Samek W (2024).
“AudioMNIST: Exploring Explainable Artificial Intelligence for Audio Analysis on a Simple Benchmark”.
In: *Journal of the Franklin Institute* 361(1):418–428.
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4. Achibat R, Dreyer M, Eisenbraun I, Bosse S, Wiegand T, Samek W and **Lapuschkin S** (2023).
“From attribution maps to human-understandable explanations through Concept Relevance Propagation”.
In: *Nature Machine Intelligence* 5(9):1006–1019.
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5. Hedström A, Bommer P, Wickström K K, Samek W, **Lapuschkin S** and Höhne M-C M (2023).
“The Meta-Evaluation Problem in Explainable AI: Identifying Reliable Estimators with MetaQuantus”.
In: *Transactions on Machine Learning Research* 2835–8856.
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6. Weber L, **Lapuschkin S**, Binder A and Samek W (2023).
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In: *Information Fusion* 92:154–176
7. Hedström A, Weber L, Krakowczyk D G, Bareeva D, Motzkus F, Samek W, **Lapuschkin S** and Höhne M-C M (2023).
“Quantus: An Explainable AI Toolkit for Responsible Evaluation of Neural Network Explanations and Beyond”.
In: *Journal of Machine Learning Research* 24(34):1–11.
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8. Hofmann S M, Beyer F, **Lapuschkin S**, Golterman O, Loeffler M, Müller K-R, Villringer A, Samek W and Witte A V (2022).
“Towards the Interpretability of Deep Learning Models for Multi-modal Neuroimaging: Finding Structural Changes of the Ageing Brain”.
In: *NeuroImage* 261:119504
9. Ma J, Schneider L, **Lapuschkin S**, Achibat R, Durchrau M, Krois J, Schwendicke F and Samek W (2022).
“Towards Trustworthy AI in Dentistry”.
In: *Journal of Dental Research* 00220345221106086
10. Rieckmann A, Dworzynski P, Arras L, **Lapuschkin S**, Samek W, Onyebuchi A A, Rod N H, Ekström C T (2022).
“Causes of Outcome Learning: A Causal Inference-inspired Machine Learning Approach to Disentangling Common Combinations of Potential Causes of a Health Outcome”.
In: *International Journal of Epidemiology* dyac078.
<https://github.com/ekstroem/cool> | <https://www.causesofoutcomelearning.org>
11. Slijepcevic D, Horst F, **Lapuschkin S**, Horsak B, Raberger A-M, Kranzl A, Samek W, Breiteneder C, Schöllhorn W I and Zeppelzauer M (2022).
“Explaining Machine Learning Models for Clinical Gait Analysis”.
In: *ACM Transactions on Computing for Healthcare* 3(2):14:1–27.
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12. Anders C J, Weber L, Neumann D, Samek W, Müller K-R and **Lapuschkin S** (2022).
“Finding and Removing Clever Hans: Using Explanation Methods to Debug and Improve Deep Models”.
In: *Information Fusion* 77:261–295
13. Sun J, **Lapuschkin S**, Samek W and Binder A (2022).
“Explain and Improve: LRP-inference Fine-tuning for Image Captioning Models”.
In: *Information Fusion* 77:233–246

14. Samek W, Montavon G, **Lapuschkin S**, Anders C J, and Müller K-R (2021).
“Explaining Deep Neural Networks and Beyond: A Review of Methods and Applications”.
In: *Proceedings of the IEEE* 109(3):247–278
15. Yeom S-K, Seegerer P, **Lapuschkin S**, Binder A, Wiedemann S, Müller K-R and Samek W (2021).
“Pruning by Explaining: A Novel Criterion for Deep Neural Network Pruning”.
In: *Pattern Recognition* 115:107899.
https://github.com/seulkiyeom/LRP_pruning | https://github.com/seulkiyeom/LRP_Pruning_toy_example
16. Aeles J, Horst F, **Lapuschkin S**, Lacourpaille L, and Hug F (2021).
“Revealing the Unique Features of Each Individual’s Muscle Activation Signatures”.
In: *Journal of the Royal Society Interface* 18(174):20200770.
<https://github.com/sebastian-lapuschkin/interpretable-emg-signatures>
17. Horst F, Slijepcevic D, Zeppelzauer M, Raberger AM, **Lapuschkin S**, Samek W, Schöllhorn WI, Breiteneder C, and Horsak B (2020).
“Explaining Automated Gender Classification of Human Gait”.
In: *Gait & Posture* 81(S1):159–160
18. Hägele M, Seegerer P, **Lapuschkin S**, Bockmayr M, Samek W, Klauschen F, Müller K-R and Binder A (2020).
“Resolving Challenges in Deep Learning-based Analyses of Histopathological Images using Explanation Methods”.
In: *Scientific Reports* 10:6423
19. Alber M, **Lapuschkin S**, Seegerer P, Hägele M, Schütt K T, Montavon G, Samek W, Müller K-R, Dähne S and Kindermans P-J (2019).
“iNNvestigate Neural Networks!”.
In: *Journal of Machine Learning Research* 20(93):1–8.
<https://github.com/albermax/innvestigate>
20. **Lapuschkin S**, Wäldchen S, Binder A, Montavon G, Samek W and Müller K-R (2019).
“Unmasking Clever Hans Predictors and Assessing what Machines Really Learn”.
In: *Nature Communications* 10:1069
21. Horst F, **Lapuschkin S**, Samek W, Müller K-R and Schöllhorn W I (2019).
“Explaining the Unique Nature of Individual Gait Patterns with Deep Learning”.
In: *Scientific Reports* 9:2391.
<https://github.com/sebastian-lapuschkin/interpretable-deep-gait>
22. Montavon G, **Lapuschkin S**, Binder A, Samek W and Müller K-R (2017).
“Explaining NonLinear Classification Decisions with Deep Taylor Decomposition”.
In: *Pattern Recognition* 65:211–222.
Pattern Recognition Best Paper Award and Pattern Recognition Medal winner
23. Samek W, Binder A, Montavon G, **Lapuschkin S**, and Müller K-R (2017).
“Evaluating the Visualization of what a Deep Neural Network has Learned”.
In: *IEEE Transactions of Neural Networks and Learning Systems*
24. Sturm I, **Lapuschkin S**, Samek W and Müller K-R (2016).
“Interpretable Deep Neural Networks for Single-Trial EEG Classification”.
In: *Journal of Neuroscience Methods* 274:141–145
25. **Lapuschkin S**, Binder A, Montavon G, Müller K-R and Samek W (2016).
“The Layer-wise Relevance Propagation Toolbox for Artificial Neural Networks”.
In: *Journal of Machine Learning Research* 17(114):1–5.
https://github.com/sebastian-lapuschkin/lrp_toolbox
26. **Bach S**, Binder A, Montavon G, Klauschen F, Müller K-R and Samek W (2015).
“On Pixel-wise Explanations for Non-Linear Classifier Decisions by Layer-wise Relevance Propagation”.
In: *PLoS ONE* 10(7):e0130140

Contributions to Conference Proceedings and Workshops

1. Bareeva D, Yolcu GÜ, Hedström A, Wiegand T, Samek W **Lapuschkin S** (2024).
“Quanda: An Interpretability Toolkit for Training Data Attribution Evaluation and Beyond”.
In: *NeuRIPS 2024 Workshop on Attributing Model Behavior at Scale (ATTRIB 2024)* . (Green Open Access)
<https://github.com/dilyabareeva/quanda>
2. Naujoks J R, Krasowski A, Weckbecker M, Wiegand T, **Lapuschkin S**, Samek W and Klausen R P (2024).
“PINNfluence: Influence Functions for Physics-Informed Neural Networks”.

- In: *NeuRIPS 2024 Workshop on Machine Learning and the Physical Sciences (ML4PS)* .
<https://github.com/aleks-krasowski/PINNfluence>
 Reproducibility Badge Winner
3. Kopf L, Bommer P L, Hedström A, **Lapuschkin S**, Höhne M M-C and Bykov K (2024).
 “CoSy: Evaluating Textual Explanations of Neurons”.
 In: *Advances in Neural Information Processing Systems (NeuRIPS)* TBA. (*OpenReview*)
<https://github.com/lkopf/cosy>
 4. Nobis G, Springenberg M, Aversa M, Detzel M, Daems R, Murray-Smith R, Nakajima S, **Lapuschkin S**, Ermon S, Birdal T, Oppel M, Knochenhauer C, Oala L and Samek W (2024).
 “Generative Fractional Diffusion Models”.
 In: *Advances in Neural Information Processing Systems (NeuRIPS)* TBA. (*OpenReview*)
<https://github.com/GabrielNobis/gfdm>
 5. Mekala R R, Pahde F, Baur S, Chandrashekar S, Diep M, Wenzel M A, Wisotzky E L, Yolcu G Ü, **Lapuschkin S**, Ma J, Eisert P, Lindvall M, Porter A and Samek W (2024).
 “Synthetic Generation of Dermatoscopic Images with GAN and Closed-Form Factorization”.
 In: *ECCV 2024 Workshop on Synthetic Data for Computer Vision (SyntheticData4CV)* TBA. (*Green Open Access*)
 6. Achitibat R, Hatefi S M V, Dreyer M, Jain A, Wiegand T, **Lapuschkin S**, Samek W (2024).
 “AttnLRP: Attention-Aware Layer-wise Relevance Propagation for Transformers”.
 In: *Proceedings of the 41st International Conference on Machine Learning (ICML)* 135–168.
<https://github.com/rachitibat/LRP-for-Transformers>
 7. Hatefi S M V, Dreyer M, Achitibat R, Wiegand T, Samek W and **Lapuschkin S** (2024).
 “Pruning By Explaining Revisited: Optimizing Attribution Methods to Prune CNNs and Transformers”.
 In: *Proceedings of the European Conference on Computer Vision (ECCV) Workshops* TBA.
<https://github.com/erfanhatefi/Pruning-by-explaining-in-PyTorch>
 8. Hedström A, Weber L, **Lapuschkin S**, Höhne M M-C (2024).
 “A Fresh Look at Sanity Checks for Saliency Maps”.
 In: *Proceedings of the 2nd XAI World Conference* 403–420. (*Green Open Access*)
<https://github.com/annahedstroem/sanity-checks-revisited>
 9. Tinauer C, Damulina A, Sackl M, Soellradl M, Achitibat R, Dreyer M, Pahde F, **Lapuschkin S**, Schmidt R, Ropele S, Samek W, Langkammer C (2024).
 “Explainable Concept Mappings of MRI: Revealing the Mechanisms Underlying Deep Learning-based Brain Disease Classification”.
 In: *Proceedings of the 2nd XAI World Conference* 202–216. (*Green Open Access*)
 10. Dreyer M, Pürelku E, Vielhaben J, Samek W, **Lapuschkin S** (2024).
 “PURE: Turning Polysemantic Neurons Into Pure Features by Identifying Relevant Circuits”.
 In: *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR) Workshops* 8212–8217.
<https://github.com/maxdreyer/PURE> | *Spotlight Paper*
 11. Bareeva D, Dreyer M, Pahde F, Samek W and **Lapuschkin S** (2024).
 “Reactive Model Correction: Mitigating Harm to Task-Relevant Features via Conditional Bias Suppression”.
 In: *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR) Workshops* 3532–3541.
https://github.com/dilyabareeva/reactive_correction
 12. Dreyer M, Achitibat R, Samek W and **Lapuschkin S** (2024).
 “Understanding the (Extra-)Ordinary: Validating Deep Model Decisions with Prototypical Concept-based Explanations”.
 In: *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR) Workshops* 3491–3501.
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 13. Dreyer M, Pahde F, Anders C J, Samek W and **Lapuschkin S** (2024).
 “From Hope to Safety: Unlearning Biases of Deep Models via Gradient Penalization in Latent Space”.
 In: *Proceedings of the AAAI Conference on Artificial Intelligence (AAAI)* 38(19):21046–21054.
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 14. Dawoud K, Samek W, Eisert P, **Lapuschkin S** and Bosse S (2023).
 “Human-Centered Evaluation of XAI Methods”.
 In: *Proceedings of the IEEE International Conference on Data Mining (ICDM)* 912–921. (*Green Open Access*)

15. Frommholz A, Seipel F, **Lapuschkin S**, Samek W and Vielhaben J (2023).
 “XAI-based Comparison of Audio Event Classifiers with different Input Representations”.
 In: *Proceedings of the International Conference on Content-based Multimedia Indexing (CBMI)* 126–132
16. Hedström A, Weber L, **Lapuschkin S** and Höhne M M-C (2023).
 “Sanity Checks Revisited: An Exploration to Repair the Model Parameter Randomisation Test”.
 In: *NeuRIPS 2023 Workshop on XAIX (XAI in Action: Past, Present, and Future Applications)* (vVpefYmnsG)
17. Pahde F, Dreyer M, Samek W and **Lapuschkin S** (2023).
 “Reveal to Revise: An Explainable AI Life Cycle for Iterative Bias Correction of Deep Models”.
 In: *Proceedings of the International Conference on Medical Image Computing and Computer-Assisted Intervention* 596–606. (Green Open Access)
<https://github.com/maxdreyer/reveal2revise>
18. Binder A, Weber L, **Lapuschkin S**, Montavon G, Müller K-R and Samek W (2023).
 “Shortcomings of Top-Down Randomization-Based Sanity Checks for Evaluations of Deep Neural Network Explanations”.
 In: *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR)* 16143–16152
19. Dreyer M, Achtabat R, Wiegand T, Samek W and **Lapuschkin S** (2023).
 “Revealing Hidden Context Bias in Segmentation and Object Detection through Concept-specific Explanations”.
 In: *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR) Workshops* 3828–3838
20. Pahde F, Yolcu GÜ, Binder A, Samek W and **Lapuschkin S** (2023).
 “Optimizing Explanations by Network Canonization and Hyperparameter Search”.
 In: *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR) Workshops* 3818–3827
21. Krakowczyk D G, Prasse P, Reich D R, **Lapuschkin S**, Scheffer T, Jäger L A (2023).
 “Bridging the Gap: Gaze Events as Interpretable Concepts to Explain Deep Neural Sequence Models”.
 In: *Proceedings of the Symposium on Eye Tracking Research and Applications (ETRA)* 1–8.
Best Short Paper Award Winner
22. Krakowczyk D G, Reich D R, Prasse P, **Lapuschkin S**, Jäger L A and Scheffer T (2022).
 “Selection of XAI Methods Matters: Evaluation of Feature Attribution Methods for Oculomotoric Biometric Identification”.
 In: *NeuRIPS 2022 Workshop on Gaze Meets ML (GOLdDAP2AtI)*
23. Motzkus F, Weber L and **Lapuschkin S** (2022).
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 In: *Proceedings of the International Conference on Image Processing (ICIP)* 516–520
24. Ede S, Baghdadlian S, Weber L, Nguyen A, Zanca D, Samek W and **Lapuschkin S** (2022).
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 In: *Proceedings of the International Cross-Domain Conference for Machine Learning and Knowledge Extraction (CD-MAKE)* 1–18. (Gold Open Access link)
25. Sun J, **Lapuschkin S**, Samek W, Zhao Y, Cheung N-M and Binder A (2021).
 “Explanation-Guided Training for Cross-Domain Few-Shot Classification”.
 In: *Proceedings of the 25th International Conference on Pattern Recognition (ICPR)* 7609–7616
26. Goh G S W, **Lapuschkin S**, Weber L, Samek W and Binder A (2021).
 “Understanding Integrated Gradients with SmoothTaylor for Deep Neural Network Attribution”.
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27. Kohlbrenner M, Bauer A, Nakajima S, Binder A, Samek W, and **Lapuschkin S** (2020).
 “Towards Best Practice in Explaining Neural Network Decisions with LRP”.
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28. Sun J, **Lapuschkin S**, Samek W and Binder A (2020).
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 In: *XXAI: Extending Explainable AI Beyond Deep Models and Classifiers. ICML Workshop*
29. Anders C J, Neumann D, Marinč T, Samek W, Müller K-R and **Lapuschkin S** (2020).
 “XAI for Analyzing and Unlearning Spurious Correlations in ImageNet”.
 In: *XXAI: Extending Explainable AI Beyond Deep Models and Classifiers. ICML Workshop*
30. Sun J, **Lapuschkin S**, Samek W, Zhao Y, Cheung N-M and Binder A (2020).
 “Explain and Improve: Cross-Domain-Few-Shot-Learning Using Explanations”.
 In: *XXAI: Extending Explainable AI Beyond Deep Models and Classifiers. ICML Workshop*

31. Alber M, **Lapuschkin S**, Seegerer P, Hägele M, Schütt K T, Montavon G, Samek W, Müller K-R, Dähne S and Kindermans P-J (2018).
 “How to iNNvestigate Neural Networks’ Predictors!”.
 In: *Machine Learning Open Source Software: Sustainable Communities. NIPS Workshop*
32. **Lapuschkin S**, Binder A, Müller K-R and Samek W (2017).
 “Understanding and Comparing Deep Neural Networks for Age and Gender Classification”.
 In: *Proceedings of the ICCV’17 Workshop on Analysis and Modeling of Faces and Gestures (AMFG) 2017*:1629-1638
33. Srinivasan V, **Lapuschkin S**, Hellge C, Müller K-R and Samek W (2017).
 “Interpretable Action Recognition in Compressed Domain”.
 In: *Proceedings of the IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP) 2017*:1692-1696
34. **Bach S**, Binder A, Müller K-R and Samek W (2016).
 “Controlling Explanatory Heatmap Resolution and Semantics via Decomposition Depth”.
 In: *Proceedings of the IEEE International Conference of Image Processing (ICIP) 2016*:2271-2275
35. Binder A, Samek W, Montavon G, **Bach S**, and Müller K-R (2016).
 “Analyzing and Validating Neural Network Predictions”.
 In: *Proceedings of the ICML’16 Workshop on Visualization for Deep Learning . Best Paper Award Winner*
36. **Lapuschkin S**, Binder A, Montavon G, Müller K-R and Samek W (2016).
 “Analyzing Classifiers: Fisher Vectors and Deep Neural Networks”.
 In: *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (CVPR) 2016*:2912-2920
37. Montavon G, **Bach S**, Binder A, Samek W and Müller K-R (2016).
 “Deep Taylor Decomposition of Neural Networks”.
 In: *Proceedings of the ICML’16 Workshop on Visualization for Deep Learning 2016*:1-3
38. Samek W, Montavon G, Binder A, **Lapuschkin S** and Müller K-R (2016).
 “Interpreting the Predictions of Complex ML Models by Layer-wise Relevance Propagation”.
 In: *Proceedings of the Interpretable ML for Complex Systems NIPS’16 Workshop*

Books

1. Longo L, **Lapuschkin S** and Seifert C, editors (2024).
 “Explainable Artificial Intelligence (Second World Conference, xAI 2024, Valletta, Malta, July 17–19, 2024, Proceedings, Part I-IV)”.
 Springer (Cham), Part I ISBN: 978-3-031-63787-2. Part II ISBN: 978-3-031-63797-1.
 Part III ISBN: 978-3-031-63800-8. Part IV ISBN: 978-3-031-63803-9

Book Chapters

1. Becking D, Dreyer M, Samek W, Müller K and **Lapuschkin S** (2022).
 “ECQ^x: Explainability-Driven Quantization for Low-Bit and Sparse DNNs”.
 In: *xxAI – Beyond Explainable AI* 271-296. Springer, Cham
2. Montavon G, Binder A, **Lapuschkin S**, Samek W and Müller K-R (2019).
 “Layer-wise relevance propagation: An Overview”.
 In: *Explainable AI: Interpreting, Explaining and Visualizing Deep Learning* 193-209. Springer, Cham
3. Binder A, **Bach S**, Montavon G, Müller K-R and Samek W (2016).
 “Layer-wise Relevance Propagation for Deep Neural Network Architectures”.
 In: *Information Science and Applications (ICISA) 2016. Lecture Notes in Electrical Engineering* 276:913-922. Springer, Singapore
4. Binder A, Montavon G, **Lapuschkin S**, Müller K-R and Samek W (2016).
 “Layer-wise Relevance Propagation for Neural Networks with Local Renormalization Layers”.
 In: *Lecture Notes in Computer Science* 9887:63-71. Springer, Berlin/Heidelberg

Preprints

1. Dreyer M, Berend J, Labarta T, Vielhaben J, Wiegand T, **Lapuschkin S** and Samek W (2025).
 “Mechanistic understanding and validation of large AI models with SemanticLens”.
 In: *CoRR abs/2501.05398*.
<https://github.com/jim-berend/semanticlens> | Demo: <https://semanticlens.hhi-research-insights.eu/umap-view>
2. Yolcu G Ü, Wiegand T, Samek W and **Lapuschkin S** (2024).
 “DualView: Data Attribution from the Dual Perspective”.
 In: *CoRR abs/2402.12118*.
<https://github.com/gumityolcu/DualView>

3. Weber L, Berend J, Binder A, Wiegand T, Samek W and **Lapuschkin S** (2023).
“Layer-wise Feedback Propagation”.
In: *CoRR abs/2308.12053*
4. Gerstenberger M, **Lapuschkin S**, Eisert P and Bosse S (2022).
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In: *CoRR abs/2203.10087*
5. Pahde F, Dreyer M, Weber L, Weckbercker M, Anders C J, Wiegand T, Samek W and **Lapuschkin S** (2022).
“Navigating Neural Space: Revisiting Concept Activation Vectors to Overcome Directional Divergence”.
In: *CoRR abs/2202.03482*
6. Anders C J, Neumann D, Samek W, Müller K-R and **Lapuschkin S** (2021).
“Software for Dataset-wide XAI: From Local Explanations to Global Insights with Zennit, CoRelAy, and ViRelAy”.
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<https://github.com/virelay/corelay> | <https://github.com/virelay/virelay>
7. Schwenk G and **Bach S** (2014).
“Detecting Behavioural and Structural Anomalies in Media-Cloud Applications”.
In: *CoRR abs/1409.8035*