

Michaël Defferrard

"I make machines learn; better by leveraging structure."

Strengths

- Experienced with Machine/Deep Learning on graphs/networks/manifolds/meshes/complexes.
- Skilled in software development (ML frameworks, scientific Python, package maintenance).
- Published at top ML and domain-specific venues and contributed to open-source software.

Education

- 2015–2021 **PhD Machine Learning**, *École Polytechnique Fédérale de Lausanne (EPFL)*.
- Thesis: Leveraging topology, geometry, and symmetries for efficient Machine Learning.
 - Adviser: Prof. Pierre Vandergheynst.
 - Examiners: Martin Jaggi (EPFL), Max Welling (UvA, MSR), Yann LeCun (NYU, FAIR).
- 2012–2015 **MSc Electrical and Electronic Engineering**, *EPFL*, *GPA 96%*.
- Thesis: Structured auto-encoder with application to music genre recognition.
 - Minor in Computational Neuroscience.
 - Courses and projects on signal processing, data analysis, machine learning.
- 2009–2012 **BASc Electrical Engineering**, *École d'Ingénieurs de Fribourg (EIA-FR)*, *GPA 98%*.
- Courses and projects on electronic design, analog and digital circuits, embedded systems.
 - Exchange year at the Hochschule München.
- 2005–2009 **Federal VET Diploma in Electronics**, *EPAL*, Fribourg CH, *GPA 96%*.

Experience

- present **Research Assistant**, *École Polytechnique Fédérale de Lausanne (EPFL)*.
- 2014-02 I researched on Machine Learning and data structured by graphs and manifolds. I published papers in top-tier venues, co-led interdisciplinary research teams, supervised students, gave talks, taught courses, developed software. My work pioneered graph ML research and proved useful in tackling important real-world problems.
- 2015-08 **Software Engineer**, *Infoteam*, Givisiez CH.
- 2011-08 Part-time job in the Energy R&D team. I ported a core product of the company, a control-command tool for energy distribution and production, to embedded systems. My work enabled the company to close its largest contract to date.
- 2012-08 **Research Intern**, *Lawrence Berkeley National Laboratory (LBNL)*.
- 2012-05 I characterized the performance of a new particle detector for the ATLAS experiment at the CERN's Large Hadron Collider (LHC).
- 2011-03 **Electronics Specialist**, *Meggitt*, Fribourg CH.
- 2005-08 Apprenticeship and part-time job. Production, test, quality assurance, repair, certification and development of sensing systems for the aerospace and energy markets.

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updated March 2022, latest at deff.ch/cv.pdf

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Awards

- 2021 Nominated for the EPFL Doctorate award. Given to the best 2 of ~ 420 theses.
- 2020 Spotlight talk for [7] at ICLR.
- 2016, 2017 Nominated by EPFL for a Google PhD Fellowship.
- 2014 Selected and funded for the Silicon Valley Startup Camp.
- 2012 Award from Phonak Communications for an excellent BAsC thesis.
- 2009 Awards from the UPCF and the SFP for the highest GPA.

Scientific output

- Publications **10+ papers, 5000+ citations, h-index of 10.** Published at top ML conferences (NeurIPS, ICLR) as well as domain-specific journals (NeuroImage, Astronomy & Computing) and conferences (The Web Conference, ISMIR). List below, on Google Scholar, and at deff.ch with code, data, reviews.
- Software Maintainer of 3 Python packages. Contributor to the Python scientific stack (NumPy, SciPy, Matplotlib, Jupyter, etc.). List below, with more open-source contributions (paper implementations, teaching materials) at github.com/mdeff.
- Talks I gave 20+ talks. List with slides and some videos at deff.ch.
- Teaching I co-taught 8 courses around Machine Learning, Networks, and Data Science, in various roles (TAing, lecturing, teaching team & student management, curriculum design) and forms (university class, workshop, summer school). List with roles and resources at deff.ch.

Leadership

- Supervision I supervised 20+ students (MSc theses, semester projects, internships). List of students with project title, co-supervisors, and outputs at deff.ch.
- Collaborations I tackle real-world problems by assembling and leading interdisciplinary collaborations. So far in Neuroscience, Cosmology, Biology, Geoscience.
- Organization
 - Machine Learning for Earth, Seminar, 2019–now.
 - Musical Genre Recognition Challenge, The Web Conference (WWW), 2018.
 - Open Science in Practice, Summer School, EPFL, 2017.
 - Deep Learning on Irregular Domains, Workshop, BMVC, 2017.
- Extra I serve as the president of a band of 40 musicians and a leadership member at a firefighting brigade of 80.

Miscellaneous

- Open Open science, open source, open data, and reproducibility are values I advocate for and adhere to in my research.
- Extra Brass band musician, militia firefighting officer, runner, computing enthusiast.

- [1] [M. Defferrard](#). “Generalized convolutions”. *In preparation*. 2022.
- [2] G. Ghiggi, [M. Defferrard](#), W. Feng, Y. Y. Haddad, N. Bolón Brun, I. Lloréns Jover, P. Dueben. “DeepSphere-Weather: Deep Learning on spherical unstructured grids for weather/climate applications”. *In preparation* (2022).
- [3] Z. Harteveld, J. Southern, [M. Defferrard](#), A. Loukas, P. Vandergheynst, M. M. Bronstein, B. E. Correia. “Deep sharpening of topological features for de novo protein design”. 2022.
- [4] A. Scheck, S. Rosset, [M. Defferrard](#), A. Loukas, J. Bonet, P. Vandergheynst, B. E. Correia. “RosettaSurf—A surface-centric computational design approach”. *PLOS Computational Biology* 18.3 (Mar. 2022). bioRxiv: 2021.06.16.448645, pp. 1–23.
- [5] H. Aguetzaz, E. J. Bekkers, [M. Defferrard](#). “ChebLieNet: Invariant spectral graph NNs turned equivariant by Riemannian geometry on Lie groups”. 2021. arXiv: 2111.12139.
- [6] J. Banjac, L. Donati, [M. Defferrard](#). “Learning to recover orientations from projections in single-particle cryo-EM”. 2021. arXiv: 2104.06237.
- [7] [M. Defferrard](#), M. Milani, F. Gusset, N. Perraudin. “DeepSphere: a graph-based spherical CNN”. *International Conference on Learning Representations (ICLR)*. 2020. arXiv: 2012.15000.
- [8] S. Ebli, [M. Defferrard](#), G. Spreemann. “Simplicial Neural Networks”. *Topological Data Analysis and Beyond workshop at NeurIPS*. 2020. arXiv: 2010.03633.
- [9] K. Glomb, J. Rué Queralt, D. Pascucci, [M. Defferrard](#), S. Tourbier, M. Carboni, M. Rubega, S. Vulliémoz, G. Plomp, P. Hagmann. “Connectome spectral analysis to track EEG task dynamics on a subsecond scale”. *NeuroImage* 221 (2020). bioRxiv: 2020.06.22.164111, pp. 117–137.
- [10] [M. Defferrard](#), N. Perraudin, T. Kacprzak, R. Sgier. “DeepSphere: towards an equivariant graph-based spherical CNN”. *ICLR Workshop on Representation Learning on Graphs and Manifolds*. 2019. arXiv: 1904.05146.
- [11] N. Perraudin, [M. Defferrard](#), T. Kacprzak, R. Sgier. “DeepSphere: Efficient spherical Convolutional Neural Network with HEALPix sampling for cosmological applications”. *Astronomy and Computing* 27 (Apr. 2019), pp. 130–146. arXiv: 1810.12186.
- [12] [M. Defferrard](#), S. P. Mohanty, S. F. Carroll, M. Salathé. “Learning to Recognize Musical Genre from Audio. Challenge Overview”. *The 2018 Web Conference Companion*. ACM Press, 2018. arXiv: 1803.05337.
- [13] [M. Defferrard](#), K. Benzi, P. Vandergheynst, X. Bresson. “FMA: A Dataset for Music Analysis”. *18th International Society for Music Information Retrieval Conference (ISMIR)*. 2017. arXiv: 1612.01840.
- [14] Y. Seo, [M. Defferrard](#), P. Vandergheynst, X. Bresson. “Structured Sequence Modeling with Graph Convolutional Recurrent Networks”. *International Conference on Neural Information Processing (ICONIP)*. 2017. arXiv: 1612.07659.
- [15] [M. Defferrard](#), X. Bresson, P. Vandergheynst. “Convolutional Neural Networks on Graphs with Fast Localized Spectral Filtering”. *Advances in Neural Information Processing Systems (NIPS)*. 2016. arXiv: 1606.09375.

- [1] [M. Defferrard](#), L. Martin, R. Pena, N. Perraudin. *PyGSP: Graph Signal Processing in Python*. URL: <https://github.com/epfl-lts2/pygsp/>.
- [2] [M. Defferrard](#), R. Pena, N. Perraudin. *PyUNLocBoX: Optimization by Proximal Splitting*. URL: <https://github.com/epfl-lts2/pyunlocbox/>.
- [3] F. Gusset, L. Vancauwenberghe, M. Allemann, J. Fluri, N. Perraudin, [M. Defferrard](#). *DeepSphere: learning on the sphere*. URL: <https://github.com/deepsphere/>.