

# Michaël Defferrard

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

## Experience

- present **Research Scientist (Staff Engineer)**, *Qualcomm Research*, remote
- 2022-08 On the fundamental and curiosity-driven side, I leverage the fundamental principles that underpin our reality—like topology, geometry, symmetries, causality—to make machines learn better. On the applied and problem-driven side, I research how that can help the design of semiconductor chips; in collaboration with product partners and academics.
- 2021-12 **Research Assistant**, *École Polytechnique Fédérale de Lausanne (EPFL)*
- 2014-02 I worked toward a fundamental understanding of graphs, researched how to leverage that structure for machines to learn better, and applied it in Neuroscience, Cosmology, Biology, Geoscience. 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, proved useful in tackling important problems, and was nominated—by Pierre Vandergheynst, Martin Jaggi, Max Welling, Yann LeCun—for the EPFL's best PhD.
- 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.

## 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: Yann LeCun (NYU, FAIR), Max Welling (UvA, MSR), Martin Jaggi (EPFL).
  - Thesis awarded as in the best 8% and nominated for the best thesis award.
- 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%

## Awards

2022 EPFL PhD Thesis Distinction in Electrical Engineering. Awards the best 8%.  
2021 Nominated for the EPFL Doctorate award. Awards the best 2 of ~ 420 theses.  
2020 Spotlight talk for [8] 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, 7000+ 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](http://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](https://github.com/mdeff).

Talks I gave 20+ talks. List with slides and some videos at [deff.ch](http://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](http://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](http://deff.ch).

Collaborations I tackled difficult problems by assembling and leading interdisciplinary collaborations.

Organization ○ Machine Learning for Earth, Seminar, 2019–2020.  
○ 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.

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updated June 2023, latest at [deff.ch/cv.pdf](http://deff.ch/cv.pdf)

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Extra Brass band musician, militia firefighting officer, runner, computing enthusiast.

## Publications

[scholar.google.com/citations?user=Ztj2-gUAAAAJ](https://scholar.google.com/citations?user=Ztj2-gUAAAAJ)

- [1] [M. Defferrard](#). “Generalized convolutions”. *In preparation*. 2022.
- [2] [M. Defferrard](#). “Leveraging topology, geometry, and symmetries for efficient Machine Learning”. PhD thesis. EPFL, 2022.
- [3] 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).
- [4] 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”. *Machine Learning for Drug Discovery Workshop at ICLR*. 2022.
- [5] 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.
- [6] H. Aguetaz, E. J. Bekkers, [M. Defferrard](#). “ChebLieNet: Invariant spectral graph NNs turned equivariant by Riemannian geometry on Lie groups”. 2021. arXiv: 2111.12139.
- [7] J. Banjac, L. Donati, [M. Defferrard](#). “Learning to recover orientations from projections in single-particle cryo-EM”. 2021. arXiv: 2104.06237.
- [8] [M. Defferrard](#), M. Milani, F. Gusset, N. Perraudin. “DeepSphere: a graph-based spherical CNN”. *International Conference on Learning Representations (ICLR)*. 2020. arXiv: 2012.15000.
- [9] S. Ebli, [M. Defferrard](#), G. Spreemann. “Simplicial Neural Networks”. *Topological Data Analysis and Beyond workshop at NeurIPS*. 2020. arXiv: 2010.03633.
- [10] 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.
- [11] [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.
- [12] 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.
- [13] [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.
- [14] [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.

- [15] 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.
- [16] 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.
- [17] M. Defferrard. “Structured Auto-Encoder with application to Music Genre Recognition”. MSc thesis. EPFL, 2015.

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## Software

[github.com/mdeff](https://github.com/mdeff)

- [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/>.