GEOMETRIC DEEP LEARNING

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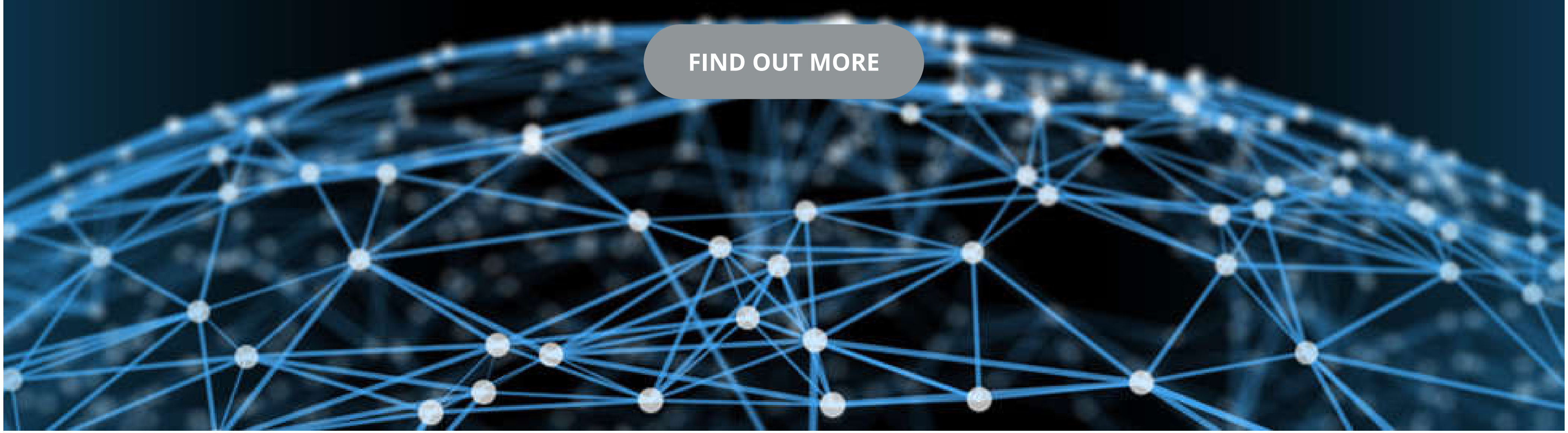
Geometric Deep Learning is one of the most emerging fields of the Machine Learning community. This website represents a collection of materials of this particular research area.

FIND OUT MORE



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# GDL

In the last decade, Deep Learning approaches (e.g. Convolutional Neural Networks and Recurrent Neural Networks) allowed to achieve unprecedented performance on a broad range of problems coming from a variety of different fields (e.g. Computer Vision and Speech Recognition). Despite the results obtained, research on DL techniques has mainly focused so far on data defined on Euclidean domains (i.e. grids). Nonetheless, in a multitude of different fields, such as: Biology, Physics, Network Science, Recommender Systems and Computer Graphics; one may have to deal with data defined on non-Euclidean domains (i.e. graphs and manifolds). The adoption of Deep Learning in these particular fields has been lagging behind until very recently, primarily since the non-Euclidean nature of data makes the definition of basic operations (such as convolution) rather elusive. Geometric Deep Learning deals in this sense with the extension of Deep Learning techniques to graph/manifold structured data.
This website represents a collection of materials in the field of Geometric Deep Learning. We collect workshops, tutorials, publications and code, that several differet researchers has produced in the last years. Our goal is to provide a general picture of this new and emerging field, which is rapidly developing in the scientific community, thanks to the broad applicability it presents.

GET STARTED!

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# Workshops

## IPAM Workshop on New Deep Learning Techniques

UCLA, 5-9 February 2018

## ICCV Second Workshop Geometry Meets Deep Learning

Venice, 28 October 2017

## BMVC Workshop on Deep Learning on Irregular Domains

London, 7 September 2017

## ECCV First Workshop Geometry Meets Deep Learning

Amsterdam, 9 October 2016

## Geometric deep learning on graphs and manifolds

*SIAM 2018 Tutorial*, Portland, 12 July 2018

## Geometric deep learning

*SGP Tutorial*, Paris, 8 July 2018

## Geometric deep learning on graphs and manifolds

*ODSC Tutorial*, Boston, 1 May 2018
[CODE]

## Geometric deep learning on graphs and manifolds

*NIPS Tutorial*, Long Beach, 4 December 2017

## 3D Deep Learning

*CVPR Tutorial*, Honolulu, 21 July 2017

## Geometric Deep Learning on Graphs

*CVPR Tutorial*, Honolulu, 21 July 2017

## Geometric Deep Learning on Graphs and Manifolds

## Machine Learning Meets Geometry

*SGP Tutorial*, London, June 2017

## Geometric Deep Learning

*SIGGRAPH Asia Tutorial*, Macao, December 2016

## Geometric Deep Learning

*ECCV Tutorial*, Amsterdam, October 2016

## Deep Learning for Shape Analysis

*EUROGRAPHICS Tutorial*, Lisbon, May 2016

# Papers & Code

- M. M. Bronstein, J. Bruna, Y. LeCun, A. Szlam, P. Vandergheynst, Geometric deep learning: going beyond Euclidean data, *IEEE Signal Processing Magazine* 2017 **(Review**

- H. Maron, M. Galun, N. Aigerman, M. Trope, N. Dym, E. Yumer, V. G. Kim, Y. Lipman, Convolutional Neural Networks on Surfaces via Seamless Toric Covers, 2017

- K. T. Schütt, P. Kindermans, H. E. Sauceda, S. Chmiela, A. Tkatchenko, K. Müller, SchNet: A continuous-filter convolutional neural network for modeling quantum interactions, *NIPS* 2017

- T. Lei, W. Jin, R. Barzilay, T. Jaakkola, Deriving Neural Architectures from Sequence and Graph Kernels, *ICML* 2017

- R. Levie*, F. Monti*, X. Bresson, M. M. Bronstein, CayleyNets: Graph convolutional neural networks with complex rational spectral filters, 2017 **(CayleyNet framework)** [COMMUNITY DATASET]

- O. Litany, T. Remez, E. Rodolà, A. M. Bronstein, M. M. Bronstein, Deep Functional Maps: Structured Prediction for Dense Shape Correspondence, 2017 **(FMNet framework)** [CODE]

- F. Monti, X. Bresson, M. M. Bronstein, Geometric matrix completion with recurrent multi-graph neural networks, *NIPS* 2017 **(CNNs on multiple graphs)** [CODE]

- J. Gilmer, S. S. Schoenholz, P. F. Riley, O. Vinyals, G. E. Dahl, Neural Message Passing for Quantum Chemistry, *ICML* 2017

- Z. Huang, C. Wan, T. Probst, L. Van Gool, Deep Learning on Lie Groups for Skeleton-based Action Recognition, *CVPR* 2017 [CODE]

[CODE]

- L. Yi, H. Su, X. Guo, L. Guibas, SyncSpecCNN: Synchronized Spectral CNN for 3D Shape Segmentation , *CVPR* 2017 **(spectral transformer networks)**
- F. Monti*, D. Boscaini*, J. Masci, E. Rodolà, J. Svoboda, M. M. Bronstein, Geometric deep learning on graphs and manifolds using mixture model CNNs, *CVPR* 2017 **(MoNet framework)** [CODE] [VIDEO]
- T. Kipf, M. Welling, Semi-supervised Classification with Graph Convolutional Networks, *ICLR* 2017 **(simplification of ChebNet)** [CODE]
- M. Defferrard, X. Bresson, P. Vandergheynst, Convolutional Neural Networks on Graphs with Fast Localized Spectral Filtering, *NIPS* 2016 **(ChebNet framework)** [TF CODE] [PyTorch CODE]
- M. Niepert, M. Ahmed, K. Kutzkov, Learning Convolutional Neural Networks for Graphs, *ICML* 2016
- H. Dai, B. Dai, L. Song, Discriminative embeddings of latent variable models for structured data, *ICML* 2016
- D. Boscaini, J. Masci, E. Rodolà, M. M. Bronstein, Learning shape correspondence with anisotropic convolutional neural networks, *NIPS* 2016 **(Anisotropic CNN framework)**
- J. Masci, D. Boscaini, M. M. Bronstein, P. Vandergheynst, Geodesic convolutional neural networks on Riemannian manifolds, *3dRR* 2015 **(Geodesic CNN framework)**

A. Aspuru-Guzik, R. P. Adams, Convolutional Networks on Graphs for Learning Molecular Fingerprints, *NIPS* 2015 **(molecular fingerprints using graph CNNs)**

- J. Atwood, D. Towsley, Diffusion-Convolutional Neural Networks, 2015
- M. Henaff, J. Bruna, Y. LeCun: Deep Convolutional Networks on Graph-Structured Data, 2015
- J. Bruna, W. Zaremba, A. Szlam, Y. LeCun, Spectral Networks and Deep Locally Connected Networks on Graphs, *ICLR* 2014 **(spectral CNN on graphs)**
- F. Scarselli, M. Gori, A. C. Tsoi, M. Hagenbuchner, G. Monfardini, The graph neural network model, *Trans. Neural Networks* 20(1):61-80, 2009 **(first neural networks on graphs)**

## Let's Get In Touch!

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