Hemant Tyagi

Contact Information

Inria Lille - Nord Europe,
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Research Interests

High dimensional statistics, Numerical analysis, Optimization, Statistical learning theory, Inverse problems on graphs.

Employment

Permanent Researcher (CR) at Inria Lille - Nord Europe (MODAL team).
December, 2018 - *present*

Research fellow at the Alan Turing Institute, London and the School of Mathematics, University of Edinburgh.
September, 2016 - *November,* 2018

Intern in LIONS, LTS4 laboratories at EPFL, Switzerland.
August, 2011 - May, 2012

Senior Engineer, ITTIAM Systems, Bangalore, India.
July, 2006 - *July,* 2008

Education

ETH Zürich, Switzerland

Ph.D, Theoretical Computer Science, June, 2016.

- Dissertation Topic: "On low-dimensional models for functions in high dimensions".
- Advisor: Prof. Bernd Gärtner.

École Polytechnique Fédérale de Lausanne (EPFL), Lausanne, Switzerland

M.S., Communication Systems, July, 2011.

- Thesis Topic: "Local sampling analysis for quadratic embeddings of Riemannian manifolds".
- Advisor: Prof. Pascal Frossard.

National Institute of Technology, Surathkal (NITK), Karnataka, India

B.E., Electrical and Electronics Engineering, June, 2006.

Honors and Awards

Gold Medal for securing 1^{st} Rank in B.E Electrical & Electronics Engineering, in the Final Degree Examinations held in 2006.

M.R Shenoy Memorial Prize for best student of the final year in B.E Electrical & Electronics Engineering, during the year 2005-2006.

Certificate of Merit from the Institution of Engineers (Students Chapter), NITK Surathkal for securing 1^{st} Rank in the years 2003-04, 2004-05 in B.E Electrical & Electronics Engineering.

Keerthy Trophy Gold Medal and *Incident 1981 Committee Prize* for Best Student in Electrical & Electronics Engineering, during the year 2005-06, for having secured the highest percentage of marks in I to VII Semester B.E Examinations.

Selected for the *Summer Fellowship Programme* in the Indian Institute of Technology, Madras (June - August, 2005).

Alan Turing Institute Research Fellowship from September 2016 - August 2019. Grant value: 168, 347 GBP.

Teaching Experience

Teaching assistant in the following courses taught at ETH Zürich.

- Informatik II – Spring 2013.
- Informatik für Mathematiker und Physiker – Fall 15.
- Machine Learning – Fall 2013.
- Data Mining for Large Data Sets – Spring 2014.
- Geometry: Combinatorics & Algorithms – Fall 2014, 2015.
- Modelling and Simulation – Spring 2015.

Co-taught (with Armin Eftekhari) a module titled *Parsomonius representations in data science* as part of the course "Research skills in computational applied mathematics" at University of Edinburgh in March 2018.

Instructor for the following courses at École Centrale de Lille.

- Statistics I (M1 Data Science): Fall 2020, Fall 2021, Fall 2022.
- Statistics II (M1 Data Science): Spring 2021, Spring 2022, Spring 2023.

Supervision

Aldo Glielmo (June - September 2018), PhD intern at Alan Turing Institute (with Mihai Cucuringu).

Peter Davies (June - September 2018), PhD intern at Alan Turing Institute (with Mihai Cucuringu).

Tayeb Zarrouk (May 2019 - August 2019), Masters internship at Inria Lille.

Apoorv Vikram Singh (October 2019 - January 2020), Research internship at Inria Lille (with Mihai Cucuringu).

Guillaume Braun (January 2020 - December 2022), PhD student at Inria Lille (with Christophe Biernacki).

Cadmos Kahale-Abdou (May 2020 - August 2020), Masters internship at Inria Lille (with Alain Celisse).

Eglantine Karle (November 2020 -), PhD student at Inria Lille (with Cristian Preda).

Ernesto Araya Valdivia (January 2021 -), Postdoc at Inria Lille.

Emile Moubarak (January 2022 - June 2022), Masters internship at Inria Lille.

Organizational work

Co-organized the *Approximating high dimensional functions* workshop from $18-19$ December, 2017 at the Alan Turing Institute (with Aretha Teckentrup). Funding received: 5000 GBP.

Co-organized the *Theory and algorithms for data science (TADS) seminar* at the Alan Turing Institute during $2016-18$ (with Mihai Cucuringu, Armin Eftekhari, Vidit Nanda).

Organize the *MODAL seminar* at Inria Lille (2019 - current).

Co-organized the workshop *Statistical learning on large scale graphs* at Inria Lille during March 9-10, 2023 (with Christophe Biernacki).

Research Grants

Lloyd's Register Foundation (LRF), *Decomposing low-dimensional structure and detecting anomalies from incomplete data*, 2017 (with Mihai Cucuringu, Armin Eftekhari, Jared Tanner). Grant value: $46,900$ GBP.

Received funding from Inria Lille to hire a doctoral student for the project *Large scale inverse problems on dynamic graphs*. Duration: November, 2020 - November, 2023.

Reviewing activities

Conferences: NeurIPS (Neural Information Processing Systems), ICML (International Conference on Machine Learning), ICLR (International Conference on Learning Representations), SoCG (Symposium on Computational Geometry), LoG (Learning on Graphs).

Journals: Journal of Machine Learning Research, Applied and Computational Harmonic Analysis,

IEEE Transactions on Signal Processing, Transactions on Pattern Analysis and Machine Intelligence, Information and Inference: A Journal of the IMA, IEEE Open Journal of Signal Processing, Journal of the Royal Statistical Society, Foundations of Computational Mathematics, Mathematical Reviews.

Journal publications

[J1] H. Tyagi, E. Vural and P. Frossard, Tangent space estimation for smooth embeddings of Riemmanian manifolds, *Information and Inference: A Journal of the IMA*, 2013, 2:1, 69-114. (**Second prize at the Information and Inference best paper prize meeting**)

[J2] H. Tyagi and V. Cevher, Learning non-parametric basis independent models from point queries via low-rank methods, *Applied and Computational Harmonic Analysis (ACHA)*, 2014, 37:3, 389-412.

[J3] H. Tyagi, S. Stich and B. Gärtner, On two continuum armed bandit problems in high dimensions, *Theory of Computing Systems (TOCS)*, 2016, 58:1, 191-222.

[J4] H. Tyagi, A. Kyrillidis, B. Gärtner and A. Krause, Algorithms for learning SPAMs with interactions in high dimensions, *Information and Inference: A Journal of the IMA*, 2018, 7:2, 183-249.

[J5] H. Tyagi and J. Vybiral, Learning general sparse additive models from point queries in high dimensions, *Constructive Approximation*, 2019, 50, 403-455. (*)

[J6] A. Eftekhari, J. Tanner, A. Thompson, B. Toader and H. Tyagi, Sparse non-negative super-resolution - simplified and stabilised, *Applied and Computational Harmonic Analysis (ACHA)*, 50, 216-280, 2021. (*)

[J7] M. Cucuringu and H. Tyagi, Provably robust estimation of modulo 1 samples of a smooth function with applications to phase unwrapping, *Journal of Machine Learning Research (JMLR)*, 21(32):1-77, 2020. (*)

[J8] S. Chretien and H. Tyagi, Multi-kernel unmixing and super-resolution using the Modified Matrix Pencil method, *Journal of Fourier Analysis and Applications* 26, 18, 2020. (*)

[J9] A. d'Aspremont , M. Cucuringu and H. Tyagi, Ranking and synchronization from pairwise measurements via SVD, *Journal of Machine Learning Research (JMLR)*, 22(19): 1-63, 2021. (*)

[J10] M. Fanuël and H. Tyagi, Denoising modulo samples: k-NN regression and tightness of SDP relaxation, *Information and Inference: A Journal of the IMA*, 11(2):637-677, 2022. (*)

[J11] H. Tyagi, Error analysis for denoising smooth modulo signals on a graph, *Applied and Computational Harmonic Analysis (ACHA)*, 57:151-184, 2022.

[J12] M. Cucuringu, A.V. Singh, D. Sulem, H. Tyagi, Regularized spectral methods for clustering signed networks, *Journal of Machine Learning Research (JMLR)*, 22(264):1-79, 2021. (*)

[J13] M. Cucuringu, and H. Tyagi, An extension of the angular synchronization problem to the heterogeneous setting, *Foundations of Data Science*, 4(1):71-122, 2022. (*)

[J14] G. Braun, and H. Tyagi, Minimax Optimal Clustering of Bipartite Graphs with a Generalized Power Method, *Information and Inference: A Journal of the IMA (to appear)*, 2022.

(*) *denotes authors in alphabetical order*

Conference publications (peer-reviewed)

[C1] H. Tyagi, R.M. Hegde, H.A. Murthy, and A. Prabhakar, Automatic identification of bird calls using spectral ensemble average voice prints, 13^{th} *European Signal Processing Conference (EUSIPCO)*, 2006, 1-5.

[C2] H. Tyagi and V. Cevher, Learning ridge functions with randomized sampling in high dimensions, 37^{th} *International Conference on Acoustics, Speech, and Signal Processing (ICASSP)*, 2012, 2025-2028.

[C3] H. Tyagi and V. Cevher, Active Learning of Multi-Index Function Models, *Advances in Neural Information Processing Systems (NIPS)*, 2012, 1475-1483.

[C4] H. Tyagi, E. Vural and P. Frossard, Tangent space estimation bounds for smooth manifolds,

10^{th} *International Conference on Sampling Theory and Applications (SAMPTA)*, 2013, 452-455.

[C5] H. Tyagi and B. Gärtner, Continuum armed bandit problem of few variables in high dimensions, *Proc.* 11^{th} *Workshop on Approximation and Online Algorithms (WAOA)*, 2014, LNCS 8447, 108-119.

[C6] H. Tyagi, A. Krause and B. Gärtner, Efficient Sampling for Learning Sparse Additive Models in High Dimensions, *Advances in Neural Information Processing Systems (NIPS)*, 2014, 514-522.

[C7] H. Tyagi, A. Kyrillidis, B. Gärtner and A. Krause, Learning Sparse Additive Models with Interactions in High Dimensions, 19^{th} *International Conference on Artificial Intelligence and Statistics (AISTATS)*, 2016, 111-120 (**oral presentation**).

[C8] M. Cucuringu and H. Tyagi, On denoising modulo 1 samples of a function, 21^{st} *International Conference on Artificial Intelligence and Statistics (AISTATS)*, 2018, 1868-1876. (*)

[C9] A. Eftekhari, J. Tanner, A. Thompson, B. Toader, and H. Tyagi, Non-negative super-resolution is stable, *Proc. of IEEE Data Science Workshop (DSW)*, 2018, pp. 1-5. (*)

[C10] M. Cucuringu, P. Davies, A. Glielmo, and H. Tyagi, SPONGE: A generalized eigenproblem for clustering signed networks, 22^{nd} *International Conference on Artificial Intelligence and Statistics (AISTATS)*, 2019, 1088-1098. (*)

[C11] G. Braun, H. Tyagi, and C. Biernacki, Clustering multilayer graphs with missing nodes , 24^{th} *International Conference on Artificial Intelligence and Statistics (AISTATS)*, 2021, 2260-2268.

[C12] M. Fanuel and H. Tyagi, Recovering Hölder smooth functions from noisy modulo samples, 55^{th} *Asilomar Conference on Signals, Systems, and Computers*, 857-861, 2021. (*)

[C13] G. Braun, H. Tyagi, and C. Biernacki, An iterative clustering algorithm for the Contextual Stochastic Block Model with optimality guarantees, *39th International Conference on Machine Learning (ICML)*, 2022, 2257-2291.

PREPRINTS (UNDER REVIEW)

[P1] E. Karlé and H. Tyagi, Dynamic Ranking with the BTL Model: A Nearest Neighbor based Rank Centrality Method, 2021, *arXiv:2109.13743*.

[P2] E. Araya, E. Karlé and H. Tyagi, Dynamic Ranking and Translation Synchronization, 2022, *arXiv:2207.01455* (*).

[P3] E. Araya, G. Braun, and H. Tyagi, Seeded graph matching for the correlated Wigner model via the projected power method, 2022, *arXiv:2204.04099* (*).

[P4] H. Tyagi and D. Efimov, Learning linear dynamical systems under convex constraints, 2023, *arXiv:2303.15121*.

TALKS

Learning multi ridge functions in high dimensions via low rank matrix recovery. Mittagsseminar, ETH Zürich, April, 2012.

Tangent space estimation for smooth embeddings of manifolds. Mittagsseminar, ETH Zürich, January, 2013.

Continuum armed bandit problem of few variables in high dimensions. Mittagsseminar, ETH Zürich, July, 2013.

Continuum armed bandit problem of few variables in high dimensions. 11th Workshop on Approximation and Online Algorithms (WAOA), September, 2013.

The adversarial multi-armed bandit problem. Mittagsseminar, ETH Zürich, December, 2013.

Interpolation with cubic splines. Mittagsseminar, ETH Zürich, May, 2014.

Efficient sampling for learning SPAMs in high dimensions. Mittagsseminar, ETH Zürich, October, 2014.

Tangent space estimation for smooth embeddings of manifolds. Information and Inference best paper

prize meeting, University of Oxford, UK, August, 2015.

Learning SPAMs with pairwise interaction terms.

- Mittagsseminar, ETH Zürich, November, 2015.
- 19th International Conference on Artificial Intelligence and Statistics (AISTATS), Cadiz, Spain, May 11, 2016.
- ANC Seminar, School of Informatics, University of Edinburgh, UK, October 25, 2016.
- ACM Seminar, School of Mathematics, University of Edinburgh, UK, October 26, 2016.
- Algorithms Day, Alan Turing Institute, London, UK, March 17, 2017.
- Numerical Analysis Seminar, University of Oxford, UK, February 14, 2017.
- Minisymposia on *Learning functions from data* at the 27th Biennial Numerical Analysis Conference at Glasgow, 27 – 30 June, 2017.

Provably robust estimation of modulo 1 samples of a smooth function. July, 2018, ISMP, Bordeaux.

SPONGE: A generalized eigenproblem for clustering signed networks.

- MODAL days, INRIA Lille-Nord Europe, January, 2019.
- Laboratoire de Mathématiques, Université de Franche-Comté, Besancon, France, June, 2019.
- Probability and Statistics seminar, University of Lille, France, September, 2019.

Spectral clustering on graphs. January, 2020, Cafe de Sciences, Inria Lille.

Learning general sparse additive models from point queries in high dimensions.

- January 2020, MODAL days, Inria Lille.
- February 27 2020, STADIUS seminar, KU Leuven.
- November 20 2020, Séminaire SAMM : Statistique, Analyse et Modélisation Multidisciplinaire, Université Paris 1.

Recovering Hölder smooth functions from noisy modulo samples. September 15, 2021, Invited session on Computational Sampling, Asilomar Conference on Signals, Systems, and Computers.

Dynamic Ranking and Translation Synchronization. January 12, 2023, City University of Hong Kong (Department of Mathematics)

References

Prof. Christophe Biernacki
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