Daniele Bigoni *Curriculum Vitae*

Contact Information

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Publons: publons.com/a/1575407

Actual Occupation

Accenture S.p.A., Modena, Italy

Ind & Func AI Decision Science Manager
Team Lead Financial Services **Jan 2025 - present**

Head of Data Science (Ammagamma part of Accentture) **Jan 2024 - Dec 2024**

Team Leader Data Scientist (Ammagamma s.r.l.) **May 2020 - Dec 2023**

Senior Data Scientist (Ammagamma s.r.l.) **Sept. 2019 - April 2020**

Spoken Languages

Italian: native
English: full professional proficiency (TOEFL 108/120 obtained on October 14^{th}, 2011)
Danish: A2 beginner

Research Interests

Mathematical analysis, linear algebra, stochastic differential equations, non-linear dynamics, uncertainty quantification, machine learning, data assimilation, optimal transport, design under uncertainty, parallel computing, distributed systems.

Education

The Technical University of Denmark, 2800 Kgs. Lyngby, Denmark
Department of Applied Mathematics and Computer Science

Ph.D., Applied Mathematics and Computer Science **Dec. 2011 - Dec. 2014**

Thesis Topic: *Uncertainty Quantification with Applications to Engineering Problems*
Advisers: Assoc. Prof. Allan P. Engsig-Karup and Prof. Jan S. Hesthaven

The Technical University of Denmark, 2800 Kgs. Lyngby, Denmark
Department of Applied Mathematics and Computer Science

M.Sc., Mathematical Modeling and Computation, **Sept. 2009 - Aug. 2011**

Thesis Topic: *Curving Dynamics on High Speed Trains*
Advisers: Assoc. Prof. Allan P. Engsig-Karup and Assoc. Prof. Hans True
Area of Study: Non-linear Dynamics, Numerical Methods for Differential Equations

Universitá degli studi di Trento, 38122 Trento, Italy

B.Sc., Computer Science, **Sept. 2005 - Oct. 2008**

Thesis Topic: *Decentralized Network Analysis: Development and Simulation*
Adviser: Assoc. Prof. Alberto Montresor
Area of Study: Algorithms and Data Structures, Distributed Systems

Academic Experience

Massachusetts Institute of Technology, Cambridge, MA, United States
Department of Aeronautics and Astronautics, Uncertainty Quantification group

Research Scientist **Nov. 2018 - Aug. 2019**

Postdoctoral Associate **Jun. 2015 - Oct. 2018**

- TransportMaps: development of methodologies and software for Bayesian inference based on optimal transport – funding DOE, USA
- ScramjetUQ: uncertainty quantification in LES computations of turbolent multiphase combustion in a scramjet engine – funding DARPA, USA
- UNQUESTIONABLE: INRIA-MIT collaboration in the analysis of aspects in sensitivity analysis, data assimilation and reduced order modeling – funding INRIA, FR

The Technical University of Denmark, 2800 Kgs. Lyngby, Denmark
Department of Applied Mathematics and Computer Science

Research Assistant **Feb. 2015 - March. 2015**

Massachusetts Institute of Technology, Cambridge, MA 02139-4307, USA
Uncertainty Quantification Group in the Department of Aeronautics and Astronautics.

Visiting PhD Student **Jun. 2013-Dec. 2013**
Topic: Uncertainty Quantification for advanced engineering applications

Professional Experience

Danish Product Development Ltd., DK-3070 Snekkersten, Denmark

Consultant and Software Developer. **Oct. 2010 - Jun. 2013**
Development of the Graphic User Interface of CatSysPD, software for the early diagnosis of Parkinson's disease. Competences:

- National Instrument Software (NIDAQmx)
- Java Native Access (JNA)
- Java Persistence API (JPA)
- Digital Signal Processing

Alstom Transport, Le Creusot, France

Intern aiming the realization of the MSc. thesis. **Mar. 2011 - Aug. 2011**
Study of non-linear dynamics on very-high speed trains. Competences:

- Multi-body (non-linear) dynamics

Universitá degli Studi di Trento, Facoltá di Scienze, Povo (TN), Italy

Technical Support at the Laboratories. **Mar. 2007 - Nov. 2007**
Support activity at the laboratories and the offices at the Science Faculty of the University of Trento. Maintenance of the laboratories in the faculties and assistance to the students.

References Available to Contact

Associate Professor **Dr. Youssef M. Marzouk** (e-mail: ymarz@mit.edu)
Department of Aeronautics and Astronautics,
Massachusetts Institute of Technology
Room 37-451, 77 Massachusetts Avenue, Cambridge, MA 02139, USA
Dr. Marzouk is my current PostDoc adviser.

Associate Professor **Dr. Allan P. Engsig-Karup** (e-mail: apek@dtu.dk)
Department of Applied Mathematics and Computer Science,
The Technical University of Denmark
Matematiktorvet, Building 303b/108, 2800 Kgs.-Lyngby, Denmark
Dr. Engsig-Karup was my graduate adviser.

Teaching Experience

Massachusetts Institute of Technology, 02139 Cambridge, MA, USA
Department of Aeronautics and Astronautics

Teaching Assistant **Jun. 2015 - Present**

- Oct. - Nov. 2015: 16.940 Numerical Methods for Stochastic Modeling and Inference

The Technical University of Denmark, 2800 Kgs. Lyngby, Denmark
Department of Applied Mathematics and Computer Science

Teaching Assistant **Dec. 2011 - Dec. 2014**

- Sep. - Dec. 2012: Study in Spectral Methods for solution of Partial Differential Equations
- Feb. - Mar. 2012: Scientific Computing for differential equations (02685)
- Jan. 2012: The Finite Element Method for Partial Differential Equations (02623)

Teaching **Dec. 2011 - Dec. 2014**

- Mar. - May. 2015: Scientific Computing for differential equations (02685)
- Feb. - Mar. 2013: Scientific Computing for differential equations (02685)

Students Supervision

The Technical University of Denmark, 2800 Kgs. Lyngby, Denmark
Department of Applied Mathematics and Computer Science

Master Thesis

- Sep. 2015 - Feb. 2016: Kristian Berg Thomsen *Theory and application of the Multilevel Monte Carlo method* (co-supervisor)
- Feb. 2015 - Aug. 2015: Andreas F. Mieritz *Robust massively parallel free surface simulation using the Spectral Element Method* (co-supervisor)
- Nov. 2014 - Apr. 2015: Claus L. Jensen *Reduced Order Modeling for Partial Differential Equation* (co-supervisor)
- Dec. 2012 - May. 2013: Emil B. Kærgaard *Spectral Methods for Uncertainty Quantification* (co-supervisor)
- Dec. 2012 - May. 2013: Emil K. Nielsen *Study in Modern Uncertainty Quantification Methods* (co-supervisor)

Bachelor Thesis

- Sep. 2012 - Feb. 2013: Christian H. Brams *Spectral Methods for Uncertainty Quantification* (co-supervisor)

Projects

- Feb. - May. 2014: Bachelor project in modeling and simulation of railway vehicle dynamics (co-supervisor)
- Feb. - May. 2013: Bachelor project in modeling and simulation of railway vehicle dynamics (co-supervisor)

Service

Massachusetts Institute of Technology, 02139 Cambridge, MA, USA
Department of Aeronautics and Astronautics

Organization of reading groups **2015-2019**

The Technical University of Denmark, 2800 Kgs. Lyngby, Denmark
Department of Applied Mathematics and Computer Science

Organization of the Ph.D. seminar series **2014-2015**

REFEREE SERVICE

- *Vehicle System Dynamics – Taylor & Francis*
- *Journal of Rail and Rapid Transit – Sage journals*
- *Computers & Fluids – Elsevier*
- *Journal of Computational Physics – Elsevier*
- *Mathematics and Computers in Simulation – Elsevier*
- *Transactions on Emerging Topics in Computing – IEEE*
- *Transcations on Mathematical Software – ACM*
- *Annual Conference on Neural Information Processing Systems*
- *Proceedings of the Royal Society A*

CONFERENCE SERVICE

(2024) Organizer of mini-symposium: Handling Uncertainties in Industry. In *SIAM Conference on Uncertainty Quantification* , Trieste, Italy.

(2019) Organizer of mini-symposium: Advances in data assimilation. In *International Congress on Industrial and Applied Mathematics*, Valencia, Spain.

(2019) Organizer of mini-symposium: Dimension reduction in inverse problems. In *Applied inverse problems conference*, Grenoble, France

(2019) Organizer of mini-symposium: Statistical applications of continuous and discrete transport. In *SIAM confrence in Computational Science and Engineering*, Spokane, WA, USA

(2018) Organizer of mini-symposium: Dimension reduction in Bayesian inference. In *SIAM conference in Uncertainty Quantification*, Garden Grove, CA, USA.

(2017) Organizer of mini-symposium: Measure Transport Approaches for Statistical Problems. In *SIAM conference in Computational Science and Engineering*, Atlanta, GA, USA

Thesis Dissertations

Bigoni, D. (2015). *Uncertainty Quantification with Applications to Engineering Problems*. Technical University of Denmark. PhD Thesis

Bigoni, D. (2011). *Curving Dynamics on High Speed Trains*. Technical University of Denmark. Master Thesis.

Bigoni, D. (2008). *Decentralized Network Analysis: Development and Simulation*. Universitá degli studi di Trento. Bachelor Thesis.

Refereed Journal Publications

Bigoni, **D**, Y Marzouk, C Prieur, and O Zahm (Dec. 2022). "Nonlinear dimension reduction for surrogate modeling using gradient information". en. In: *Information and Inference: A Journal of the IMA* 11.4, pp. 1597–1639. ISSN: 2049-8772. DOI: 10.1093/imaiai/iaac006.

Bigoni, **D**, Y Chen, N Garcia Trillos, Y Marzouk, and D Sanz-Alonso (Oct. 2020). "Data-driven forward discretizations for Bayesian inversion". In: *Inverse Problems* 36.10, p. 105008. DOI: 10.1088/1361-6420/abb2fa.

Brennan, M., **D. Bigoni**, O. Zahm, A. Spantini, and Y. Marzouk (2020). "Greedy inference with structure-exploiting lazy maps". In: *Advances in Neural Information Processing Systems*. Ed. by H. Larochelle, M. Ranzato, R. Hadsell, M. F. Balcan, and H. Lin. Vol. 33. Curran Associates, Inc., pp. 8330–8342.

Spantini, A., **D. Bigoni**, and Y. Marzouk (2018). "Inference via low-dimensional couplings". In: *Journal of Machine Learning Research* 19.66, pp. 1–71. arXiv: 1703.06131.

Bigoni, **D.**, A. P. Engsig-Karup, and C. Eskilsson (2016). "Efficient uncertainty quantification of a fully nonlinear and dispersive water wave model with random inputs". In: *Journal of Engineering Mathematics*. ISSN: 0022-0833. DOI: 10.1007/s10665-016-9848-8. arXiv: 1410.6338.

Bigoni, **D.**, A. P. Engsig-Karup, and Y. Marzouk (Jan. 2016). "Spectral Tensor-Train Decomposition". In: *SIAM Journal on Scientific Computing* 38.4, A2405–A2439. ISSN: 1064-8275. DOI: 10.1137/15M1036919. arXiv: 1405.5713.

Engsig-Karup, A.P., C. Eskilsson, and **D. Bigoni** (Aug. 2016). "A stabilised nodal spectral element method for fully nonlinear water waves". In: *Journal of Computational Physics* 318, pp. 1–21. ISSN: 00219991. DOI: 10.1016/j.jcp.2016.04.060. arXiv: 1512.02548.

Bigoni, **D.**, H. True, and A.P. Engsig-Karup (Apr. 2014). "Sensitivity analysis of the critical speed in railway vehicle dynamics". In: *Vehicle System Dynamics* May 2014, pp. 272–286. ISSN: 0042-3114. DOI: 10.1080/00423114.2014.898776.

True, H., A.P. Engsig-Karup, and **D. Bigoni** (Jan. 2014). "On the numerical and computational aspects of non-smoothnesses that occur in railway vehicle dynamics". In: *Mathematics and Computers in Simulation* 95, pp. 78–97. ISSN: 03784754. DOI: 10.1016/j.matcom.2012.09.016.

Refereed Conference Publications

Engsig-Karup, A. P., C. Eskilsson, and **D. Bigoni** (2016). "Unstructured Spectral Element Model for Dispersive and Nonlinear Wave Propagation". In: *The 26th International Ocean and Polar Engineering Conference*. Rhodes, Greece.

Bigoni, **D.**, A. P. Engisg-Karup, and H. True (July 2014). "Global Sensitivity Analysis of Railway Vehicle Dynamics on Curved Tracks". In: *Volume 2: Dynamics, Vibration and Control; Energy; Fluids Engineering; Micro and Nano Manufacturing*. Copenhagen, Denmark: ASME, V002T07A023. ISBN: 978-0-7918-4584-4. DOI: 10.1115/ESDA2014-20529.

Bigoni, **D.**, A. P. Engsig-Karup, and H. True (2013a). "Anwendung der Uncertainty Quantification bei eisenbahndynamischen problemen". In: *Z E Vrail - Glasers Annalen* 137.SPL.ISSUE, pp. 152–158. ISSN: 1618-8330.

— (Oct. 2013b). "Modern Uncertainty Quantification Methods in Railroad Vehicle Dynamics". In: *ASME 2013 Rail Transportation Division Fall Technical Conference*. Altoona: ASME, V001T01A009. ISBN: 978-0-7918-5611-6. DOI: 10.1115/RTDF2013-4713.

Bigoni, **D.**, H. True, and A. P Engsig-Karup (2013). "Sensitivity Analysis of the critical speed in railway vehicle dynamics". In: *23rd IAVSD Symposium on Dynamics of Vehicles on Roads and Tracks*. Qingdao.

Bigoni, **D.**, A.P. Engsig-Karup, and H. True (2012). "Comparison of Classical and Modern Uncertainty Quantification Methods for the Calculation of Critical Speeds in Railway Vehicle Dynamics". In: *13th mini Conference on Vehicle System Dynamics, Identification and Anomalies*. Budapest, Hungary.

Conference Activities

T. Gallingani*, R. Benaglia, **D. Bigoni** (2024) Data Assimilation and Inverse Problems for Oil Spill Response Operations In *SIAM Conference on Uncertainty Quantification* , Trieste, Italy.

D. Bigoni*, A. Spantini, R. Baptista, Y. Marzouk (2019) Data assimilation via low-rank couplings. In *International Congress in Industrial and Applied Mathematics* . Valencia, Spain. (Talk)

D. Bigoni*, O. Zahm, A. Spantini, Y. Marzouk (2019) Layers of lazy maps for large-scale inference. In *Applied Inverse Problems Conference* . Grenoble, France. (Talk)

D. Bigoni*, O. Zahm, A. Spantini, Y. Marzouk (2019) Layers of low-rank couplings for large-scale Bayesian inference. In *SIAM Conference on Computational Science and Engineering*. Spokane, WA, USA. (Talk)

J. Chen*, P. Chen, **D. Bigoni**, Y. Marzouk, O. Ghattas (2019) Dimension Adaptive Sparse Quadrature and Sparse Polynomial Parametrized Transport Maps for High Dimensional Bayesian Integration. In *SIAM Conference on Computational Science and Engineering*. Spokane, WA, USA. (Talk)

D. Bigoni*, A. Spantini, R. Baptista, Y. Marzouk (2019) Variational Bayesian filtering and smoothing via low-dimensional transports. In *7th International Symposium in Data Assimilation*. Kobe, Japan. (Poster - Best poster award)

D. Bigoni*, R. Baptista, A. Spantini, Y. Marzouk (2018) Variational Bayesian filtering and smoothing via low-dimensional transports. In *AGU Fall Meeting*. Washington, MA, USA (Talk)

D. Bigoni*, A. Spantini, Y. Marzouk (2018) Ordering heuristics for tensor-train decomposition. In *SIAM Annual Meeting*. Portland, OR, USA (Talk)

D. Bigoni*, A. Spantini, Y. Marzouk (2018) Adaptive construction of Transport-Maps for efficient sampling. In *13th International Conference in Monte Carlo and Quasi-Monte Carlo Methods in Scientific Computing*. Rennes, France (Talk)

D. Bigoni*, A. Spantini, R. Morrison, R. Baptista, Y. Marzouk (2018) Bayesian Inference and Statistical Modeling with TransportMaps. In *SIAM Conference on Uncertainty Quantification*. Garden Grove, CA, USA (Poster)

D. Bigoni*, A. Spantini, Y. Marzouk (2018) Scalable Inference with Transport Maps. In *SIAM Conference on Uncertainty Quantification*. Garden Grove, CA, USA (Talk)

D. Bigoni*, A. Spantini, Y.M. Marzouk. (2017) Measure transport approaches to uncertainty quantification. In *QUIET17: Quantification of Uncertainty: Improving Efficiency and Technology*. Trieste, Italy (Poster)

D. Bigoni*, A. Spantini, Y.M. Marzouk. (2017) An Automated Measure Transport Framework for Online Nonlinear Filtering and Smoothing. In *SIAM Annual Meeting*. Pittsburgh, PA, USA. (Talk)

D. Bigoni*, A. Spantini, Y.M. Marzouk. (2017) Robust and Adaptive Construction of Measure Transports for Bayesian Inference. In *SIAM conference in Computational Science and Engineering*. Atlanta, GA, USA. (Talk)

A. Spantini*, **D. Bigoni**, Y.M. Marzouk. (2017) Bayesian Filtering and Smoothing Via Measure Transport. In *SIAM conference in Computational Science and Engineering*. Atlanta, GA, USA. (Talk)

D. Bigoni*, A. Spantini, Y.M. Marzouk. (2016) Adaptive construction of measure transports for Bayesian inference. In *Annual Conference on Neural Information Processing Systems - Advances in Approximate Bayesian Inference*. Barcelona, Spain. (Paper, Poster)

A. Spantini*, **D. Bigoni**, Y.M. Marzouk. (2016) Variational inference via decomposable transports: algorithms for Bayesian filtering and smoothing. In *Annual Conference on Neural Information Processing Systems - Advances in Approximate Bayesian Inference*. Barcelona, Spain. (Paper, Poster)

D. Bigoni*, A. Spantini, Y.M. Marzouk. (2016) Adaptive construction of measure transports, with application to Bayesian inference. In *Bi-annual congress of the Italian Society of Industrial and Applied Mathematics (SIMAI)* . Milan, Italy. (Talk)

A. Spantini*, **D. Bigoni**, Y.M. Marzouk. (2016) Measure transport, inference and low-dimensional maps. In *Bi-annual congress of the Italian Society of Industrial and Applied Mathematics (SIMAI)* . Milan, Italy. (Talk)

D. Bigoni*, Y.M. Marzouk. (2016) Ordering Heuristics for Minimal Rank Approximations in Tensor-Train Format. In *SIAM Conference on Uncertainty Quantification*. Lausanne, Switzerland. (Talk)

D. Bigoni*, Y.M. Marzouk, A.P. Engsig-Karup. (2015) Adaptive spectral tensor-train decomposition. In *13th U.S. National Congress on Computational Mechanics*. San Diego, California, USA. (Talk)

D. Bigoni*, A.P. Engsig-Karup, C. Eskilsson. (2015) Towards non-linear wave models with random inputs. In *SIAM Conference on Mathematical and Computational Issues in Geosciences*. Stanford University, California, USA. (Talk)

A.P. Engsig-Karup*, C. Eskilsson, **D. Bigoni**. (2015) Towards Uncertain Hydrodynamic Loads on Offshore Wind Turbines By Spectral Methods. In *2nd Frontiers in Computational Physics Conference: Energy Sciences*. Zurich, Switzerland. (Talk)

D. Bigoni*, A.P. Engsig-Karup, Y.M. Marzouk. (2015) Adaptive spectral tensor-train decomposition for the construction of surrogate models. In *SIAM conference on Computational Science and Engineering*. Salt Lake City, Utah, USA. (Poster presentation)

A.P. Engsig-Karup*, **D. Bigoni**, C. Eskilsson. (2015) A spectral element method for nonlinear and dispersive water waves. In *SIAM conference on Computational Science and Engineering*. Salt Lake City, Utah, USA. (Poster presentation)

D. Bigoni*, A.P. Engsig-Karup, Y.M. Marzouk. (2014) Spectral tensor-train decomposition for low-rank surrogate models. In *Workshop on Spatial Statistics and Uncertainty Quantification on Supercomputers*. Bath, United Kingdom. (Poster presentation)

D. Bigoni*, A.P. Engsig-Karup, Y.M. Marzouk. (2014) Surrogate models for uncertainty quantification via spectral tensor-train decomposition. In *Workshop on Uncertainty Quantification in Computational Fluid Dynamics*. Pisa, Italy. (Talk)

D. Bigoni*, A.P. Engsig-Karup, H. True. (2014) Global sensitivity analysis of Railway Vehicle Dynamics on curved tracks. In proceeding of *ASME 2014 12th Biennial Conference on Engineering Systems Design and Analysis*. Copenhagen, Denmark. (Talk and proceeding)

A.P. Engsig-Karup*, **D. Bigoni**, S.L. Glimberg (2013) Stochastic Wave Dynamics and Uncertainty Quantification. In *38th Woudschoten Conference*. Zeist, Netherlands. (Poster presentation)

D. Bigoni*, A.P. Engisg-Karup, H. True. Modern uncertainty quantification methods in railroad vehicle dynamics. In proceeding of *ASME 2013 Rail Transportation Division Fall Technical Conference*. Oct 2013, Altoona, Pennsylvania, USA. (Talk and proceeding)

D. Bigoni*, A.P. Engsig-Karup, H. True. Sensitivity analysis of the critical speed in railway vehicle dynamics. In proceeding of *23rd International Symposium on Dynamics of Vehicles on Roads and Tracks (IAVSD2013)*. Aug 2013, Qingdao, China. (Talk and proceeding)

D. Bigoni*, A.P. Engsig-Karup, H. True. Comparison of Classical and Modern Uncertainty Quantification Methods for the Calculation of Critical Speeds in Railway Vehicle Dynamics. *13th Mini Conference on Vehicle System Dynamics, Identification and Anomalies*. Nov 5-7, 2012 at Budapest University of Technology and Economics, Hungary. (Talk and proceeding)

D. Bigoni*, A.P. Engsig-Karup, H. True, J.S. Hesthaven. Uncertainty quantification of critical speed for railway vehicle dynamics. *BIT Circus 2012*. Aug 23-24, 2012 at DTU, Denmark. (Talk)

D. Bigoni*, A.P. Engsig-Karup, H. True. Uncertainty Quantification on High-speed Railway Dynamics. *Uncertainty Quantification for High-Performance Computing Workshop.* May 2-4, 2012 at ORNL in Oak Ridge (TN), USA. (Poster presentation)

SOFTWARE DEVELOPMENT

- TransportMaps (Python): measure transport for statistical inference and estimation.
- SpectralToolbox (Python): construction of basis functions for spectral approximations.
- UQToolbox (Python): methods for Uncertainty Quantification.
- TensorToolbox (Python): methods for low-rank tensor decomposition.
- mpi_map & phantom_scheduler (Python): routines for parallel and cluster computing.
- DYTSI (C++): DYnamic Train SImulation for railway vehicle dynamics.