

## Massimiliano Ruocco, PhD

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CONTACT INFORMATION	<p><i>E-mail:</i> <a href="mailto:massimiliano.ruocco@sintef.no">massimiliano.ruocco@sintef.no</a> <i>Linkedin:</i> <a href="https://www.linkedin.com/in/massimilianoruocco">https://www.linkedin.com/in/massimilianoruocco</a> <i>Web(NTNU):</i> <a href="https://www.ntnu.edu/employees/massimiliano.ruocco">https://www.ntnu.edu/employees/massimiliano.ruocco</a> <i>Web(SINTEF):</i> <a href="https://www.sintef.no/en/all-employees/employee/massimiliano.ruocco/">https://www.sintef.no/en/all-employees/employee/massimiliano.ruocco/</a></p>
RESEARCH INTERESTS	<ul style="list-style-type: none"><li>• Machine Learning and Deep Learning (for text, image and time series analysis).</li><li>• Data Efficient Machine Learning / Deep Learning (Unsupervised, Semi-supervised, Few-Shot and Active Learning).</li><li>• Machine Learning for Time Series analysis.</li><li>• Robust AI.</li><li>• Synthetic Data Generation and Privacy Preservation.</li><li>• Information Retrieval and Natural Language Processing.</li></ul>
BRIEF OVERVIEW	<p>As a Senior Researcher at SINTEF and an Associate Professor at NTNU, I engage in the intersection of theoretical development and practical application of machine learning and AI, with a focus on time series analysis, data-efficient machine learning, and general advancements in deep learning. My core research addresses modern AI techniques for anomaly detection, prediction, forecasting, and synthetic data generation, aiming to enhance and streamline these processes in various sectors. In my role, I also lead the area and strategy of machine learning within the SPIN group at SINTEF, contributing to the strategic direction of our research. I collaborate with both industrial and academic partners to apply research findings in a way that addresses real-world challenges. My experience in project coordination extends across national and international collaborations, where I strive to align research objectives with broader strategic goals. Public speaking and dissemination of research are also part of my responsibilities, aimed at making complex AI and ML concepts accessible and applicable for various audiences. This balance of research and application serves to drive the field of AI forward, not only in theoretical exploration but also in its practical implementation across industries.</p>
EDUCATION	<p><b>PhD, Computer Science</b> <span style="float: right;">July 2009 - May 2014</span> Department of Computer and Information Science, Norwegian University of Science and Technology</p> <ul style="list-style-type: none"><li>• Thesis Topic: <i>Geo-Temporal Mining and Searching of Events from Web-based Image Collections</i>, (defended on May 2014)</li><li>• Supervisor: Prof. Heri Ramamapiaro</li><li>• Area of Study: Information Retrieval, Machine Learning, Web Mining, Spatio-Temporal Statistics</li></ul> <p>- Implementing/Improving supervised learning algorithm for extraction of Event-Related pictures from social media applications, by considering textual, geographical and temporal dimensions.</p> <p>- Exploring/Visualizing novel spatio-temporal features from social media data for spatio-temporal patterns detection.</p> <p>- Implementing novel query expansion model by investigating/implementing machine learning algorithms for combining heterogeneous information, (temporal geographical and textual) for the selection of the best expansion terms.</p> <p><b>M.Sc., Computer Science</b> <span style="float: right;">June 1999 - Sept. 2005</span></p>

Department of Computer Science,  
University of Verona

- Thesis Title: *Multicamera Head-Tracking*
- Advisor: Prof. Andrea Fusiello
- Area of Study: Pattern Recognition, Computer Vision, Image Processing

- Developing of a realtime system to follow head tracking with reduced computational costs, robust also in low video resolutions.

PROFESSIONAL  
EXPERIENCE

***Senior Research Scientist***

October 2020 to present

**Sintef Digital**, Trondheim, NORWAY

As a Senior Researcher at SINTEF Digital, I lead the strategic development and implementation of Machine Learning activities and strategy within the SPIN group. My role involves coordinating and develop advanced research projects, developing innovative AI solutions, and fostering collaboration between academia and industry. I am responsible for guiding the direction of our research initiatives, ensuring they align with cutting-edge advancements and industry needs. Additionally, I mentor junior researchers and oversee the integration of machine learning techniques across various projects, enhancing our group's impact and productivity.

***Senior Research Scientist***

August 2015 to September 2020

**Telenor Research**, Trondheim, NORWAY

Researcher in the areas of Deep Learning, Machine Learning, Natural Language Processing and Recommender Systems in the Analytics and AI group at Telenor Research. Responsible for the research activities in the group and for the relation with NAIL (Norwegian Open AI Lab), where I am also part of the board.

***Adjunct Associate Professor***

January 2015 to present

**NTNU Department of Computer and Information Science (DART Group)**,  
Trondheim, NORWAY

(See *Teaching Experience* Section).

***Software Engineer***

October 2013 to July 2015

**Telenor Digital**, Trondheim, NORWAY

I am in the Global ID group, involved in handling the ID datastore and various infrastructure components. User facing parts of the Global ID system is handled by the API team.

***Lecturer***

August 2014 to December 2014

**NTNU Department of Computer and Information Science (DART Group)**,  
Trondheim, NORWAY

(See *Teaching Experience* Section).

***Research Fellow***

July 2009 to September 2013

**NTNU**, Trondheim, NORWAY

PhD candidate in the Computer and Information System Department at Norwegian University of Science and Technology.

***Software Engineer***

July 2007 – June 2009

**RGI S.r.l.**, Verona, ITALY

We manage the Gruppo Cattolica Assicurazione, the third most important insurance of Italy and delivers it solutions and personalization of PASS (web application). I was responsible for bug fixing, and of the implementation of new business part on specific

request of the client. In my case I was involved in re-engineering some part of the business logics too.

**Software Engineer**

Jan. 2006 - June 2007

**InfoCamere S.p.a.**, Padova, ITALY

I've worked in National Business Registry division developing a project aimed at renewing the "Copernico system" which deals with "telecommunication files" of the Chambers of Commerce. The target was to develop a client/server system for xml database data download in J2EE environment using XML for data exchange and JSP and Javascript technologies for client system. I was renewing the server system too, using EJB 3.0. technologies.

**Research Intern**

Sept. 2004 - Dec. 2005

**FBK, Fondazione Bruno Kessler**, Trento, ITALY

I worked in collaboration with the Vision Technologies Team developing a project regarding head tracking. I created a real time application to study how to follow the attention focus of a user in a museum. I studied the monitoring of people head position during a round table in a multi-camera environment, examining also the distributed software architecture.

TEACHING  
EXPERIENCE

**NTNU**, Department of Computer and Information Science, Trondheim, NORWAY  
*Teaching Assistant (TA), Lecturer (L) and Coordinator*

- Modern ML for Time Series Analysis [Coordinator] (TDT99) Fall 2020
- Machine Learning [L] (TDT4173) Fall 2017, Fall 2018, Fall 2019, Spring 2019, Spring 2020, Spring 2021, Spring 2022, Spring 2023
- Recommender Systems [L] (TDT4215) Fall 2019
- Web Intelligence [L] (TDT4215) Fall 2016, Fall 2017, Fall 2018
- Information Retrieval [TA] (TDT4117) Fall 2011, Fall 2012, Fall 2014
- Operating System [TA] (TDT4186) Fall 2011, Fall 2012

ATTENDED  
COURSES AND  
SCHOOL

**University of Plymouth**, Plymouth, UK

- **ISSPR 2010**, *International Summer School on Pattern Recognition* Sept. 2010

The 8th International Summer School on Pattern Recognition covered the following topics:

- statistical pattern recognition and multivariate statistics
- neural networks and reinforcement learning
- evolutionary computation and optimization
- classification, and data mining
- machine learning systems for real applications

The summer school speakers were ones of the leading international practitioners of pattern recognition technology, with exceptional track record of publishing, book writing and research work.

**NTNU**, Department of Computer and Information Science, Trondheim, NORWAY

- *Web Intelligence* (PhD Course) Spring 2010
- *Topics in Information Technology* (PhD Course) Spring 2010
- *Advanced Information Retrieval* (PhD Course) Fall 2009
- *Web Mining* (PhD Course) Fall 2009

**FBK, Fondazione Bruno Kessler**, Trento, ITALY

- **VISMAL 2004** , *Machine Vision School* Nov. 2004

INVITED TALKS  
AND OTHER  
ACTIVITIES

**MLDM@AIXIA**, Invited Talk, *Deep Learning meets CFD: Innovations in Wind Flow Modeling and real-time Analysis in Urban Environment* , Rome, Nov 2023

**ICAPAI2023**, Invited Talk, *Transformers for Time Series Analysis*, Halden, May 2023

**Prosjekt Norge Webinar**, Invited Talk, *Databygg-projekt and how we use machine learning to predict building energy use*, Trondheim, November 2021

**NorwAI and NAIL Series on AI Research and Innovation**, Invited Talk, *Generative Adversarial Networks for Anomaly Detection on Telco multivariate time series*, Trondheim, November 2021

**NOBIDS2019**, Invited Talk, *AI Applications in Telenor*, Trondheim, November 2019

**NOKIOS2019**, Panelist at *Sesjon 1A: AI – hype eller håp?*, Trondheim October 2019

**NAIS Symposium**, PC at First NAIS Symposium, Trondheim, May 2019

**AI for Text Summarization**, AILab presentation to Sygve Brekke, CEO - Telenor, Trondheim, February 2019

**Reinforcement Learning and GAN for Text Summarization**, guest lecture at BRAIN organization at NTNU (BRAIN Talks), Oslo, November 2018

**Introduction to Machine Learning**, guest lecture at HIOA ("Research Methods and Data Analysis" Master Course), Oslo, November 2018

**Unsupervised Learning: Make Sense of your (not labelled) data**, guest lecture at NTNU Online organization (Fagkveld med KiD: Maskinl ring og Big Data), Trondheim, September 2018

**Learn How to Active Learn: Metalearning approaches to (Deep) Active Learning**, guest lecture at University of Modena and Reggio Emilia, Modena, Italy, May 2018

**Bias in AI**, panelist at Technoport 2018 (Technoport 2018), Trondheim, February 2017

**Introduction to AI**, guest lecture at NTNU (IT Seminar for IT avdeling), Trondheim, December 2017

**Introduction to Machine Learning**, guest lecture at HIOA ("Research Methods and Data Analysis" Master Course), Oslo, November 2017

**Internet of Things meet ML**, guest lecture at HIOA ("IoT" Master Course), Oslo, April 2017

**First Telenor-NTNU AI Lab Hackathon**, Organizers and PC of the First Telenor-NTNU AILab Hackathon, Trondheim, 17-18 March, 2017

**Geographical Data in R - From Visualization to Analysis**, guest lecture at NITH ("Big Data" Master course), *Oslo, October 2014*

**Geospatial Data and Location-based Search**, Big Data Meetup, *Trondheim, September 2014*

**Exploring Temporal Proximity and Spatial Distribution of Terms in Web-based Search of Event-Related Images**, at ACM Conference on Hypertext and Social Media, *Paris, May 2013*

**Exploratory Analysis on Heterogeneous Tag-Point Patterns for Ranking and Extracting Hot-Spot Related Tags**, at 5th ACM SIGSPATIAL International Workshop on Location-Based Social Networks, *Redondo Beach, CA, May 2012*

**Context-aware image semantic extraction in the social web**, at 21st World Wide Web Conference, WWW 2012, *Lyon, France, April 2012*

**NTNU@MediaEval 2011 Social Event Detection Task (SED)**, at MediaEval 2011 Workshop, *Pisa, September 2011*

**Event Clusters Detection on Flickr Images using a Suffix-Tree Structure**, at IEEE International Symposium on Multimedia, *Taichung, December 2010*

LANGUAGE SKILLS *Italian*: mother-tongue  
*English*: fluent in written and spoken  
*Norwegian*: intermediate in written and spoken

AWARDS **TILab, Telecom Italia Lab**, Torino, ITALY  
*Winner of TELECOM ITALIA LAB (TLab) competition "Applications for mobile terminals" in collaboration with the University of Verona.* Jan. 2004  
The project consisted of the development of a client server system for communication between a mobile terminal (mobile phone) and some household appliances connected by a router. I developed a graphic interface on a mobile terminal through J2ME for the client part, a net among the household appliances for server part and a communication record XML that permits communication among the appliance. The system has been presented at Tlab seat in Turin and has been followed by a practical demonstration.

PROJECTS **SYNTHAIR -Improved Automation and Simulation Through AI-Based Universal Models for Synthetic Data Generation** Sept 2023 -  
**Coordinator** of the Project.  
SynthAIR's mission is to increase the level of automation of ATM system by delivering novel AI-methods for synthetic data generation. This will leverage the potential of synthetic data for tackling structural obstacles such as data access and scarcity, privacy issues and bias in the data, for accelerating the adoption of AI in ATM system  
**Funding**: 1M EUR  
**Timeline**: 2023-2025  
**Project type**: EU H2020,

**BARTIMAEUS - New Automatic Tool Replacement System with Intelligent Machine Vision Features for the Machining Industry** Nov 2021 to Dec 2023

**WP Leader** of the work package "*WP4 - AI algorithms for wear classification, estimation and RUL prediction*".

BARTIMAEUS project aims at developing a new technological solution for dealing with production bottlenecks and improving current management practices in the machining industry, namely through new advanced automation solutions.

**Funding:** 15.1M NOK

**Timeline:** 2021-2025

**Project type:** Funded from Research Council of Norway (BIA/IPN),

**RICO - Robust Intelligent Control** Apr 2022 to March 2026

**WP Leader** of the work package "*WP4 - Data-Driven Generative Model for Robust Prediction and Control*".

RICO aims to develop new and robust methods for intelligent control and methods for evaluating their robustness will be developed and evaluated in industrial settings to meet the society's and industry's standards for deployment of trustworthy AI systems in industry.

**Funding:** 12M NOK

**Timeline:** 2022-2025

**Project type:** Funded from Research Council of Norway (IKT+),

**ML4ITS - Machine Learning for Irregular Time Series** Jan 2021 to Dec 2024

**Principal Investigator** and **Coordinator** of the project.

ML4ITS aims to explore modern AI techniques for analysis of (multivariate) and irregular time series.

**Funding:** 15.6M NOK

**Timeline:** 2021-2024

**Project type:** Funded from Research Council of Norway (IKT+),

**LANDSKAPE - LandScape - Hybrid Physical-Based Deep Learning for Fast and Reliable Wind Flow Estimation** Jan 2021 to Dec 2023

**Scientific Coordinator** and **WP Leader** of the work package "*WP3 - ML Surrogate Model Definition*".

Traditional CFD methods produce high-accuracy results, but they are computationally expensive and does not work well in the design process of new prototypes in a given domain. To obtain results, it often takes several hours or days, depending on the prototype's complexity. LANDSKAPE aim to explore deep learning with the objective of creating an interactive tool for testing new designs, even when they are getting computationally hard for physical solvers. In particular, we plan to go in a similar direction and define DL-based architectures that can generate wind flows for arbitrarily shaped buildings in scenario of different complexity (city maps) with the motivation of building a surrogate model that can be used in an interactive tool for smart building assessments.

**Funding:** 4.9M NOK

**Timeline:** 2021-2023

**Project type:** Funded from Research Council of Norway (BIA/IPN),

**DATABYGG - Data-driven intelligent control of buildings** Jan 2020 to December 2023

**Project Manager** for SINTEF Digital of "*WP4 - Data Management and Analysis*".

The Databygg project focuses on predicting buildings' energy use, such as heating and cooling needs. A smart predictive building anticipates future operating conditions, adjusts control systems based on extensive data, and communicates measures to users, tenants, owners, and communities. It utilizes historical data to improve prediction models without compromising user experience, leveraging AI to foresee events and enhance thermal comfort or mitigate risks. The system learns unique energy use patterns, continuously updating them to account for changes like upgrades or renovations, thereby refining control algorithms.

**Funding:** 15M NOK

**Timeline:** 2020-2023

**Project type:** Funded from Research Council of Norway (ENERGIX),

**MAX** (Internal)

July 2017 to 2019

MAX (Machine-automated experience) project, was a cross-departmental project aiming the use of Machine Learning for automating processes in the digital customer service of VIMLA (MVNO owned by Telenor Sweden). I was leading the research part of the project mainly in the area of Deep Learning for Text Classification and Deep Active Learning for efficient data usage and collection.

**CAIM**

July 2009 to 2014

The CAIM (Context-Aware Image Retrieval and Management) project will focus on research and the development of tools for context-aware image management, where image description, query formulation, retrieval from heterogeneous distributed environments, and ranking are designed for using context information. Important application domains are those requiring image capture and multimodal retrieval in mobile environments.

**CHIL**

Sept. 2004 - Dec. 2005

The objective of this project was to create environments in which computers serve humans who focus on interacting with other humans instead of having to attend to and being preoccupied with the machines themselves.

**PEACH**

Sept. 2004 - Dec. 2005

The project objective was that of studying and experimenting with advanced technologies that can enhance cultural heritage appreciation by creating an interactive and personalized guide. The aim was that of developing and using innovative technology to provide an educational and entertaining experience fitted for each individual's background, needs and interests.

## PUBLICATIONS

Thiry, Z., Ruocco, M., Nocente, A., and Spitieris, M.,

**Enhancing Indoor Temperature Forecasting through Synthetic Data in Low-Data Environments.**

*Proceedings of SCAI'24 - The 14th Scandinavian Conference on AI*, 2024.

Aemmer, Z., Sørbo, S., Clemente, A., and Ruocco, M.,

**Generalization Strategies for Improving Bus Travel Time Prediction across Networks.**

*Journal of Urban Management*, Springer, 2024.

Clemente, A.V., Giljarhus, K.E.T., Oggiano, L., and Ruocco, M.,

**Rapid Pedestrian-Level Wind Field Prediction for Early-Stage Design using**

**Pareto-Optimized Convolutional Neural Networks.**

*Computer-Aided Civil and Infrastructure Engineering*, 2024.

Clemente, A.V., Giljarhus, K.E.T., Oggiano, L., and Ruocco, M.,

**Configurable Convolutional Neural Networks for Real-Time Pedestrian-Level Wind Prediction in Urban Environments.**

*arXiv preprint arXiv:2311.07985*, 2023.

Clemente, A.V., Nocente, A., and Ruocco, M.,

**Global Transformer Architecture for Indoor Room Temperature Forecasting.**

*Journal of Physics: Conference Series*, IOP Publishing, 2023.

Haugsdal, E., Malacarne, S., and Ruocco, M.,

**Circle Attention: Forecasting Network Traffic by Learning Interpretable Spatial Relationships from Intersecting Circles.**

*Joint European Conference on Machine Learning and Knowledge Discovery in Databases*, Springer Nature Switzerland Cham, 2023, pp. 106-121.

Aftab, S., Ramampiaro, H., Langseth, H., and Ruocco, M.,

**Deep Contextual Grid Triplet Network for Context-Aware Recommendation.**

*IEEE Access*, IEEE, 2023.

Sørbo, S., and Ruocco, M.,

**Navigating the Metric Maze: A Taxonomy of Evaluation Metrics for Anomaly Detection in Time Series.**

*Data Mining and Knowledge Discovery*, Springer US New York, 2023, pp. 1-42.

Haugsdal, E., Aune, E., and Ruocco, M.,

**Persistence Initialization: A Novel Adaptation of the Transformer Architecture for Time Series Forecasting.**

*Applied Intelligence*, Springer US New York, 2023, pp. 26781-26796.

Hoeiness, H., Gjerde, K., Oggiano, L., Giljarhus, K.E.T., and Ruocco, M.,

**Positional Encoding Augmented GAN for the Assessment of Wind Flow for Pedestrian Comfort in Urban Areas.**

*arXiv preprint arXiv:2112.08447*, 2021.

Bach, K., and Ruocco, M.,

**Nordic Artificial Intelligence Research and Development.** 2019.

Kvistad, A., Ruocco, M., de Souza da Silva, E., and Aune, E.,

**Augmented Memory Networks for Streaming-Based Active One-Shot Learning.**

*arXiv preprint arXiv:1909.01757*, 2019.

Phan, J., Ruocco, M., and Scibilia, F.,

**Dual Active Sampling on Batch-Incremental Active Learning.**

*Nordic Artificial Intelligence Research and Development: Third Symposium of the Norwegian AI Society, NAIS 2019, Trondheim, Norway, May 27-28, 2019, Proceedings*, Springer International Publishing, 2019, pp. 127-132.

Vassøy, B., Ruocco, M., de Souza da Silva, E., and Aune, E.,

**Time is of the Essence: A Joint Hierarchical RNN and Point Process Model for Time and Item Predictions.**

*Proceedings of the Twelfth ACM International Conference on Web Search and Data Mining*, 2019, pp. 591-599.



- Christensen, S., Johnsrud, S., Ruocco, M., and Ramampiaro, H.,  
**Context-Aware Sequence-to-Sequence Models for Conversational Systems.**  
*arXiv preprint arXiv:1805.08455*, 2018.
- Agarwal, B., Ramampiaro, H., Langseth, H., and Ruocco, M.,  
**A Deep Network Model for Paraphrase Detection in Short Text Messages.**  
*Information Processing and Management*, Pergamon, 2018.
- Ruocco, M., Lillestøl Skrede, O.S., and Langseth, H.,  
**Inter-Session Modeling for Session-Based Recommendation.**  
*Proceedings of the 2nd Workshop on Deep Learning for Recommender Systems*, 2017,  
pp. 24-31.
- Ruocco, M.,  
**Geo-Temporal Mining and Searching of Events from Web-Based Image Collections.**  
PhD thesis, Norwegian University of Science and Technology, Trondheim, Norway, 2014.
- Ruocco, M., and Ramampiaro, H.,  
**Geo-Temporal Distribution of Tag Terms for Event-Related Image Retrieval.**  
*Information Processing and Management*, Pergamon, 2015.
- Ruocco, M., and Ramampiaro, H.,  
**Event-Related Image Retrieval: Exploring Geographical and Temporal Distribution of User Tags.**  
*International Journal of Multimedia Information Retrieval*, Springer London, 2013.
- Ruocco, M., and Ramampiaro, H.,  
**Exploring Temporal Proximity and Spatial Distribution of Terms in Web-Based Search of Event-Related Images.**  
*Proceedings of the 24th ACM Conference on Hypertext and Social Media*, 2013, pp. 248-252.
- Ruocco, M., and Ramampiaro, H.,  
**Exploratory Analysis on Heterogeneous Tag-Point Patterns for Ranking and Extracting Hot-Spot Related Tags.**  
*Proceedings of the 5th ACM SIGSPATIAL International Workshop on Location-Based Social Networks*, 2012, pp. 16-23.
- Ruocco, M., and Ramampiaro, H.,  
**A Scalable Algorithm for Extraction and Clustering of Event-Related Pictures.**  
*Multimedia Tools and Applications*, Springer US, 2014.
- Ruocco, M.,  
**Context-Aware Image Semantic Extraction in the Social Web.**  
*Proceedings of the 21st International Conference on World Wide Web*, 2012, pp. 179-184.
- Ruocco, M., and Ramampiaro, H.,  
**Event Clusters Detection on Flickr Images using a Suffix-Tree Structure.**  
*2010 IEEE International Symposium on Multimedia*, IEEE, 2010, pp. 41-48.