

Redouane Lguensat

Postdoc Researcher

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Machine Learning for Geoscience

Research Interests

Machine Learning, Computer Vision, Signal and Image Processing, Data Assimilation, Remote Sensing

Current Position

Since 03/2020 **Postdoctoral Researcher**,
Laboratory: LOCEAN/Sorbonne Université & LSCE/CEA Saclay
Team: NEMO R&D; Science Advisor: Julie Deshayes and Venkatramani Balaji (Princeton Univ.)
Funding: 2-yrs Postdoctoral Grant (Make Our Planet Great Again)

PhD Thesis (10/2014 - 10/2017)

Topic **Learning from Ocean Remote Sensing data: from Analog methods to Deep Learning**
Institution IMT Atlantique (ex Télécom Bretagne) /Université Bretagne Loire
Supervisor Prof. Ronan Fablet
Committee

- Prof. Sylvie Thiria - Université Paris VI (Chair)
- Prof. Antonio Turiel - Institut de Ciències del Mar, Spain (Reviewer)
- Prof. Marc Bocquet - Ecole des Ponts- ParisTech (Reviewer)
- Dr. Bertrand Chapron - Ifremer
- Dr. Pierre Ailliot - Université de Bretagne Occidentale
- Dr. Clément Ubelmann - CLS

Professional Record

01 Dec 2019 – **Separation of wave/eddy processes from SSH measurements** *CNRS Postdoc researcher - MEOM team; IGE; Grenoble Alpes University, Grenoble, France*
29 Feb 2020 Numerical Models, Deep Learning, Computational physics

01 Dec 2017 – **Inversion of SWOT mission data using data-driven methods** *CNES funded Postdoc researcher - MEOM team; IGE; Grenoble Alpes University, Grenoble, France*
30 Nov 2019 Numerical Models, Deep Learning, Computational physics

01 Nov 2014 – **Data-driven interpolation of geophysical dynamics using analog methods** *PhD student - LabSTICC; IMT Atlantique; Bretagne-Loire University, Brest, France*
31 Oct 2017 Stochastic filtering, Analog methods, Data Assimilation, Deep Learning

- Apr – May 2016 **Sea Altimetry Mapping using Analog Data Assimilation** *Visiting PhD student - Ocean University of China - MIT lab*, Qingdao, China
Analog Hidden Markov Models, Sea Level Anomalies, Multi-Scale Reconstruction.
- Avr – Sep 2014 **Solving nonlinear non-convex inverse problems under sparsity constraints.** *Research intern - CEA Saclay - Cosmostat team*, Saclay, France
Convex/non-convex optimization, Sparsity, Greedy algorithms, Proximal algorithms
- Jul – Aug 2013 **Study of electric vehicles charging strategies and their impact on the smart grid** *Research intern - IRISA - OCIF team*, Rennes, France
Smart grid, Game theory, Reinforcement Learning.

Awards and Grants

- Nvidia Graphics Processing Unit (GPU) card grant through the Nvidia Developer GPU grant program
- CNES Postdoctoral grant (2yrs) to conduct research at IGE Grenoble
- EURASIP Ranked second at the "3 min thesis" competition of EUSIPCO 2016 Budapest, submitted video can be seen here <https://youtu.be/bp6m0Xf7BJY>
- "Norman Miller's Prize" Best Student Poster at IEEE/MTS OCEANS'16 Conference in Shanghai, China
- "Morocco Science Award" 2016 Delivered by the "Moroccan Scientific Community", a science communication initiative run by a team of volunteers covering different areas of expertise. The prize was given for the category "3 min thesis"

Education

- 2014–2017 **Doctor of Philosophy (PhD) in Computer Vision.** *IMT Atlantique*, Brest, France
www.imt-atlantique.fr (formerly known as Telecom Bretagne) / Thesis supervisor: Prof. Ronan Fablet
- 2011–2014 **Engineer's degree, major: Image Processing and Remote Sensing.** *IMT Atlantique*, Brest, France
- 2013–2014 **Research master degree "Sciences, Technologies, Santé", SISEA, major: Image Processing.** *Université de Rennes I*, Rennes, France
- 2011–2012 **Bachelor's degree: Mathematics.** *Université de Bretagne Occidentale*, Brest, France
- 2009–2011 **Preparatory classes for French "Grandes Ecoles"** *CPGE Mohamed V*, Casablanca, Morocco, *MPSI/MP**

Publications (H-index: 8; >200 citations; source Google Scholar)

Journal papers

Submitted

- M. Sonnewald and **R. Lguensat**. "Revealing mechanisms of change in the Atlantic Meridional Overturning Circulation under global heating", submitted to Science Advances.
- H. Frezat, G. Balarac, J. Le Sommer, R. Fablet, **R. Lguensat**. "Physical invariance in neural networks for subgrid-scale scalar flux modeling", submitted to Physical Review Fluids

Accepted

- X. Sun, M. Zhang, J. Dong, **R. Lguensat**, Y. Yang, X. Lu. "A Deep Framework for Eddy Detection and Tracking From Satellite Sea Surface Height Data" *IEEE Transactions in Geoscience and Remote Sensing*, 2019. ((JCR, IF 5.85)).
- **R. Lguensat**, Viet, P. H., Sun, M., Chen, G., Fenglin, T., Chapron, B., and Fablet, R. "Data-driven Interpolation of Sea Level Anomalies using Analog Data Assimilation." *Remote Sensing*, 2019. ((JCR, IF 4.11))
- **R. Lguensat**, P. Tandeo, P. Aillot, M. Pulido and R. Fablet, "The Analog Data Assimilation" *Monthly Weather Review*, 2017. ((JCR, IF 3.24))
- R. Fablet, P. Viet, **R. Lguensat**, P-H Horrein and B. Chapron, "Spatio-Temporal Interpolation of Cloudy SST Fields Using Conditional Analog Data Assimilation" *Remote Sensing*, 2018. ((JCR, IF 4.11))
- R. Fablet, P. Viet, and **R. Lguensat**. "Data-driven Methods for Spatio-Temporal Interpolation of Sea Surface Temperature Images". *IEEE Transactions on Computational Imaging*, 2017. ((JCR, IF 4.546))
- Y. Yang, J. Dong, X. Sun, **R. Lguensat**, M. Jian, X. Wang. "Ocean Front Detection from Instant Remote Sensing SST Images". *IEEE Geoscience and Remote Sensing Letters*, 2016 ((JCR, IF 3.53))

Conference papers

Submitted

- ...
- Accepted
- **R. Lguensat**, R. Fablet, J. Le Sommer, S. Metref, E. Cosme. K. Ouenniche, L. Drumetz, J. Gula. "Filtering Internal Tides From Wide-Swath Altimeter Data Using Convolutional Neural Networks". IGARSS 2020: IEEE International Conference on Geoscience and Remote Sensing, Hawaii, USA.
- **R. Lguensat**, W. Jones, A. Charantonis, D. Watson-Parris. "The 2020 Climate Informatics Hackathon: Generating Nighttime Satellite Imagery from Infrared Observations". Climate Informatics Conference 2020, Oxford, UK.
- Harder et al. "NightVision: Generating Nighttime Satellite Imagery from Infra-Red Observations" Climate Change AI workshop, NeurIPS 2020. Vancouver, Canada.
- **R. Lguensat**, J. Le Sommer, R. Fablet, S. Metref, E. Cosme. "Learning Generalized Quasi-Geostrophic Models Using Deep Neural Numerical Models" Machine Learning and the Physical Sciences workshop, NeurIPS 2019. Vancouver, Canada.
- H. Chergui, K. Tourki, **R. Lguensat**, M. Benjillali, C. Verikoukis, M. Debbah, "Classification Algorithms for Semi-Blind Uplink/Downlink Decoupling in sub-6 GHz/mmWave 5G Networks." IWCMC19: International Wireless Communications and Mobile Computing Conference. Tangier, Morocco.
- **R. Lguensat**, M. Sun, R. Fablet, E. Mason, P. Tandeo, G. Chen. "EddyNet: A deep neural network for the detection and classification of ocean eddies" IGARSS 2018: IEEE International Conference on Geoscience and Remote Sensing. Valencia, Spain.
- R. Fablet, P. Viet, and **R. Lguensat**. "Data-driven assimilation of irregularly-sampled image time series" ICIP 2017: IEEE International Conference on Image Processing, Beijing, China.
- **R. Lguensat**, M. Sun, G. Chen, T. Lin, R. Fablet, Spatio-Temporal Interpolation of Altimeter-Derived SSH Fields Using Analog Data Assimilation: A Case-Study In The South China Sea. IGARSS 2017 : IEEE International Geoscience and Remote Sensing Symposium, Fort Worth, Texas, USA.
- **R. Lguensat**, R. Fablet, P. Ailliot and P. Tandeo, An Exemplar-based HMM framework for nonlinear state-space models. EUSIPCO 2016 : IEEE European Signal Processing

Conference, Budapest, Hungary.

- **R. Lguensat**, P. Tandeo, P. Ailliot, B. Chaperon and R. Fablet, Using archived datasets for missing data interpolation in ocean remote sensing observation series, MTS/IEEE OCEANS'16, Shanghai, China.
- R. Fablet, P. Viet, **R. Lguensat** and B. Chapron, Exploiting ocean observation and simulation big data to improve satellite-derived geophysical products: Analog strategies. BiDS'17: Big Data from Space Conference. Toulouse, France.
- P. Tandeo, P. Ailliot, B. Chapron, **R. Lguensat** and R. Fablet, The analog data assimilation: application to 20 years of altimetric data, Climate Informatics 2015, Boulder, Colorado.
- **R. Lguensat**, P. Tandeo, R. Fablet and P. Ailliot, Non-parametric Ensemble Kalman methods for the inpainting of noisy dynamic textures. ICIIP 2015 : IEEE International Conference on Image Processing, Quebec City, Canada.
- **R. Lguensat**, P. Tandeo, R. Fablet and R. Garelo, Spatio-temporal interpolation of Sea Surface Temperature using high resolution remote sensing data, OCEANS'14, St. John's, Canada.
- S. Dimitrov, **R. Lguensat**, Reinforcement Learning Based Algorithm for the Maximization of EV Charging Station Revenue, Mathematics and Computers in Sciences and Industry (MCSI 2014), Varna, Bulgaria.

PhD thesis

- **R. Lguensat**, Learning from Ocean Remote Sensing Data. PhD dissertation, IMT Atlantique/Univ. Bretagne Loire, 2017.

Master thesis

- **R. Lguensat**, Nonlinear optimization under sparsity constraints: Algorithms for solving nonlinear inverse problems. Master SISEA, Universite de Rennes I, 2014.

Technical
Reports

- S. Rjiba, **R. Lguensat**, E. Mason, R. Fablet and J. Le Sommer. "Convolutional Neural Networks for the Segmentation of Oceanic Eddies from Altimetric Maps", 2018.

Invited conferences and workshop talks

- Invited talk: "Physical Oceanography meets Deep Learning"; Data Science for the future, a workshop of Global Science Week 2019, Grenoble, France.
- Talk on "Hybrid ocean numerical models: Physics + Deep Learning" at AI4Climate seminar, LOCEAN lab, March 2019, Paris, France.
- Talk on "Quasi-geostrophy driven Deep learning" at the LEFE/MANU AI & Ocean Atmosphere workshop, February 2019, Rennes, France.
- Talk on "EddyNet: a deep neural network for the detection and classification of oceanic eddies" at Gdr-ISIS/CNES TSI joint meeting, October 2018, Paris, France.
- Talk on "Delving Deep in the ocean with Deep Learning" at Grenoble Data Club, March 2018, Grenoble, France.
- Talk on "Analog Data Assimilation" at Stochastic Weather Generators (SWGEM), 17 May 2016, Vannes, France.
- Talk on the use of historical datasets in geophysics at a joint Seminar between the MIT Lab and Vision Lab of Ocean University of China, 19 April 2016, Qingdao, China.
- Talk on inpainting of noisy and noncomplete image sequences using Analog Ensemble Kalman methods

at the first MissData 2015 conference, 18-19 June, Rennes, France.

Teaching/Supervision

French "Qualification MdC" 2018, Section 61

- (2020) Master Data Engineering EHTP (Morocco): 4h introduction to deep neural networks + 1h30 tutorial. Materials can be found here: https://github.com/redouanelg/TeachingMaterials/tree/master/EHTP_DataEng
- (2015-2016) IMT Atlantique: 64h of supervised work/exercise class on Statistics, Probability, Digital communication theory, Image and signal processing.
- Supervision of several Master students:
 - IMT Atlantique: Hamza Ameer (2015), Mael Bompais (2016), Phi Hyunh Viet (2016), Mohamed Fannane (2017), Saifeddine Rjiba (2018)
 - Univ Grenoble Alpes: Audrey Monsimer (2019), Mickael Lalande (2019)

Spoken languages

Arabic-Amazigh	Native speaker	French	Fluent
English	Fluent	Chinese	A2 level

Participation to scientific societies, conference committees and reviewing activities.

Workshop organisation

- **Co-convener** at vEGU21. Session: "Machine learning for Earth System modelling"
- **Co-convener** at AGU'2020 fall meeting. Session: "Innovation and Exploration in Observed and Model Oceanographic Data Using Interpretable Machine Learning"
- **Data Challenge chair** at Climate Informatics'2020 <https://ci2020.web.ox.ac.uk/organizing-committee>
- **Co-convener** at EGU'20. Session: "Machine learning for Earth System modelling"
- **Data Challenge chair** at Climate Informatics'19 <https://sites.google.com/view/climateinformatics2019>
- **General chair** of the *IndabaXMorocco* 2019, a scientific workshop for Artificial Intelligence in Morocco <https://indabaXMorocco.github.io>.
- Member of the organization committee of *Data Science & Environment 2017*: IMT Atlantique, international workshop, <http://conferences.telecom-bretagne.eu/dse2017/committees/>
- Organizer of PhD students day 2015: IMT Atlantique, Signal & Communications department, <http://conferences.telecom-bretagne.eu/jdsc15>

Scientific societies

- *EURASIP* member since 2016
- *IEEE* member since 2014
- *EGU* member since 2018
- *AGU* member since 2020
- Member in several French scientific societies: Gdr-Isis, SSFAM, etc..

Reviewing
activities

- Journals: IEEE JSTARS, Proceedings A, Remote Sensing of the Environment, Journal of Atmospheric and Oceanic Technology, Mathematical Problems in Engineering
- Conferences: Climate Informatics'20/'19, IndabaXMorocco'19, INTIS'19