IA for water

A joint RAINSMORE/SWOT workshop on the use of Artificial Intelligence for time series and images processing for Hydrometeorological applications,

24th-28th of october 2022 - Fortaleza, Brasil

RAINSMORE Innovation in data and methods for rain estimation and prediction

In the framework of the international research network RAINSMORE and the SWOT NordEste project, we are happy to invite you to a 5 days workshop on the topic Artificial Intelligence (IA) applied to surface water and rainfall time series and images analysis.

The morning sessions (also available online) - 9-12 h Brasilia time (GMT-3) will be dedicated to lectures on IA and its use for time series analysis and prediction, image classification, object detection, with examples in the domain of rainfall and surface water.

The afternoon sessions (limited attendance) will be dedicated to hands on using open source IA packages (python based) and sample data sets.

Surface Water and Oceanography Topography (SWOT) Applications in the Brasilian Nord Este

Where : LABOMAR/EOLLAB (Av. da Abolição, 3207 - Meireles, **Fortaleza**)

For Whom : The workshop is aimed in priority at PhD and master level students, as well as researchers willing to learn and use IA methods.

Organizers : The workshop is co-organized by Federal University of Ceara (UFC)/Earth Observation Labomar Laboratory (EOLLAb) and GTEL (Wireless Telecommunications Research Group), and the French Institut de Recherche pour le Développement (IRD) in collaboration with Université du Littoral Côte d'Opale (LISIC lab) and Weather-Force.

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Please contact marielle.gosset@ird.fr and antonio.ferreira@ufc.br for further information

PROGRAM

MONDAY - 24/10 Introduction to rainfall/water monitoring needs and IA methods	
Morning (Lectures open to the public registered in the event via ZOOM) - EOLLAB + zoom - 9h-12h BRT (GMT-3)	Afternoon (Limited attendance: Class at the LABOMAR's Computer Laboratory) 14h-17h BRT
9h-10h - Introduction to the workshop • Context and objectives of the workshop (Dr Marielle Gosset IRD ; Pr Geraldo Fereira EOLAB ; 15') • Why and how studying Extreme rainfall, limits of usual estimation / prediction models (Dr Modeste Kacou UFHB; Dr Romulo Oliveira, IRD/HydroMatters ; 30') • Why and how studying Small Water Surface (lakes, reservoirs), satellite data and actual limits (Rafel Reis - FUNCEME ; 15') 10h-12h Introduction to IA methods • IA methods, a general overview (Pr Emilie Caillault Univ Littoral, 45'+questions) • Time series forecasting using kernel regression methods. (Pr Guillerme Barreto, UFC/DETI, 45'+questions)	Hands on - EOLLAB - Computer lab - Python installation/setup (installation, creation of virtual environments, required packages) - Regression with data visualization. - Data treatment/splitting: training, testing, and validation datasets. - Usual metrics.

TUESDAY - 25/10 - Time series analysis and prediction using IA. Application to rainfall estimation from MW links ; radar and satellite	
Morning (public) - EOLLAB + zoom -9h-12h15 BRT (GMT-3)	Afternoon (Limited attendance: Class at the LABOMAR's Computer Laboratory) 14h-17h BRT
9h-11h • Time series prediction, from time alignment to basic algorithms (Dr Kelly Grassi, Weather Force ; 45') • Times series completion algorithms used for prediction - DTWB (Pr Emilie Caillault Univ Littoral ; 45') 11h15-12h15 • Times series prediction by LSTM. Theory and example from Ceara (Pr Nícolas Araujo ; 45') • Example of problem to be solved - Rainfall time series analysis from Commercial Microwave links or sound sensors (Dr Marielle Gosset, IRD ;15')	Hands-on in Python (jupyter) EOLLAB (computer lab) a- Notebook explained / Guided tutorial by Emilie Caillault 1h Alignment. completion. prediction (kalman, DTWBI, LSTM, Random Forest) b- Application to study cases with support (Emilie CAillault, Kelly Grassi) 2h min. - Using Dataset #1 Obs: Apply algorithms to vector data (not images at this point) which will meet the nature of the data presented in the morning sessions

WEDNESDAY - 26/10 - Images classification and pattern detection using IA - 1- Supervised approach Application to water detection, reservoir monitoring - Application to Rainfall / convection tracking.	
Morning (Lectures open to the public registered in the event via ZOOM) - EOLLAB + zoom - 9h-12h15 BRT (GMT-3)	Afternoon (Limited attendance: Class at the LABOMAR's Computer Laboratory) 14h-17h BRT
9h-11h ● Detection of patterns by Deep NN, transfert learning - (Pr Nicolas Araujo, UFC/GTEL ; 45') ● Deep learning and object detection - Examples from medical applications - (Pr Manuel Sánchez-Montañés, University Valencia Spain; 45 ') 11h15-12h15 ● Training Rare Object Detection in Satellite Imagery by GAN and autoencoders (Pr Nicolas Araujo, UFC/GTEL ; 45')	Hands-on in Python (jupyter) EOLLAB (computer lab) - Supervised learning methods - Introduction to NN: MLP, Transfert Learning (deep NN) - Mention of more advanced techniques: GANs, Federated Learning, etc., but not hands-on (due to time/computing constraints). - Which dataset will be used? (small resolution!) a- Notebook explained / Guided tutorial 1-2h (data preparation and classification) b- Application to study cases with support 2h min.

THURSDAY - 27/10 - Images classification and pattern detection using IA - 2- UNSupervised approach Application to water detection, reservoir monitoring - Application to Rainfall / convection tracking.	
Morning (Lectures open to the public registered in the event via ZOOM) - EOLLAB + zoom - 9h-12h15 BRT (GMT-3)	Afternoon (Limited attendance: Class at the LABOMAR's Computer Laboratory) 14h-17h BRT
9h-10h30 ● Clustering approach : Density, Shape, Hierarchical Kernel - approaches (Pr Emilie Caillault Univ Littoral ; 45') ● MSC a multi-level spectral clustering approach to detect extreme events, unknown patterns -> (Dr Kelly Grassi, Weather Force ; 30') 11h-12h ● How to combine clustering and classification results, relevant object class (Pr Emilie Caillault Univ Littoral ; 45') ● Examples of application of unsupervised learning (Dr Kelly Grassi, Weather Force ; 30')	Hands-on in Python (jupyter) EOLLAB (computer lab) - Detect on Dataset #1 the raining period (start, end) - clustering vs explicit segmentation based on rupture/breaks a- Notebook explained / Guided tutorial 1h (clustering) b- Application to study cases with support 2h min.

FRIDAY - 27/10 - Other methods and applications **Results from hands on**	
Morning (Lectures open to the public registered in the event via ZOOM) - EOLLAB + zoom - 9h-12h15 BRT (GMT-3)	Afternoon (Limited attendance: Class at the LABOMAR's Computer Laboratory) 14h-17h BRT
9h-10h ● Semantic Segmentation of Satellite Images (DR Valdivino Alexandre de Santiago, INPE ; 45'). 10h-11h ● Results from participants (2' / 1 slide per participant) ● Discussion 11h-12h ● panel discussion / next workshop ?	EOLLAB (computer lab) ● Q&A on the exercises & practice of the week? ● Tutoring.