ARTIFICIAL INTELLIGENCE

INRIM - Anomaly detection and forecasting in time series: environmental and space applications

Funded By	I.N.RI.M. - ISTITUTO NAZIONALE DI RICERCA METROLOGICA [P.iva/CF:09261710017]
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Context of the research activity	Anomaly detection and forecasting in time series: environmental and space applications
Objectives	Time series problems arise in all areas of science, such as biology, healthcare, finance, physics and natural science. To analyze and predict the short and long term behavior of these systems, where the ordered nature of the data is essential, two main approaches based on AI have been proposed. The first approach consists in Deep learning models based on recurrent neural networks (such as the Long-Short-Term-Memory), tailored on specific tasks and used for forecasting rich, multivariate, time-series data with excellent performance (see the recent M5 competition). The second involves new foundation models, trained on a broad spectrum of generalized and unlabeled data and capable of performing a wide variety of general tasks. Examples are generative AI models, such as TimeGPT, TimeFM. All these tools promise fine-tuning for “all” data, low latency (no time-consuming data training), and easy detection of any anomaly in the signal. In this rapidly evolving scenario, the central question is: how good are these models to be able to predict and detect anomalies in real cases? Are they general enough, and robust for any kind of anomaly? Do they really outperform traditional statistical models? Here at INRIM we foresee to apply robust and validated AI tools, going beyond statistical tools, to cases where detection of anomalies, and real-time data-driven decisions are crucial: i) Atomic space clocks signals of Global Navigation Satellite Systems (GNSS) (from public repository of International GNSS Service), and ii) concentration of dissolved oxygen in seawater in relation to other environmental parameters (in collaboration with ENEA). In the former context, the anomalies can arise as phase and frequency jumps and changes in drift and variance of the clocks, which may impact the GNSS users. In the latter, the level of oxygen must remain with well defined limits to ensure the water quality for a clean, safe and healthy sea for marine life, and

	for a sustainable blue economy.

Skills and competencies for the development of the activity	Solid basics in linear algebra, probability and statistics; Good programming in Matlab and Python; Experience in data processing and analysis; General knowledge of AI tools, Machine Learning and Deep Learning; Knowledge on time series processing not required but preferred; Good working knowledge in spoken and written English. Seat of work: INRIM For more information, please contact: Gianfranco Durin Ilaria Sesia Francesca Pennecchi