39th IAHR WORLD CONGRESS GRANADA, SPAIN 2022 From Snow to Sea 19-24 June 2022

Proceedings of the 39th IAHR World Congress
19–24 June 2022, Granada, Spain
doi://10.3850/IAHR-39WC252171192022key1

KEYNOTEP

Keynote 1
Coastal Resilience in a changing climate: the CoastPredict solution

Nadia Pinardi
UN Ocean Science Decade, Bologna University Italy

Abstract

The Global Coastal Ocean concept, at the centre of CoastPredict https://www.coastpredict.org/, considers all coastal ocean regions as an interface area. In particular that area extending inshore from the estuarine mouths to river and urban settlements and offshore from the surf zone to the continental shelf and slope where waters of continental origins meet open ocean currents.

Atmosphere, land, ice, hydrology, coastal ecosystems, open ocean and humans interact on a multiplicity of space and time scales that need to be resolved with proper scientific methods and consideration of uncertainties. This concept helps to design solutions for a healthy and safe ocean and achieve many of the targets of the Sustainable Development Goals, as well as increasing coastal resilience for the human population and the ecosystems.

The key science paradigm is to concentrate the attention on the prediction issues requiring an integrated approach of observing and modelling that will allow to improve our understanding, test theories and hypothesis, reduce uncertainties from events to the climate time scales. CoastPredict is part of the Global Ocean Observing System (GOOS) strategy to design and implement a permanent global system for observations, modelling and analysis of marine and ocean variables to support operational ocean services worldwide. GOOS and CoastPredict will provide: 1) accurate descriptions of the present state of the coastal oceans; 2) continuous forecasts of the future coastal ocean conditions as far ahead as possible; 3) the basis for predictions of climate change impacts on the coasts.

Keywords: CoastPredict, Coastal Resilience, Climate.

Biography

Nadia PINARDI holds a Ph.D. in Applied Physics from Harvard University, and she is full professor of Oceanography at Bologna University. Her interests range from ocean numerical modelling and predictions to data assimilation, numerical modelling of the marine physical-biological interactions and pollutants at sea. She has written more than hundred and sixty papers in peer reviewed journals on a wide range of subjects. The last topic of her research is the understanding of uncertainties in ensemble forecasting, oil spill numerical modelling coupled to operational oceanographic forecasts and the analysis of climate indices in the Mediterranean Sea, such the Mediterranean Sea Overturning Circulation index.

She has been the director of the National Group of Operational Oceanography of the National Institute of Geophysics and Vulcanology from 2004 to 2013. She has been Member of the European Space Agency Space Advisory Group, of the European Environment Agency Scientific Advisory Committee and of the European Research Council for Earth Sciences.

From 2012 to 2019 she was co-president of the Joint Committee for Oceanography and Marine Meteorology (JCOMM) of UNESCO-IOC and WMO and she is, since 2019, vice-president of the Commission for Observation, Infrastructure and Information Systems (Infrastructure Commission) of WMO.

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Keynote 2
Water Challenges in Spain

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Director General for Water, Ministry for the Ecological Transition and Demographic Challenge, Spain

Abstract

Spain's climate and hydrological variability together with expected climate change scenarios requires us to improve our response and adaptation capacity to achieve greater water security. It is necessary to address the multiple challenges in water management in a gradual and coordinated manner, in the context of the important social, environmental and institutional transformations that have occurred in recent years.

Such a response complies with Spain's aim to change our economy towards a production model focused on the protection of people and the environment, in line with EU's Green Deal, jointly working towards achieving closer coordination with relevan administrations in water supply and sanitation as well as in agriculture and livestock.

Biography

Teodoro Estrela is a doctor and engineer of Roads, Canals, and Ports from the Polytechnic University of Valencia and has served as a civil servant of the General State Administration since 1989. Prior to his appointment as the new general director for water he worked at the CEDEX Hydrographic Studies Centre, where he was technical-scientific coordinator of the Hydrology Area and collaborated with the European Environment Agency as a member of the European Topic Centre for Inland Waters. In the Júcar Hydrographic Confederation he has held the positions of deputy director and head of the Hydrological Planning Office.

He has also served as deputy general director of Planning and Sustainable Use of Water of the Ministry of the Environment, and this work within the water administration has provided him with the opportunity to serve in academia, since 2005, as an associate professor at the

Polytechnic University of Valencia, where he has directed five doctoral theses and published numerous articles in scientific journals. He has also served as permanent technical secretary of the Mediterranean Network of Basin Organisations and recently as president of the Water Committee of the World Council of Civil Engineers.

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doi://10.3850/IAHR-39WC252171192022key3

Keynote 3
Machine Learning for Scientific Discovery, with Examples in Fluid Mechanics

Steven L. Brunton
University of Washington, USA

Abstract

Donald R. F. Harleman Lectureship

This work describes how machine learning may be used to develop accurate and efficient nonlinear dynamical systems models for complex natural and engineered systems. We explore the sparse identification of nonlinear dynamics (SINDy) algorithm, which identifies a minimal dynamical system model that balances model complexity with accuracy, avoiding overfitting. This approach tends to promote models that are interpretable and generalizable, capturing the essential "physics" of the system. We also discuss the importance of learning effective coordinate systems in which the dynamics may be expected to be sparse. This sparse modeling approach will be demonstrated on a range of challenging modeling problems in fluid dynamics, and we will discuss how to incorporate these models into existing model-based control efforts. Because fluid dynamics is central to energy, transportation, health, and defense systems, we will emphasize the importance of machine learning solutions that are interpretable, explainable, generalizable, and that respect known physics.

Biography

Dr. Steven L. Brunton is a Professor of Mechanical Engineering at the University of Washington. He is also Adjunct Professor of Applied Mathematics and Computer science, and a Data Science Fellow at the eScience Institute. Steve received the B.S. in mathematics from Caltech in 2006 and the Ph.D. in mechanical and aerospace engineering from Princeton in 2012. His research combines machine learning

with dynamical systems to model and control systems in fluid dynamics, biolocomotion, optics, energy systems, and manufacturing. He is a co-author of three textbooks, received the University of Washington College of Engineering junior faculty and teaching awards, the Army and Air Force Young Investigator Program (YIP) awards, and the Presidential Early Career Award for Scientists and Engineers (PECASE).

