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Artificial/Natural Intelligence and Fluid Mechanics: Alloys

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ABSTRACT:

Over the last last thirty years we have experienced more than a billion-fold increase in hardware capabilities and a dizzying pace of acquiring and transmitting massive amounts of data. Artificial Intelligence (AI) has been the beneficiaries of these advances and today it is increasingly embedded in technologies that touch every aspect of humanity. However along with the abundance of promise there is an ever increasing amount of hype, in particular regarding the capabilities of learning algorithms to model, predict and control complex fluid mechanics problems.

In this talk I would offer a perspective on forming alloys of AI and simulations for the prediction and control of complex flow systems. I will present novel algorithms for learning the Effective Dynamics (LED) of complex flows and a fusion of multi-agent reinforcement learning and scientific computing (SciMARL) for modeling and control of complex flow-structure interactions. I will juxtapose successes and failures and argue that the proper fusion of fluid mechanics knowledge and AI expertise are essential to advance scientific frontiers.

BIOGRAPHY:

Petros Koumoutsakos is Herbert S. Winokur, Jr. Professor of Engineering and Applied Sciences, Faculty Director of the Institute for Applied Computational Science (IACS) and Department Chair of Applied Mathematics at Harvard John A. Paulson School of Engineering and Applied Sciences (SEAS). He studied Naval Architecture (Diploma-NTU of Athens, M.Eng.-U. of Michigan), Aeronautics and Applied Mathematics (PhD-Caltech) and has served as the Chair of Computational Science at ETH Zurich (1997-2020). Petros is elected Fellow of the American Society of Mechanical Engineers (ASME), the American Physical Society (APS), the Society of Industrial and Applied Mathematics (SIAM). He is recipient of the Advanced Investigator Award by the European Research Council and the ACM Gordon Bell prize in Supercomputing. He is elected International Member to the US National Academy of Engineering (NAE). His research interests are on the fundamentals and applications of computing and artificial intelligence to understand, predict and optimize fluid flows in engineering, nanotechnology, and medicine.