

The amazing simulation powers of particles and what we can/not do with them

Petros Koumoutsakos*

* ETH Zurich
Switzerland
e-mail: petros@ethz.ch

ABSTRACT

Particles are used to simulate phenomena spanning twenty orders of magnitude, from the folding of proteins to the formation of our universe. I distinguish particle methods for the discretisation of continuum conservation laws and particle models of complex systems. In this talk, I will emphasize the need for controlling the accuracy of continuum particle methods and demonstrate how particle remeshing allows for a seamless integration of grids and particles. I will also discuss the need for data driven, uncertainty quantification of particle models. I will provide examples from the capabilities and challenges for particle methods through flow simulations in massively parallel computing architectures, ranging from fish swimming and cavitation to cell sorting in microfluidic channels.