VIDEO ARTICLE

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# A 6M Digital Twin for Reservoir Engineering

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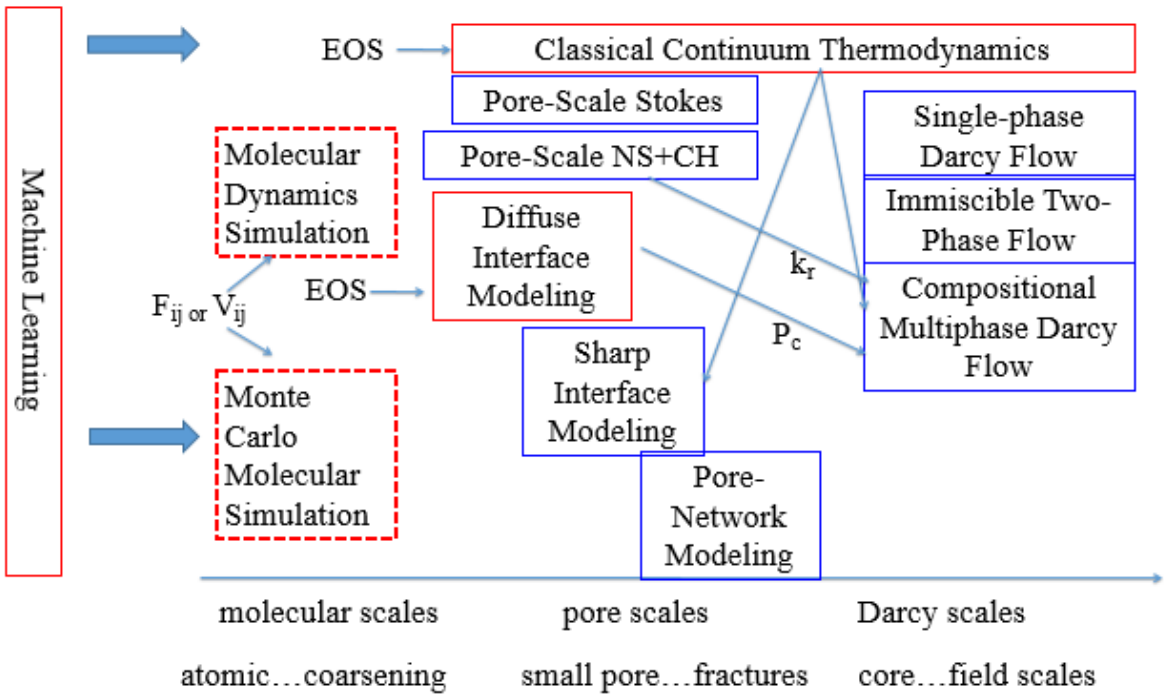
## Graphical Abstract




## Abstract

Modelling and simulation of flow, transport and geo-mechanics in the subsurface porous media is an effective approach to help make decisions associated with the management of subsurface oil and gas reservoirs, as well as in other wide application areas including groundwater contamination and carbon sequestration. Accurate modelling and efficient, robust simulation have always been the main purposes of reservoir researches, and a 6M digital twin (multi-scale, multi-domain, multi-physics and multi-numerics numerical modelling and simulation of multi-component and multi-phase fluid flow in porous media) is designed in this work, using certain advanced models and algorithms equipped with pronounced features, to better digitally model and simulate the engineering processes and procedures in the physical reality of reservoirs and further control and optimize such processes and procedures. A comprehensive mathematical tool package is generated in the digital space, equipped with advanced models and algorithms regarding various numerical schemes including Navier-Stokes equations, LBM formulations and Darcy equation. Deep learning algorithms are incorporated in the

digital space to accelerate certain time-consuming computations, for example, flash calculation and geological feature detection. A number of engineering processes are successfully reflected in the digital twin, in multiple simulation scales including in a single pore, in a porous media and in a pipeline/separator, to provide plenty of feedback to the physical entity of the industry. Finally, a complete digital twin with the 6M properties is concluded and certain promising extensions from our digital twin is organized and we remark on the future developments.

**Keywords:** Digital twin, reservoir simulation, multi-phase flow.

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## Reference

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## Biography of Presenting Author

**Tao Zhang** is currently a postdoctoral fellow and research assistant in King Abdullah University of Science and Technology, Saudi Arabia. Accurate modeling and efficient, robust simulation for reservoir fluids have always been the main focuses of Tao's research and a rich output is recognized with numerous publications and citations. Tao stands for one of the first steps into the application of deep learning algorithm in petroleum industry. His publications on accelerating multi-component flash calculation using optimized deep neural networks enabled the establishment of fast, accurate and robust phase equilibrium calculation schemes for general reservoir fluids, and he is currently working on establishing a thermodynamics-informed neural network for general engineering purposes. Very recently, Tao led an international research group carrying out a thorough and comprehensive review on Space Energy to explore the potential development of energy resources in the outer space with the advanced technologies developed in geo-energy. Until January 2022, Tao has published 15 journal papers as the first author, 14 as the co-author, 5 conference proceedings paper and 1 U.S. patent as the 2$^{nd}$ contributor. The total citation on google scholar is 339 with h-index as 12. He has been awarded the China National Scholarship, the best paper award in the 8$^{th}$ Asian Symposium on Computational Heat Transfer and Fluid Flow (ASCHT), the 16$^{th}$ Chinese National Annual Conference on Fluid Mechanics in Porous Media and the best poster award in the 1$^{st}$ InterPore Saudi Chapter Annual Meeting. In 2020, per nominated and invited, Tao published a book with Elsevier and Gulf Publishing, "Reservoir Simulations: Machine Learning and Modeling", which has won a good reputation. Tao is also an active organizer in a number of special issues, minisymposiums and workshops.

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