Quantum Computing Enhanced Data-Driven Computational Mechanics for Composite Structures

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Abstract

By passing constitutive modeling, the distance-minimizing data-driven computational mechanics has its potential in the modeling and simulation of advanced composite materials and structures. However, the numerous distance calculations between constitutive database and conservation law are extremely heavy in high-dimensional cases, and often consume most of the computational resources. Here, we propose a quantum computing enhanced data-driven framework, where the distance calculation tasks are assigned to a quantum computer. Compared to the classical computing, the use of quantum computing allows to achieve an exponential reduction in computational complexity. This framework has been validated not only on a quantum simulator but also on a real superconducting quantum computer. Furthermore, to address the quantum hardware noise issue, an error mitigation technique is implemented to improve the accuracy of quantum computing. We believe this work represents a promising step towards using the power of quantum computing in the field of composite materials and structures.