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PROCEEDINGS

Quantum Computing in Computational Mechanics: A New Frontier for Finite Element Method

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ABSTRACT

This study heralds a new era in computational mechanics through the integration of Quantum Computing with the Finite Element Method (FEM), representing a quantum leap forward in addressing complex engineering simulations. Our approach utilizes Variational Quantum Algorithms (VQAs) to tackle challenges that have been traditionally well-solved on classical computers yet pose significant obstacles in the quantum computing domain. This innovation not only surmounts these challenges but also extends the applicability of quantum computing to real-world engineering problems, moving beyond mere conceptual demonstrations of quantum computing in numerical methods. The development of a novel strategy for implementing general boundary conditions within the quantum framework is a key aspect of this research. This advancement is crucial in engineering applications where boundary conditions are essential. Moreover, our method's adaptability to diverse geometries and material properties, along with its scalability and precision in handling boundary conditions, positions it as a powerful tool for complex engineering challenges. The successful application of quantum computing to advanced simulations in this study marks a significant milestone, reshaping the approach to computational mechanics through a quantum lens without compromising accuracy, and paving the way for future innovations in quantum computing applications in engineering.

KEYWORDS

Quantum computing; Variational Quantum Algorithm; Finite Element Method; Euler–Bernoulli beam; boundary conditions

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