

Quantum Computing for laminates optimization – stacking sequence retrieval

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ABSTRACT

With the growing scale and maturity of Quantum Computing (QC), research on the application of QC algorithms for structural problems is gaining momentum. In this talk, the author presents recent works of the QAIMS team on the applications of various QC and quantum-inspired algorithms on structural optimization problems, with particular focus on the stacking sequence retrieval problem which is a key step in the laminates optimization problem. To transform the stacking sequence retrieval problem into a quantum optimization problem, the laminate is represented as a quantum system, where each ply is represented by a few qubits, the number of which depends on the choices of fibre angles per ply. The stacking sequences of the laminate are mapped into quantum state vectors. The objective function and manufacturing constraints are represented as the Hamiltonian of the quantum system. The optimal stacking sequence solution is then embedded in the minimum eigenstate of the Hamiltonian, which can be solved by several QC and quantum-inspired algorithms such as Variational Quantum Algorithms and DMRG. It is found that DMRG, an algorithm predominantly used by physicists but not so much by engineers yet, already offers competitive performance against well-known classical algorithms such as Genetic Algorithm on large-scale problems [1].

REFERENCES

- [1] Wulff A., Chen B.*, Steinberg M., Tang Y., Möller M., Feld S., *Quantum Computing and Tensor Networks for Laminate Design: A Novel Approach to Stacking Sequence Retrieval*, Computer Methods in Applied Mechanics and Engineering, Vol. 432, pp. 117380, 2024.