

Towards Quantum Computational Mechanics



Lecture of

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The emergence of quantum computers, operating on entirely different physical principles and abstractions than classical digital computers, heralds a new era in computing with transformative improvements in performance. Despite this, the application of quantum computing to computational mechanics remains largely unexplored. In this seminar, I will demonstrate how quantum computing can solve representative volume element (RVE) problems in computational homogenisation with polylogarithmic complexity of $O((\log N)^c)$, compared to $O(N^c)$ in classical computing. The proposed quantum RVE solver combines conventional algorithms, such as a fixed-point iteration for a homogeneous reference material and the Fast Fourier Transform (FFT). I will discuss several techniques we employ or develop, including the Quantum Fourier Transform (QFT), quantum encoding of polynomials, classical piecewise Chebyshev approximation of functions and an algorithm for implementing the fixed-point iteration. Our results confirm that an exponential speedup in solving RVE problems on quantum computers is indeed possible.