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A Quantum Algorithm for Modeling of Reactant Conversion Rate in Homogeneous Turbulence[1] GUANGLEI XU, ANDREW DALEY, Department of Physics and SUPA, University of Strathclyde, PEYMAN GIVI, Mechanical Engineering and Petroleum Engineering, University of Pittsburgh, ROLANDO SOMMA, Theoretical Division, Los Alamos National Laboratory — Developments in quantum computing techniques have the potential to revolutionise a range of computational subjects. With significant progress in the construction of necessary quantum hardware, it is important to identify possible applications in a wide range of fields. Turbulent reactive flows have been the subject of significant computational investigations. In particular, probability density function (PDF) methods simulated via Monte Carlo (MC) methods have been widely used for modeling and simulation of these flows. However, the cost of such computation in high precision parameter estimations can be enormous and problematic. We have developed a quantum algorithm for reacting flow simulations with a quadratic speed-up over classical MC methods in terms of the number of repetitions required to reach a certain accuracy. We analyze our algorithm as it would apply to simulate the limiting rate of reactant conversion rate in homogeneous turbulence via a transported PDF model. By computing statistical error scaling, we identify regimes in which our quantum algorithm would outperform MC methods. This is a starting point for identifying further applications of quantum algorithms in turbulent combustion, and to analyze the hardware requirements for applications in this area of science.

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