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Genetic braid optimization for topological quantum computation
R.B. MCDONALD, Department of Physics & Astronomy, Texas A&M University, H.G. KATZGRABER, Department of Physics & Astronomy, Texas A&M University, Department of Physics, ETH Zurich — In topologically-protected quantum computation quantum gates can be carried out by adiabatically braiding quasiparticles in two space dimensions, reminiscent of entangled world lines. Bonesteel *et al.* [Phys. Rev. Lett. **95**, 140503 (2005)] showed recently how to find braids that yield a universal set of quantum gates. Mathematically, the problem of executing a gate becomes that of finding a product of the matrices in that set that approximates the gate, up to an error. To date efficient methods to compute these gates only strive to optimize for accuracy. We explore the possibility of using evolutionary (genetic) algorithms to efficiently find optimal braids while allowing the user to optimize for the relative utilities of accuracy and length. Furthermore, when optimizing for error only, the method can efficiently produce braids of error $\sim 10^{-6}$ outperforming brute force approaches.

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