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Quantum annealing algorithms for track pattern recognition

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The pattern recognition of the trajectories of charged particles is at the core of the computing challenge for the HL-LHC, which is currently the center of a very active area of research. There has also been rapid progress in the development of quantum computers, including the D-Wave quantum annealer. In this talk we will discuss results from our project investigating the use of annealing algorithms for pattern recognition. We will present results we achieved expressing pattern recognition as a Quadratic Unconstrained Binary Optimization (QUBO) that can be solved using a D-Wave Quantum Annealer. We generated QUBOs that encode the pattern recognition problem at the LHC on the TrackML dataset, and we solved them using D-Wave qbsolv hybrid optimizer. These achieved a performance exceeding 99% for purity, efficiency, and for the TrackML score at low track multiplicities. We will discuss how the algorithm performs at track multiplicities expected at the HL-LHC. We will also report on early results comparing digital annealers to quantum annealers. We will also discuss results from the application of annealing algorithms to resolve between tracks in the dense cores of jets, and possible improvement of the annealing algorithm in a new workflow with a quantum/classical hybrid optimizer. We will conclude with future perspectives on using annealing-based algorithms for pattern recognition in high-energy physics experiments.

Consider for promotion

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