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Computation of Jones polynomial with replica exchange Monte Carlo algorithm

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Jones polynomial is a kind of knot invariants. It is known that the computation of this polynomial belongs to the complexity class NP. Thus it is regarded to be difficult to compute this quantity by deterministic computation. And, the algorithm according to measurement based quantum computation is known.

On the other hand, to Jones polynomial, correspondence between classical statistical mechanics model is known. Classical statistical mechanics models are the targets that the numerical efficient sampling method is extensively researched.

Thus, we calculate the Jones polynomial by computing the density state distribution using multiple histogram reweighting method and replica exchange Monte Carlo method. Then, through the convergence of the error rate, we compare the computational performance of quantum and classical algorithm.