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【551】Universal quantum circuits for transforming unitary operations: Exponential advantages with adaptive strategies and the power of indefinite causality

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Given a quantum gate implementing a unitary operation U without any specific description but its dimension, we present a universal quantum circuit that implements its inverse by making k uses of the given operation. We consider probabilistic and deterministic scenarios, in both cases, the performance exponentially approaches to a perfect implementation. The protocols employ an adaptive strategy, proven necessary for the exponential performance. Additionally, we discuss the power and limitations of indefinite causality by analysing the performance of processes where the use of the input-gates does not necessarily respect a definite causal order, a better performance may be obtained.

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