

Exact Model reduction for Quantum Walks and Open Systems

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When we aim to accurately simulate the behaviour of complex and networked dynamical systems, the problem of finding simpler representations for the model of interest becomes critical. We focus on completely-positive dynamics, which can be used to describe a wide variety of relevant systems for quantum and classical information, including quantum walks and open systems, as well as classical hidden-Markov models (HMM). For these models, a reduction approach is derived that leverages information on initial conditions and outputs of interests to obtain reduced models whose output matches the one of the target system while, if needed, maintaining the key characteristics of the original model. In doing this, we highlight the minimal memory resources needed to perfectly simulate a given process, probe its “quantum-ness”, and tackle an old open problem for HMM.

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