Generalizing the framework of Dominy-Shabani-Lidar for the reduced dynamics

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Abstract

Consider an open quantum system S, interacting with its environment E. Whether the reduced dynamics of the system S can be given by a linear map, or not, is an important subject, in the theory of open quantum systems. Dominy, Shabani and Lidar have proposed a general framework for linear Hermitian reduced dynamics. They have considered the case that both the system S and the environment E are finite dimensional. Their framework can be generalized to include the case that the environment is infinite dimensional too. In this paper, after demonstrating this generalization, we discuss the role of the convexity of the set $\boldsymbol{S} = \{\rho_{SE}\}$, of possible initial states of the system-environment, in their framework. Next, we give a proof for the existence of the operator sum representation, for arbitrary linear Hermitian map. This proof enables us to prove the Choi-Jamiołkowski and the Jamiołkowski isomorphisms, straightforwardly.

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