OPTIMIZING QUANTUM TRANSPORT VIA THE QUANTUM DOOB TRANSFORM

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Quantum transport plays a central role in both fundamental physics and the development of quantum technologies. While significant progress has been made in understanding transport phenomena in quantum systems, methods for optimizing transport properties remain limited, particularly in complex quantum networks. Building on recent advances in classical network optimization via the generalized Doob transform, we introduce a novel method that extends this approach to quantum networks. Our framework leverages a single diagonalization of the system generator to efficiently tailor both the Hamiltonian and dissipative contributions, optimizing transport observables such as currents and activities. We demonstrate the method's effectiveness through extensive numerical explorations, showing that optimal performance arises from non-trivial modifications to both coherent and incoherent dynamics. We also assess the robustness of the optimization under constraints that preserve specific physical features, such as fixed dissipative structures and input-output interactions. Finally, we discuss the connection between optimized transport and centrosymmetry, highlighting the relevance of this property for enhanced transport efficiency in quantum systems.

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[1] D. Esteve, C. Pérez-Espigares, R. Gutiérrez, and D. Manzano, *Optimizing quantum transport via the quantum Doob transform*, arXiv:2508.04622 (2025).