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Measuring the distance between unitary propagators of quantum systems of differing dimensions MATTHEW GRACE, Thermal/Fluids Science & Engineering Department, Sandia National Laboratories, JASON DOMINY, Program in Applied & Computational Mathematics, Princeton University, ROBERT KOSUT, SC Solutions, Inc., CONSTANTIN BRIF, HERSCHEL RABITZ, Department of Chemistry, Princeton University — In this work, we develop a general distance measure that evaluates the distance between unitary quantum operations of differing dimensions which is (i) independent of the initial state of the system, (ii) straightforward to numerically calculate, and, most importantly, (iii) designed to directly evaluate quantum operations resulting from open-system dynamics. This measure is a natural extension of distance and corresponding fidelity measures employed in previous works that construct closed-system unitary operations. The properties of this measure are desirable for the calculation of distance, e.g., optimal control applied to open systems for quantum information processing, and enable a consistent comparison of quantum operations resulting from both closed- and open-system dynamics. As a numerical example, this distance measure is used to evaluate the fidelity of quantum operations resulting from the optimal control of one- and two-qubit unitary operations in the presence of a decohering environment. This example illustrates the utility of this measure for use in designing unitary quantum operations from open-system dynamics.

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