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Probability Distributions for Random Quantum Operations[1]
KEVIN SCHULTZ, Johns Hopkins University Applied Physics Lab — Motivated by uncertainty quantification and inference of quantum information systems, in this work we draw connections between the notions of random quantum states and operations in quantum information with probability distributions commonly encountered in the field of orientation statistics. This approach identifies natural sample spaces and probability distributions upon these spaces that can be used in the analysis, simulation, and inference of quantum information systems. The theory of exponential families on Stiefel manifolds provides the appropriate generalization to the classical case. Furthermore, this viewpoint motivates a number of additional questions into the convex geometry of quantum operations relative to both the differential geometry of Stiefel manifolds as well as the information geometry of exponential families defined upon them. In particular, we draw on results from convex geometry to characterize which quantum operations can be represented as the average of a random quantum operation.

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