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Optimal Estimation of Single Qubit Quantum Evolution Parameters DAVID COLLINS, Physical and Environmental Sciences Department, Mesa State College, MICHAEL FREY, Department of Mathematics, Bucknell University — The evolution of a quantum system can depends on one or more parameters. The process for determining these requires subjecting a quantum system to the evolution, performing a measurement and attempting to infer the parameter from the measurement outcome. Quantum estimation deals with this task where a finite number of copies of the quantum system are available. We consider rotations of a spin-1/2 particle about a fixed axis and which are parameterized by a rotation angle, which is to be estimated. We use the quantum Fisher information to establish optimal bounds on the variance in any estimator of this parameter in scenarios involving one use of the rotation upon each of a collection of spin-1/2 particles. We show that optimal estimation occurs when all spin-1/2 particles are entangled and present exact analytical results for the bound that is generated and the required input state. We show that this offers a significant advantage over the use of unentangled states and describe the accuracy of estimation for various possible entangled input states.

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