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Error mitigation in the control of quantum spin systems subject to environmental noise: A quaternion-based path-integral formulation RAFAEL HIPOLITO, PAUL GOLDBART, Georgia Institute of Technology — We address the task of controlling a quantum system, i.e., giving it a predetermined unitary evolution via control fields that are subject to limitations. This task is complicated by the challenge of truly isolating a quantum system from environmental effects; hence, the need to mitigate the impact of noise. We consider the case of a spin system coupled to an environment that is not necessarily in equilibrium. We develop a path-integral formulation based on an action that features degrees of freedom expressed in terms of quaternions and effective interactions determined by correlators that characterize the environment. We compare this quaternion-based description with more conventional approaches, and show that quaternions yield distinct, not solely æsthetic, advantages. For example, the quaternion formulation does not suffer from the phenomenon of 'gimbal lock', a phenomenon that can create difficulties for numerical schemes.

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