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The Design of Control Pulses for Heisenberg Always-On Qubit Models RUDOLPH MAGYAR, Sandia National Laboratories — One model for a universal quantum computer is a spin array with constant nearest neighbor interactions and a controlled unidirectional site-specific magnetic field to generate unitary transformations. This system can be described by a Heisenberg spin Hamiltonian and can be simulated for on the order of 50 spins. It has recently been shown that time-dependent density functional inspired methods may be used to relate various spin models of qubits to ones that may be easier to compute numerically allowing potentially the efficient simulation of greater numbers of spins. One of the challenges of such an agenda is the identification of control pulses that produce desired gate operations (CNOT and single qubit phase gates). We apply control theory to design a universal set of pulses for a Heisenberg always-on model Hamiltonian for a few qubits and compare to known pulses when available. We suggest how this approach may be useful to design control pulses in other realistic designs. Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Security Administration under contract DE-AC04-94AL85000.

Rudolph Magyar
Sandia National Laboratories

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