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Classical Emulation of a 2-Qubit Quantum Computer Using Analog Voltage signals MICHAEL STARKEY, BRIAN LACOUR, COREY OSTROVE, GARY WILSON, GRANVILLE OTT, UT Applied Research Laboratory — The Hilbert space mathematical structure of a gate-based quantum computer may be reproduced by mapping the computational basis states to corresponding functions in the space of complex exponentials and identifying an L^2-inner product between any two such functions. The span of these complex basis exponentials is then identified with the finite dimensional Hilbert space of the quantum computer. By using classical analog electronic components, such as four-quadrant multipliers and operational amplifiers, voltage signals representing arbitrary four-dimensional quantum states, along with the equivalent gate and measurement operations of a quantum computer have been physically realized through the corresponding circuitry. The fidelity of the emulation is measured using both a direct evaluation of the signal as well as through an emulation of quantum state tomography to infer the quantum state. For both state synthesis and gate operations, our quantum emulation device is capable of achieving over 99% fidelity.

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