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Characterization of Qudit Entanglement Through the Visualization of Spin-Coherent-State Wigner Functions TODD TILMA, Tokyo Institute of Technology, MARK EVERITT, Loughborough University, KAE NEMOTO, National Institute of Informatics, WILLIAM MUNRO, NTT Basic Research Labs — The purpose of our research is to determine whether or not there is a general relationship between the degree of entanglement and the total amount of negativity in the Wigner function of various combinations of finite-dimensional quantum states. Specifically, by using the Stratonovich-Weyl correspondence we can take the density matrix of a known, finite-dimensional quantum state (hereafter known as a "qudit") and generate its corresponding, finite-dimensional Wigner function. This Wigner function reproduces the qudit density matrix through a known volume integral. By doing the same volume integral, but with the absolute value of the Wigner function as the kernel, we get a measure of the total amount of negativity of the Wigner function instead of reproducing the density matrix. Our question is thus, is this "negative volume" equivalent to the amount of entanglement in the initial qudit state? Our results for general two-qubit states have confirmed a monotonic relationship between concurrence and this negative volume for specific cases. By analyzing the various Wigner functions of three and more qubits, as well as qubit-qutrit Wigner functions we hope to build a consensus on whether or not the negativity in the Wigner function is a measure of, or witness to, entanglement.

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