

An Introduction To Dense Coding Theory

In quantum information theory dense coding refers to Alice sending Bob messages taking advantage of the fact that each of them possesses a qudit (a quantum system whose wave function lies in a d -dimensional Hilbert space) whose quantum states are described by an entangled two-qudit wave function. The problem, on which progress has been made but on which a number of questions still are open, is to predict the maximum number of distinguishable messages Alice can send Bob via unitary operations on her qudit (but not on Bob's, which is not available to her) as a function of parameters characterizing the entanglement, the so-called Schmidt coefficients. I will review past results and then describe (without going into full details because the algebra is messy) a theorem proved recently by myself and a colleague (Paul Bourdon at Washington and Lee University), concerning the circumstances when it is possible for Alice to send $d^2 - 1$ messages. The discussion will be restricted to so-called deterministic dense coding theory (DDCT), the most important branch of dense coding theory, wherein Bob is supposed to be able to receive and distinguish Alice's messages with 100% probability of success. The talk is addressed to, and should be understandable by, persons who are not well acquainted with quantum theory.