Optimal Power Control in Interference Limited Fading Wireless Channels with Outage Probability Specifications

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We propose a new method of power control for interference limited wireless networks with Rayleigh fading of both the desired and interference signals. Our method explicitly takes into account the statistical variation of both the received signal and interference power, and optimally allocates power subject to constraints on the probability of fading induced outage for each transmitter/receiver pair. We establish several results for this type of problem. For the case in which the only constraints are those on the outage probabilities, we give a fast iterative method for finding the optimal power allocation. We establish tight bounds that relate the outage probability to an easily computed signal-to-interference margin, when statistical variation of the signal and interference powers are ignored. This allows us to show that well-known methods for allocating power, based on Perron-Frobenius eigenvalue theory, can be used to determine power allocations that are provably close to achieving optimal (*i.e.*, minimal) outage probability. In the most general case, which includes bounds on powers and other constraints, we show that the power control problem can be posed as a geometric program, which is a special type of optimization problem that can be transformed to a nonlinear convex optimization by a change of variables, and therefore solved globally and efficiently by recently developed interior-point methods.