On Adaptive Power Control for Energy Harvesting Communication Over Markov Fading Channels

Abstract:

We study a continuous-time power policy to maximize the ergodic channel throughput of an energy harvesting transmitter over a Markov fading channel. In particular, we consider transmission power policies that are adapted to the fading process of the channel as well as the storage process of the battery. We obtain a set of equations that determine the probability density of the energy in the battery at each channel state. Specifically, for an ergodic battery storage process, these equations describe the relation between the probability density of stored energy and the transmission power at each channel state. From these equations, we derive an upper bound on the average transmission power and an upper bound on the average transmission rate. To compute a lower bound on the average transmission rate, we apply a calculus of variations technique to a non-linear throughput maximization problem. As a result, we obtain a system of coupled ordinary differential equations for locally optimal power policies. We then focus on the Gilbert-Elliot channel as a special case and derive some structural results for specific classes of fast and slow fading channels. Furthermore, we numerically find a locally optimal transmission power policy for the two channel state scenario.