Optimal Sensing in Cognitive Radio Networks

M. Santhoshkumar (EDM15D001)

Dept of Electronics and Communication Engineering

Indian Institute of Information Technology,

Design and Manufacturing, Kancheepuram

Abstract

We consider a Cognitive Radio Network having one Primary User (PU) and N Secondary Users (SUs). We describe the problem of joint channel–sensing and channel–access for SUs. When the channel is in use by the PU, the signal that the PU sends and the channel fading gains are unknown to SUs. *The channel sensing problem that we consider is detecting whether or not there is an unknown signal (with random fading) in noise.* For this channel–sensing problem, we propose a sequential detection procedure based on the energy of samples that each SU observes. As soon as an SU detects the *idle/busy* state of the channel, it broadcasts it's local decision to all other SUs. We propose a global decision rule that makes a decision that the channel is *idle*, only if at least Γ out of N SUs have broadcast *idle* local decisions; otherwise, the global decision rule makes a decision that the channel is *busy*. Also, the channel access is provided to the SU that is the first one to broadcast an *idle* decision. From the Receiver Operating Characteristic (ROC), and the average sample number (ASN) metrics, we observe that our energy based sequential sensing procedure yields a better probability of detection than the known SPRT procedure for a given probability of false–alarm.

We also consider the problem of optimal sensing in a cognitive radio network which has N primary users (PUs) and one secondary user (SU). Our objective is to maximize the throughput that the SU gets for a given budget on the sensing energy. We consider a time-slotted system and the activity of each PU follows a two state (idle and busy) discrete time Markov chain. At the beginning of each time-slot, the SU senses channels in an optimal sensing order until it finds an idle channel. When the SU finds an idle channel, it stops sensing and transmits its packet in the remaining part of the time-slot. At the end of each time-slot, SU updates the posterior probability of N channels. SU spends finite energy to sense and declare a decision (idle or busy) on each channel. Therefore, sensing energy of the SU drains linearly as the number of channels sensed increases. In this work, we study the energy-throughput tradeoff of SU with optimal sensing order. In particular, we find the number of channels that should be sensed in each time-slot such that we achieve maximum throughput with a bound on sensing energy.