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Learning-Aided Sub-Band Selection Algorithms for Spectrum Sensing in Wide-Band Cognitive Radios

Abstract:

We propose wide-band spectrum sensing scheduling solutions for cognitive radios that are equipped with reconfigurable RF front-ends. The wide frequency spectrum of interest is segmented into frequency sub-bands due to software and hardware limitations. These sub-bands can be non-contiguous, and each may contain an arbitrary number of channels from an arbitrary number of systems. It is assumed that the CR can only sense one sub-band at a time. Three sub-band selection policies are proposed to find spectrum opportunities taking into account realistic hardware reconfiguration energy consumptions and time delays. Two of the proposed policies rely on the individual channel Markov properties and the sub-band Markov properties, respectively. Although these two policies may achieve good performance, they rely on complete knowledge of RF environment dynamics and thus may become computationally demanding. The third sub-band selection policy based on Q-learning is proposed to circumvent this. Performance of the three policies are compared and discussed against a performance upper-bound of the optimal solution to the corresponding partially observable Markov decision process formulation. The suitability of the Q-learning technique is validated by showing that it achieves good performance through numerical results in both simulated and real measured RF environments.