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Cross-Entropy Optimized Cognitive Radio Policies

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Abstract—**In this paper we consider cognitive processes and their impact on the performance of cognitive radio networks (CRN). We model the cognition cycle, the main control process of the cognitive radio (CR), during which CR sequentially senses and estimates the environment state, creates plans based on the knowledge (models) of itself and that of the environment, makes decisions in order to optimize certain objectives and then acts. The proposed framework is analyzed and the performance of the CRN is evaluated. We show the impact of the sensing rate and the system dynamics on the waiting times of secondary users. Then model-based analysis is used to solve control and decision making tasks, which actually gives the radio its "cognitive" ability. Particularly, we design an efficient strategy for accessing the vacant spectrum bands and managing the transmission-sampling trade-off. In order to cope with the high complexity of this problem the policy search uses the stochastic optimization method of cross-entropy. The developed cognition cycle model represents CRN ability to intelligently react to external environment and internal state changes and gives a good understanding of the cross-entropy optimized policies.**

Keywords-cognitive radio networks;dynamic spectrum access; state estimation; queueing analysis; cross-entropy

I. INTRODUCTION

Cognitive Radio Networks (CRN) provide new horizons to the next generation of wireless communications. This new communication paradigm is a candidate to cope with a wide spectrum of challenges arising in the face of the increasing demand for wireless access in voice, video, multi-media and other high rate data applications. Although researchers and standardization bodies generally agree that CR should be able to sense the environment and autonomously adapt to changing operating conditions, there are different views concerning the levels of cognitive functionality [1]. CRNs are envisioned to aid both the user and the network to mitigate the growing communication demands by their advanced capabilities represented by the cognition cycle [2].