Chapter 9

Big Data–Based Spectrum Sensing for Cognitive Radio Networks Using Artificial Intelligence

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ABSTRACT

Cognitive radio has emerged as a promising candidate solution to improve spectrum utilization in next generation wireless networks. Spectrum sensing is one of the main challenges encountered by cognitive radio and the application of big data is a powerful way to solve various problems. However, for the increasingly tense spectrum resources, the prediction of cognitive radio based on big data is an inevitable trend. The signal data from various sources is analyzed using the big data cognitive radio framework and efficient data analytics can be performed using different types of machine learning techniques. This chapter analyses the process of spectrum sensing in cognitive radio, the challenges to process spectrum data and need for dynamic machine learning algorithms in decision making process.
INTRODUCTION

The radio spectrum is a valuable and strictly regulated resource for wireless communications. With the proliferation of wireless services, the demand for the radio spectrum is constantly increasing, leading to contention of spectrum resources. Recently, standardization activities have concerned the re-use of the spectrum unused or underutilized by digital TV signals, the so-called TV white space, by exploiting it to extend the coverage of Wi-Fi signals with the IEEE 802.11af standard. A fundamental task in the development of cognitive radio is the spectrum sensing, which allows individuating specific usage patterns in the various dimensions (time, frequency, space, angle, etc.), useful to exploit free spectrum.

Since continuous spectrum sensing is a very demanding task for a wireless device, we propose the introduction of a monitoring platform that makes spectrum sensing available as a service. This service consists of a number of geographically distributed spectrum sensors, implemented through software defined radio (SDR), which carry out the sensing operation and report results to a storage and computing platform, whose task is to disseminate its available data to any requesting device. Although this service cannot completely eliminate the need of spectrum sensing by the wireless terminals, it can be extremely effective for instructing mobile devices to carry out the sensing only where it is expected to find unused radio bands, thus achieving improvements in terms of energy consumption and stand-by times extension.

A cognitive radio has the potential to learn and adapt to its operating environment without intervention from human operators. Current space networks are manually configured. The Cognitive networks and cognitive radios have received a lot of attention due to their promised feature of autonomy, cost, and scalability. Adaptive radio software could circumvent the harmful effects of space weather, increasing science and exploration data returns. A cognitive radio network could also suggest alternate data paths to the ground. These processes could prioritise and route data through multiple paths simultaneously to avoid interference. The cognitive radio’s artificial intelligence could also allocate ground station downlinks just hours in advance, as opposed to weeks, leading to more efficient scheduling. Cognitive radio may make communications network operations more efficient by decreasing the need for human intervention. An intelligent radio could adapt to new electromagnetic landscapes without human help and predict common operational settings for different environments, automating time-consuming processes previously handled by humans.

Traditional radio spectrum sensing technologies usually detect the target channel through certain sensor devices in real time or sends inquiring information to the target channel to obtain the target channel state by obtaining the feedback. When
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