



Data Mining and Knowledge Modeling of Spectrum Occupancy Measurement

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Energy detector (ED) is widely used in spectrum usage survey. However, noise floor (NF) estimation heavily affects the performance of ED and ultimately the accuracy of spectral occupancy measurements [1]. This paper constructs a model to represent the use of spectrum as knowledge. Its main feature is to obtain knowledge of spectrum occupancy without NF estimation, and obtain more spectrum usage by reasoning.

The proposed method is illustrated in Figure 1. (a) is the spectrum measurement device [2], which measures the spectrum data of 20MHz-6GHz and stores as files. (b) is a data visualization image which shows the relation between frequency and power of spectrum collected within time step t. Here, 20MHz-6GHz is divided into K frequency bands according to the radio frequency allocation chart of China. (c) is the data mining modular. Its function is to obtain the knowledge that a certain frequency band is occupied or not, based on an unsupervised way which distinguishes between signal and noise without NF estimation. (d) is the knowledge modeling module, which represents the space-time model of spectrum usage obtained through knowledge modeling. The spectrum occupancy knowledge is constructed by a three-dimensional array $X \in \mathbb{R}^{K \times H \times L}$. Here, the number of radio service frequency band K is 196; the spectrum data is collected every half an hour for 24 hours in our experiment, so the time step L is 48; H is the number of frequency points in different frequency bands for the same radio service. Through knowledge reasoning, more knowledge of spectrum usage can be obtained, for example, signal bandwidth, center frequency, modulation scheme, and whether the spectrum usage is in compliance with relevant regulations. To the best of our knowledge, this is the first time that radio spectrum data is represented as knowledge and used to aid decision-making. This work was funded by the National Natural Science Foundation of China (Grant Nos. 61963037, 61863035), and Ten Thousand Young Top-notch Talents Program of Yunnan Province (Grant No. YNWR-QNBJ-2018-310).

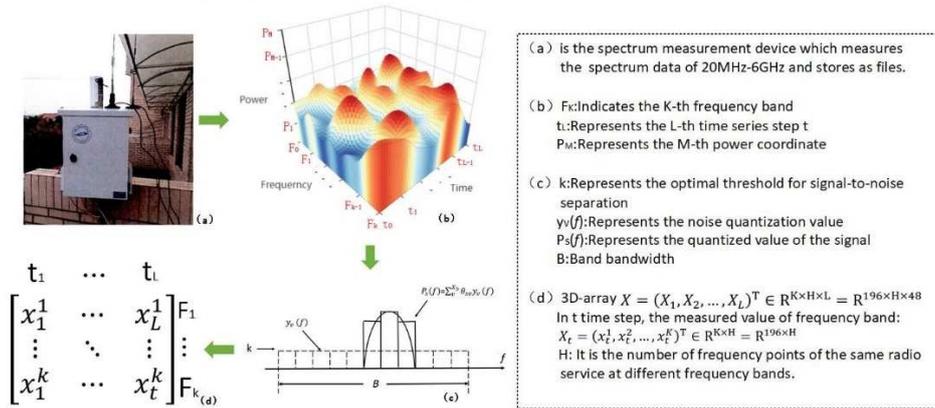


Figure 1. Knowledge modeling of radio spectrum occupancy measurement

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