Analysis of Calibration-Free Detection Techniques for Frequency-Coded Chipless Radiofrequency Identification

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The detection of the frequency-coded chipless radiofrequency identification (RFID) is mainly based on radar cross section (RCS). To obtain the RCS spectrum, the clutter and the tag response have to be measured sequentially; thus, the detection process requires two measured samples, which are impractical for real-world applications. The literature has proposed several techniques to detect the information of the chipless tag by using only one sample. In particular, the use of short-time Fourier transform (STFT) for time-domain filtering (A. Ramos *et al*., IEEE Trans. Microw. Theory Techn., 64, 2326–2337, 2016) and the subtraction between two orthogonal responses (F. Costa *et al*., IEEE Trans. Microw. Theory Techn., 64, 310–318, 2016) have been demonstrated. The two techniques can detect the chipless tag in a calibration-free manner. Although the two techniques aim at the same objective, their features are significantly different. The STFT technique uses cross polarization for the detection purpose, but the subtraction technique measures dual co-polarized components. Additionally, the tag structures for implementing the two techniques have distinct requirements. The competence of the two techniques has not yet been compared.

The goal of this study is to analyze the performance of the STFT technique and the subtraction technique. The two techniques are implemented for a five-bit chipless RFID system respectively. The operating frequency is 2.0−4.0 GHz. Different types of tags are designed, fabricated, and tested in an office environment. Fig. 1 shows some tag samples. The performance of the two calibration-free techniques is compared in terms of reliability, read range, the complexity of signal processing algorithms, the size of the tags, and the potential for capacity enhancement. By analyzing these characteristics, several design guidelines that lead to more robust performance are proposed. This study is expected to advance the frequency-coded chipless RFID toward real-world implementation.

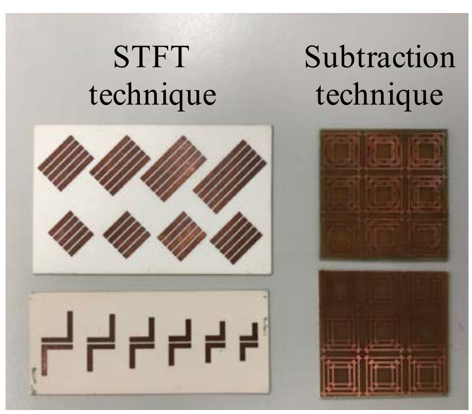

Figure 1. Test pieces of the chipless RFID tags for calibration-free detection.