A New Detection Technique for Identifying Chipless RFID Tags

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A chipless RFID system includes a reader, antenna and multiple tags presented in the main beam of the reader antenna. In addition, there are some background objects in the reader zone which makes the identifying process more challenging. Each tag has a unique ID, which is incorporated as a set of natural resonant frequencies. The presence or absence of these assigned resonances are considered as bit 1 and 0, respectively. In some practical applications, multiple tags may exist in the reader zone. In such cases, the detection and identification of the tags is challenging. Here, we introduce a new space-time-frequency identification technique by which we can distinguish the poles (complex natural resonances) of the tags successfully.

After illuminating the reader area, the backscattered signal consists of the responses from each tag. Hence, assuming the tags as scattering centers in the reader zone, the early-time and late-time responses can be expanded by the summation of complex times and complex natural resonances, respectively. By taking advantage of duality between early-time response in the Laplace-domain and late-time response in the time domain, the locations of the tags and their IDs can be obtained by applying short-time matrix pencil method (STMPM) to the frequency-domain and time-domain responses. By monitoring the scattering centers and poles/residues of the backscattered signal in space-time-frequency diagram, the identification process is performed. After some mathematical description of the proposed method, some scenarios are studied, simulated, and measured to confirm the validity and accuracy of the method.