



Detection and parameter estimation of intra-pulse modulated radar signals in complex interference environments[†]

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Abstract

The main aim of this review is to describe in detail an advanced technique to detect and estimate the prior unknown parameters of intra-pulse modulated signals and the verification with typical radar signals. The method is approved for detecting parameters successfully, including chirp rate, carrier frequency, and pulse width. The review presents already-done research on detecting and estimating single and multi-component linear frequency modulation (LFM) and binary phase shift keying (BPSK) signals in a strong noise environment and studies the technique on one more case, a mixture of LFM and BPSK signals. Firstly, the accuracy of the revised technique is shown in detecting and estimating parameters of a single and multi-component LFM signal in white noise and a mixture of continuous wave signals and noise, or a single BPSK signal in strong white noise. All of them have been done in the existing studies. This method is continuously tested in the second part by detecting a mixture of LFM and BPSK signals and estimating their parameters in intense noise. The tested experimental results demonstrate that the technique can detect single and multi-component real-time LFM signals, single BPSK as well as verification with a mixture of real-time LFM and BPSK signals with $\text{SNR} \geq -12$ dB is performed. As a result, the technique outperforms the existing detection methods based on machine learning and artificial intelligence.

Article Highlights

- This review summarizes previous papers and develops more research results of a detection method for low-power radar signals, especially LFM and BPSK signals.
- Based on this review, researchers can apply the method to other signals, even communication ones, such as amplitude modulation (AM), frequency modulation (FM), MFSK, or polyphase-coded signals.
- This review is considered a theoretical background for building a digital receiver in practice, based on the studied method for detecting radar signals, while other regular receivers can not.

Keywords Probability of detection · Probability of pulse width estimation · Frequency modulation · Phase modulation · Autocorrelation

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