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Approaches for Interference-proof Future Radar Systems

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Abstract

Automated driving reveals various shortcomings of today's commercial automotive radar systems. We address them by proposing a noise modulated pulse-Doppler radar system that uses a subset of usually required correlation filters at the receiver stage. With a validated phenomenological radar sensor model we evaluated the radar performance in various conditions such as low signal-to-noise-ratio (SNR) and interference and compared it against a commercial frequency-modulated continuous wave (FMCW) radar.

Extended Abstract

Automated driving is seen as key technology to reduce fatal traffic accidents and to improve traffic flows in combination with vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I). Thus leads to an increased density of transmitting signals by radar or communication systems calling for new strategies on dealing with interference. Since FMCW radar systems are advantageous for the price-sensitive automotive market, e.g. due to low-cost hardware, it can be expected to remain the bread and butter technology. Nevertheless, the evaluation of alternative approaches paves the way for emerging radar applications and an improved handling of interference. Radar perception within the ultimate vicinity of cars enables the application of pulsed radar systems, whereas the limitation in range is beneficial, e.g. regarding the co-existence of interference-prone FMCW and pulsed radar systems. However, additional methods still need to be implemented, such as cognitive approaches [1]. Our prototype implementation uses the phenomenological radar sensor simulation developed within the European Initiative to Enable Validation for Highly Automated Safe and Secure Systems (ENABLE-S3) [2]. There, the radar sensor model is part of a simulation platform for virtual verification and validation [3, 4]. The modular implementation of the radar sensor model allows for a low-priced evaluation of future radar concepts. The suggested noise pulsed radar features a receiver that uses greedy algorithms for signal reconstruction based on a significantly reduced amount of correlations [5, 6, 7] for signal reconstruction as suggested in [8]. We show that only ten to thirty percent of correlation filters are sufficient to retrieve the original signal in this implementation. The noise pulsed radar is compared against an automotive frequency modulated continuous wave (FMCW) radar system. We demonstrate that the noise pulsed radar outperforms commercial automotive FMCW radar systems during low SNR and interference conditions. Furthermore, we show different concepts, how the pulsed radar system can still co-exist with commercial FMCW radar systems.

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