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Study on the Potential of OFDM Radar in Automotive Application.

ABSTRACT - Masterthesis

Over the last two decades, the frequency modulated continuous wave (FMCW) radars have become the state-of-the-art radars in the automotive industry. These radars have the capability to sense the surrounding environment and assist the driver for safe and comfort driving. HELLA 24 GHz automotive radars are used for several safety applications such as automated cruise control, blind spot detection, lane change assistant, parking sensors, etc. With the rise in number of vehicles equipped with the radar entering the roads, the possibility of a radar equipped vehicle encountering another vehicle with its radar occupying the same bandwidth in their field of view has been noticeably increasing. Also, the licensed frequency bands for automotive radars have been fixed to 24 GHz and 77 GHz (in Germany) limiting the manufacturers to produce radars for different frequencies. If both the systems try to operate in the same frequency band then the system measurements might be erroneous. Such an effect is known as interference.

In recent years, the application of OFDM technology has become an active area of research and development in automotive radar systems to solve the cross-channel interference problem. The OFDM radar could be able to provide several applications such as cross-channel interference avoidance, vehicle-to-vehicle communication, ability to separate the transmit signal of different antennas in the context of OFDM radar signal processing, e.g. OFDM MIMO system. The focus of this thesis is set to interference avoidance.

At first, the system parameters for a 77 GHz OFDM radar is proposed. Further, the performance comparison between the state-of-the-art Chirp sequence radar (CSR) and OFDM radar system with respect to the measurement accuracies of the range, relative velocity and direction of arrival is considered. The influence of system noise and Doppler induced inter-carrier-interference on the system performance is presented. Later, compressed sensing (CS) based algorithm for mutual interference avoidance was selected from the literature, implemented and evaluated under varying interference power. The same algorithm with a modified mechanism is proposed in order to encounter the narrowband interference introduced by slow chirp radar. The evaluation of the proposed methodology under the influence of different system noise and interference power is carried out. At the end, a 2-dimensional CS algorithm is proposed to overcome the cons of previous 1-dimensional CS algorithm.