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- Workshop :

CW Waveforms for Automotive Radar Systems

Driving a car is a dangerous task! There are about 5000 fatalities on German roads every year, which are absolutely too many. Drivers have strong limitations in the ability to measure precisely the distance and the speed difference between cars, which is the reason for several accidents. The all-weather-capability as well as the capability of measuring target range and radial velocity simultaneously are some of the essential features, which make radar systems suitable for automotive applications.

Radio Detection and Ranging (RADAR) is a worldwide well-known technique since more than 100 years, which is originally based on the invention of the German engineer Christian Hülsmeyer, who applied his patent at the Kaiserliche Patentamt in Berlin on April the 30th, 1904. He called his invention Telemobiloskop in a good tradition of using Latin and Greek terms for technical subjects. Collision avoidance between ships was the first application for this new technique. Today we come back to the collision avoidance application however now between cars.

The general requirement on an automotive radar sensor in the 24 and 79 GHz frequency domain is to measure the target range R and radial velocity v_r simultaneously and unambiguously with high accuracy and resolution even in multi target situations, which is a matter of the appropriate waveform design. Several new waveforms have been developed for this application in the last years. In any continuous wave (CW) radar the receive signal is directly down-converted into baseband by the instantaneous transmit frequency. The receive signal is then sampled and further processed for target detection and parameter estimation. The resulting beat frequency f_B will be measured with high accuracy by an FFT procedure.

The aim of the tutorial is to introduce multiple CW waveforms and describe their performance figures. With a single chirp waveform for example the target range and radial velocity cannot be measured in multiple target situations. Therefore several alternatives have been developed to fulfill the given requirements. Chirp sequence waveforms show good performance figures in this respect. However a high computation power is needed.