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FMCW Radar / Sonar Based Multi Target Range and Velocity Estimation.

ABSTRACT - Masterthesis

Frequency modulated continuous wave (FMCW) radar systems are widely used in both civilian and military applications, e.g. to support autonomous automotive driving as well as flight monitoring and tracking, etc. With FMCW radars, both range as well as velocity of targets can be measured/estimated with high accuracy and resolution. In contrast, acoustic wave propagation-based FMCW systems, which could be used in active sonar applications, have not yet been applied. Therefore, this work aims to transfer the known methods for targets' distance and speed estimation from radar to sonar applications. For this purpose, a simulation environment in Matlab has been developed to generate signals of a FMCW sonar for predefined single target scenarios. Then, as in radar applications, a Range Doppler Map has been determined from the simulated receive signals to determine the distance and speed of an object. To extend the traditional signal processing approach opportunities for improving the performance with respect to accuracy and resolution as well as robustness against noise shall be figured out. Furthermore, by exploiting the simulation environment the accuracy of the range and velocity estimates and the robustness for various SNR conditions has been quantitatively assessed. Finally, the approach derived by utilizing the simulation environment has been applied on real experimental data. For this purpose, a laboratory experiment with either a moving transmitter or receiver is constructed and executed. The data recorded for different distance-speed scenarios are then evaluated offline using the developed method.