A PARAMETERIZED SIMULATION OF DOPPLER LIDAR

by

David B. Chester

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Approved:

Scott E. Budge, PhD Major Professor	Jacob Gunther, PhD Committee Member
Charles M. Swenson, PhD Committee Member	Mark R. McLellan, PhD Vice President for Research and Dean of the School of Graduate Studies

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CHAPTER 1

LadarSIM

LadarSIM is a robust parameterized tool for simulating lidar systems, which has been developed at Utah State University's Center for Advanced Imaging Ladar (CAIL) since 2003 [1, 2]. LadarSIM was originally developed to simulated pulsed time-of-flight lidar systems and has the flexibility to simulate a wide range of these systems by simulating parameterized lidar transceiver, focal plane arrays, and pointing/scanning systems, as well as the interaction of the lidar with a simulated 3D scene.

CHAPTER 2

Frequency Modulated Continuous Wave Detection

2.1 FMCW Basics

Frequency Modulated Continuous Wave (FMCW) detection refers to a radar/lidar system in which a continuous wave of known frequency is modulated in amplitude, transmitted, and the reflected signal is detected. A continuous wave radar in which a single microwave oscillator serves as both the transmitter and local oscillator (LO) is, generally speaking, a homodyne radar. Frequency modulated continuous waveform (FMCW) radar systems often leverage a homodyne architecture.

An FMCW radar radiates a continuous wave signal, which is chirped in frequency, to the target, an echo returns after time T_p, which is the time it takes for the signal to reach the target and reflected energy to return to the antennae. The returned signal is mixed with the signal from the LO producing a beat signal at frequency f_b. Figure 2.1 illustrates this process.

A continuous wave radar in which a single microwave oscillator serves as both the transmitter and local oscillator (LO) is, generally speaking, a homodyne radar. Frequency modulated continuous waveform (FMCW) radar systems often leverage a homodyne architecture. In FMCW homodyne radar the continuous wave signal is modulated to create a linear chirp which is transmitted via antenna toward a target. The return echo signal, which is delayed in time, is mixed with the LO signal. The result is a signal which is comprised of a linearly increasing chirp signal, which is actively filtered out, and the beat frequency which is used for detection [3].

2.2 Simplified Homodyne Detection

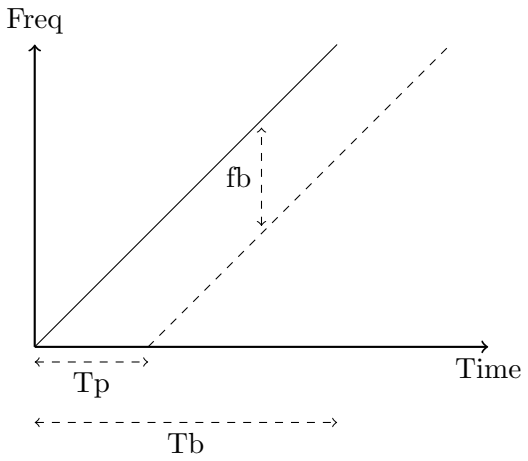

Fig. 2.1: Transmit and Receive Doppler Shift

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