

SIMULATION AND EXPERIMENTATION OF COMPLEMENTARY-CODED PULSE RADAR FOR ICE MEASUREMENT

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Airborne complementary-coded pulse radar is proposed to map the internal layers near ice bed of Antarctic and Greenland ice sheets. Information of these layers is required to understand the ice sheet dynamics and will help to make accurate calculation of ice sheet mass balance that is essential to accurate sea level rise estimation.

The challenges in mapping the ice layers near ice bed are two folds. First, the radar signals are very weak because of the huge attenuation when they reach the ice bottom and return to receiver. Secondly, ice bed echoes are much stronger compared to those from the layers near the interface so their side lobes usually mask the returns from the target ice layers near the ice bed. Pulse compression technique is used by the proposed radar to compensate for the signal attenuation and complementary coding is employed to cancel the side lobes from the ice bed.

Computer simulation and laboratory experimentation have been conducted to study side lobe cancellation. Complete side lobe cancellation has been verified for ideal case and the effects of signal waveform phase shift and amplitude imbalance that may be caused by hardware on side lobe level has been studied by simulations. As low as -60dB of side lobe level has been achieved in laboratory with complementary coded pulses generated by the waveform generator of a ice depth sounder. It has been found the side lobe level may rise to -35dB after modulation and demodulation because of the amplitude imbalance introduced into the signal waveforms by these stages.

Based on computer simulation and laboratory experiment results, the amplitude imbalance of signal waveform caused by hardware would be the challenge in the radar development. A prototype of complementary-coded radar is suggested to be built. By careful hardware design to reduce the amplitude imbalance and developing calibration algorithms in signal processing, it is expected to be able to design a radar capable of mapping the ice layers near ice bed with side lobe level 50dB below the main lobe.