



UAV-based Radar Sounding of Antarctic Ice

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We developed a compact radar for use on a small UAV to conduct measurements over the ice sheets in Greenland and Antarctica. It operates at center frequencies of 14 and 35 MHz with bandwidths of 1 MHz and 4 MHz, respectively. The radar weighs about 2 kgs and is housed in a box with dimensions of 20.3 cm x 15.2 cm x 13.2 cm. It transmits a signal power of 100 W at a pulse repetition frequency of 10 kHz and requires average power of about 20 W. The antennas for operating the radar are integrated into the wings and airframe of a small UAV with a wingspan of 5.3 m. We selected the frequencies of 14 and 35 MHz based on previous successful soundings of temperate ice in Alaska with a 12.5 MHz impulse radar [Arcone, 2002] and temperate glaciers in Patagonia with a 30 MHz monocycle radar [Blindow et al., 2012]. We developed the radar-equipped UAV to perform surveys over a 2-D grid, which allows us to synthesize a large two-dimensional aperture and obtain fine resolution in both the along- and cross-track directions. Low-frequency, high-sensitivity radars with 2-D aperture synthesis capability are needed to overcome the surface and volume scatter that masks weak echoes from the ice-bed interface of fast-flowing glaciers. We collected data with the radar-equipped UAV on sub-glacial ice near Lake Whillans at both 14 and 35 MHz. We acquired data to evaluate the concept of 2-D aperture synthesis and successfully demonstrated the first successful sounding of ice with a radar on an UAV. We are planning to build multiple radar-equipped UAVs for collecting fine-resolution data near the grounding lines of fast-flowing glaciers.

In this presentation we will provide a brief overview of the radar and UAV, as well as present results obtained at both 14 and 35 MHz.

Arcone, S. 2002. Airborne-radar stratigraphy and electrical structure of temperate firn: Bagley Ice Field, Alaska, U.S.A. *Journal of Glaciology*, 48, 317–334.

Blindow, N., C. Salat, and G. Casassa. 2012. Airborne GPR sounding of deep temperate glaciers—examples from the Northern Patagonian Icefield, 14th International Conference on Ground Penetrating Radar (GPR) June 4-8, 2012, Shanghai, China, ISBN 978-1-4673-2663-6.