# Conformal Log Periodic Folded Slot Array Antenna with Fresh Water filled Cavity Backing for Operation in Glacial Ice

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We present the design, analysis and measurements of a conformal log periodic folded slot array (LPFSA) antenna with fresh water filled quarter wavelength cavity backing is presented in this paper. This antenna is a geometry conforming, end fire radiating element operating inside fresh water ice and is part of a multi-element forward looking synthetic aperture radar (SAR) system for a cylindrical ice penetrating cryobot vehicle. The LPFSA antenna described in this paper is designed to operate in ice over a frequency band of 0.7 to 1 GHz and has a radial E-field polarization. The antenna is immersed in a thin (~1 to 3 cm) layer of surrounding low-conductivity melt water. Resonant cavity backings flooded with the same melt water are implemented to improve the radiating efficiency of the LPFSA, while adhering to the antenna size limits and enabling flush mounting onto the cryobot body. Fresh water for the resonant cavities is a dielectric of opportunity since it is readily available as long as the cryobot is actively melting through ice. Two versions of the LPFSA antenna, differing in the feed line type in between the folded slot dipole elements, are designed, fabricated and tested in situ in both an outdoor laboratory configuration and during a field study on Matanuska glacier in Alaska.

The exploration of both terrestrial and extraterrestrial glaciers and potential subglacial bodies of water is a challenging task that has been shown to be able to be facilitated by the use of an ice penetrating cryobot. The log periodic folded slot array (LPFSA) described herein is a critical design innovation for the synthetic aperture radar (SAR) system on such a penetrating vehicle. The 'Very deep Autonomous Laser-powered Kilowatt-class Yo-yoing Robotic Ice explorer (VALKYRIE)' project demonstrates proof-of-concept technologies for the subsurface exploration of ice-covered planetary bodies in the solar system and on terrestrial glaciers and ice shelves using a cylindrical cryobot vehicle with active heating and a suit of onboard sensors for scientific data collection and analysis.

This presentation will focus on: (1) Analysis of the individual cavity backed conformal folded slot antennas filled with fresh water dielectric-of-opportunity, (2) analysis of the dielectric layer of fresh melt water sheath around the antenna portion of the cryobot, including the effect on antenna input impedance and far field radiation pattern and (3) field testing of the antennas in an outdoor laboratory at Stone Aerospace Inc. and in-situ on the Matanuska glacier. The antennas have been designed and fabricated at the Center for Environmental Technology (CET) at CU-Boulder.