A Planar Ultra-wideband UHF Monopole Mills Cross Array for Ice Sounding

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The feasibility of sounding of ~1 km thick ice at UHF frequencies has recently been demonstrated using a 1-W airborne radar that was originally designed for mapping near surface accumulation layers. As compared to conventional ice sounders operating at VHF, it is much easier to integrate a wideband and electrically large aperture on airborne and spaceborne platforms to obtain significantly improved vertical resolution and spatial selectivity to suppress surface clutters that could mask ice bottom return. Greenland and Antarctica ice sheets with thicknesses of more than 3 km are common in the interior region. In order to fully validate the concept of ice sounding at UHF frequencies as well as to image internal layers within the bottom 10% of ice, a surface-based multi-channel radar system operating from 600 to 900 MHz with a significantly higher sensitivity has been designed. From the link budget calculation, the radar would require a large antenna array with a two-way gain of 60 dBi and a peak transmit power of 100 W to sound ice with more than 3 km. An electrically large ultra-wideband UHF monopole antenna array has been designed to meet these specifications. The monopole array is comprised of eight planar subarray modules, which in combination will form a 16 m by 17 m Mill's cross array configuration to maximize spatial selectivity in both cross-track and along track directions. Each planar subarray module is 1 m by 2 m in size with a 2.5 in thick rigid insulation foam panel separating the individual monopole elements from metal foil ground plane on the top such that the maximum radiation is directed to nadir. Each subarray panel consists of 4 by 8 circular monopole antenna elements with a spacing of 0.5 m. Each antenna element printed on a 130 mm by 80 mm 62 mil FR4 board. Metal foil strips are placed along each row covering the bottom half of each board, forming a contiguous ground along the entire Mill's cross array. The total weight of each subarray panel is 20 lbs., making for a very lightweight and low-profile antenna construction. The current plan is to deploy the radar system to the East Greenland Ice-core Project (EGRIP) site in summer 2018 for field tests. Radar system design with focuses on the antenna design together with field test results will be presented at the symposium.

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