Demonstration of Sparse Signal Reconstruction for Radar Imaging of Ice Sheets

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Conventional processing of ice-sounder data produces 2-D images of the ice sheet and bed, where the two dimensions are along-track and depth, while the across-track direction is fixed to nadir. The 2-D images contain information about the topography and radar reflectivity of the ice sheet's surface, bed, and internal layers in the along-track direction. Having multiple antenna phase centers in the across-track direction enables the production of 3-D images of the ice sheet and bed. Compared to conventional 2-D images, these contain additional information about the surface and bed topography, and orientation of the internal layers over a swath in the across-track direction. We apply a 3-D SAR tomographic ice-sounding method based on sparse signal reconstruction [1] to the data collected by Center for Remote Sensing of Ice Sheets (CReSIS) in 2008 in Greenland [2] using their multichannel coherent radar depth sounder (MCoRDS). The MCoRDS data have 16 effective phase centers which allows us to better understand the performance of the method. Lastly we offer sparsity improvement by including wavelet dictionaries into the reconstruction.The results show improved scene feature resolvability in across-track direction compared to MVDR beamformer.

References:
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[2] X. Wu, K. C. Jezek, E. Rodriguez, S. Gogineni, F. Rodriguez-Morales, and A. Freeman, "Ice sheet bed mapping with airborne SAR tomography". IEEE Transactions on Geoscience and Remote Sensing, vol. 49, no. 10 Part 1, pp. 3791–3802, 2011.