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Layering extraction from subsurface radargrams over Greenland and the Martian NPLD by combining wavelet analysis with Hough transforms

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Abstract:
Extracting lines from an imagery is a solved problem in the field of edge detection. Different to images taken by camera, radargrams are a set of radar echo profiles, which record wave energy reflected by subsurface reflectors, at each location of a radar footprint along the satellite's ground track. The radargrams record where there is a dielectric contrast caused by different deposits, and other subsurface features, such as facies, and internal distributions like porosity and fluids. Among the subsurface features, layering is an important one which reflect the sequence of seasonal or yearly deposits on the ground [1-2]. In the field of image processing, line detection methods, such as the Radon Transform or Hough Transform, are able to extract these subsurface layers from rasterised versions of the echograms. However, due to the attenuation of radar waves whilst propagating through geological media, radargrams sometimes suffer from gradient and high background noise. These attributes of radargrams cause errors in detection when conventional line detection methods are directly applied. In this study, we have developed a continuous wavelet analysis technique to be applied directly to the radar echo profiles in a radargram in order to detect segmented lines, and then a conventional line detection method, such as a Hough transform can be applied to connect these segmented lines. This processing chain is tested by using datasets from a radargram acquired by the Multi-channel Coherent Radar Depth Sounder (MCoRDS) on an airborne platform in Greenland and a radargram acquired by the SHAllow RADar (SHARAD) on board the Mars Reconnaissance Orbiter (MRO) [3] over Martian North Polar Layered Deposits (NPLD).

Keywords: Subsurface mapping, Radargram, SHARAD, Greenland, Martian NPLD, Subsurface layering, line detection

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