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GPR-3D data enhancement through background noise estimation and removal in frequency-wavenumber domain

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In geophysical prospecting with GPR, namely in archaeological environment, the background noise in radargrams impairs its interpretation if it is not possible to remove it effectively. This happens quite frequently when applying processing operations whose parameterization is limited, preventing their application in a personalized way to the data concerned.
Similar to the methodology used to process noised images, for its improvement, using spatial filters, the noise in radargrams can be corrected through two approaches: in the spatial domain and in the frequency-wavenumber domain. The filters applied in the frequency-wavenumber domain consists in the modification of the image in its Fourier transform, allowing to act directly in its structure, whereas in the spatial domain the filters act in each pixel. The filter design is planned from the simultaneous analysis of magnitude spectrum and wavenumber distribution of the data. After the filter design, it is applied to the input data in the frequency-wavenumber domain using the multiplication. This simple operation requires a small computational effort, even involving a big amount of data.
In this work, applying the proposed image processing approach to GPR-3D data, we produced results that correspond only to the useful information contained in the input data, allowing a better interpretation of the results and allowing a better evaluation about the existence of buried objects. The GPR-3D model produced after the noise estimation and its removal from the radargrams, allowed to detect structures that are not visible in the models obtained exclusively using commercial programs.
We conclude that the presented approach improves the noise removal and consequently allows obtaining of better interpretations of the subsurface content.

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