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Enhancement of 3D GPR datasets using singular value decomposition applied in 2D the spectral domain for clutter noise removal

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The ground-penetrating radar (GPR) datasets obtained in archaeological environments have substantial problems related the presence of clutter noise. These noisy reflections are generated by the heterogeneities of the ground and by the collapses of structures buried in the ground, that can prevent a good assessment of the subsurface with this method. The classic filtering operations available can fail to remove it effectively. This work presents an approach to filtering the GPR data in the 2D spectral domain through the singular value decomposition (SVD) factorization technique. The spectral domain present advantages such as the circular symmetry of the transformed data that turns easy the filter parametrisation and the constant computational effort whatever the amount of data considered. SVD allows the decreasing of the user dependency to parametrize the filter. The main propose of this method is to classify automatically the datasets into useful information, corresponding to buried structures, and noise, to remove the last. This approach was conceived based on the study of the GPR signal in the 2D spectral domain and the manual filter design. The tests were performed with different datasets, one from a laboratory experiment (controlled environment) and the other from a field acquisition in an archaeological site (uncontrolled environment) with subsequent excavation to proof the results. The proposed approach is effective to remove the clutter noise in the GPR datasets and constitutes a complementary operation to those already existing in the commercial software.

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