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Interpolation of GPR profiles (in 3D datasets) through Fourier Interpolation. Application to the case study of Roman Villa of Horta da Torre (Fronteira, Portugal)

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GPR data sometimes present subsampling problems that prevent an effective study about the existence of buried structures in an archaeological site. This is a frequent problem, related with the profile spacing used in the survey, when this is performed in parallel profiles to construct a 3D dataset. This difficulty can be lessened by decreasing the profile spacing, but that increases the survey time, or can be experimented in the data processing. INT-FFT algorithm is GPR data densification approach, complementary to the other standard operations, that allows to reconstruct missing data from the combined use of mathematical transforms and predictive filters. To calculate the missing signal, two requirements must be checked: (1) the data in the frequency domain must be limited in a range of values; and (2) must be able to be represented by a distribution of Fourier coefficients. Both conditions are verified in GPR data. Based on seismic trace interpolation, INT-FFT algorithm uses an open access routine (Suinterp, from Seismic Unix package) to interpolate the GPR profiles, that makes use of automatic event identification routines, through the calculation of spatial derivatives, to identify discontinuities in space from the detection very subtle changes in the signal, thus allowing for more efficient interpolation without artifacts or signal deterioration. The approach was successfully tested using GPR datasets from the archaeological site of Roman Villa of Horta da Torre (Fronteira, Portugal). The results show that there was an increase of the geometric sharpness of the GPR planimetry and has not produced any numerical artefacts. The tests performed to apply the methodology to GPR-3D data allowed to assess the interpolation efficiency, the level of recovery of missing data and the level of information lost when one chooses to increase the distance between profiles in the acquisition stage of the data.

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