

Advanced fusion of geophysical data through combined use of 2D Discrete Wavelet Transform and Multiresolution Singular Value Decomposition applied to GPR-3D and magnetic data

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Background

This work share some results of the research in effective methodologies for geophysical prospection applied to Archaeology.

Main problem

The great lack of perceptibility in geophysical datasets: GPR and Magnetics.

Apparently the data don't have useful information about buried structures in the ground.

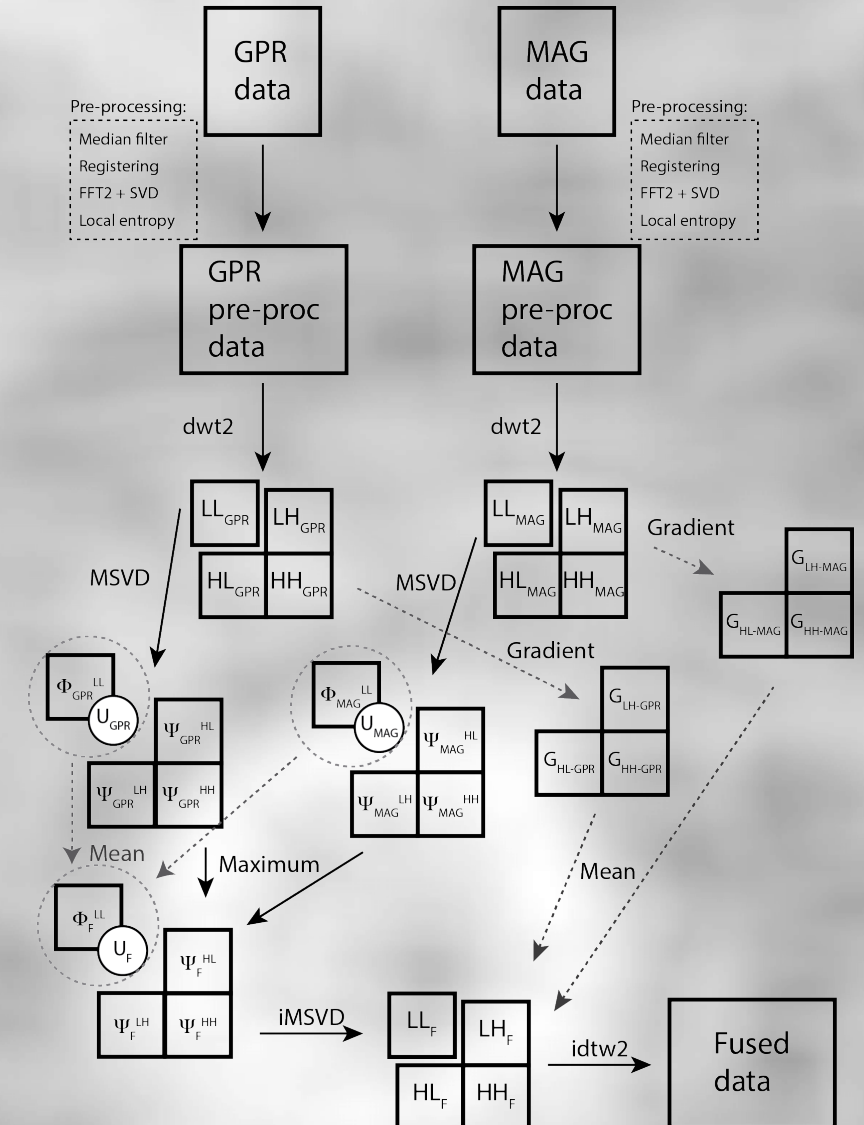
Our hypothesis is that the data has useful information hidden in the background noise.

The proposal approach

Using advanced data fusion algorithms to combine GPR and Magnetics datasets:

2D Discrete Wavelet Transform &
Multiresolution Singular Value Decomposition

Both methods acts in the spectral domain which produces better results than the fusion applied in the space domain.



Results

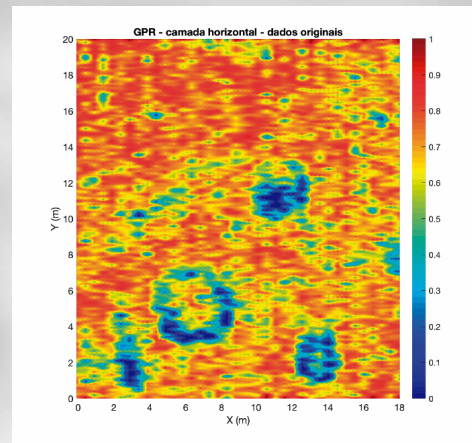
High perceptibility data

(Roman archaeological site: Cortijo de Quintos,
Córdoba - Spain)

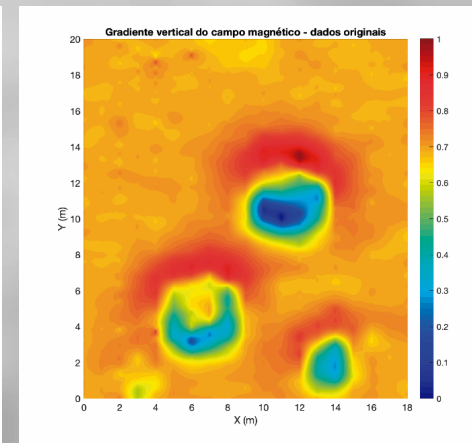
The fused data shows the
alignments that corresponds to
the buried structures (circles in
red colour).

The sharpness and quality
increases with the data fusion.

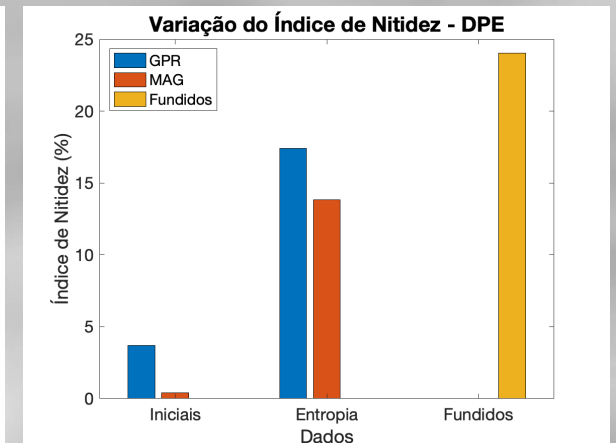
GPR data



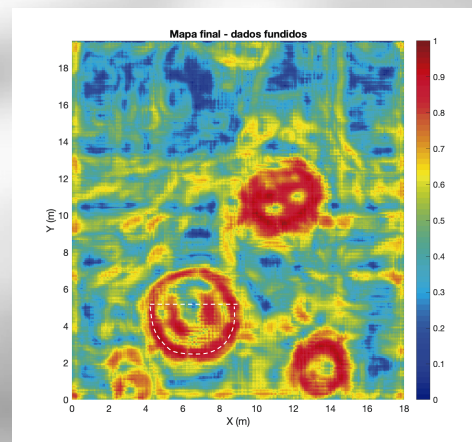
Magnetics data



Sharpness Index



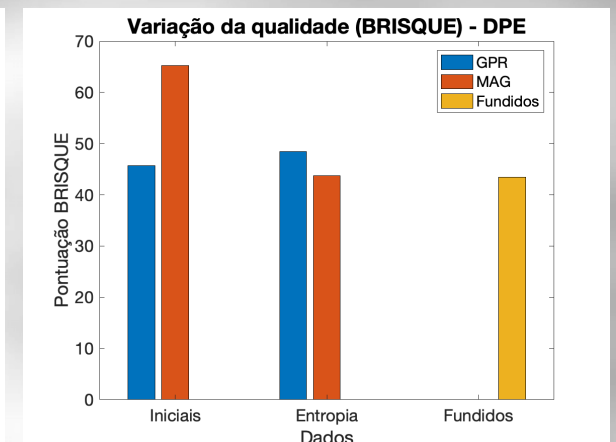
Fused data



Excavated structure



BRISQUE Quality Index



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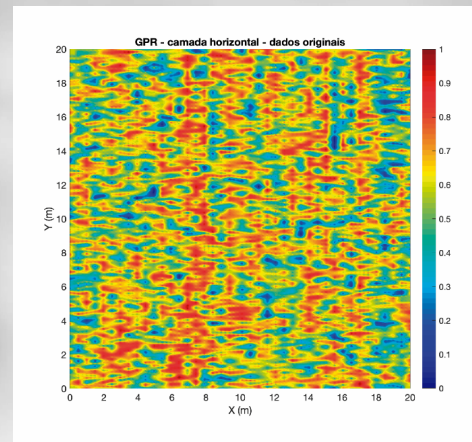
Results

Less-high perceptibility data

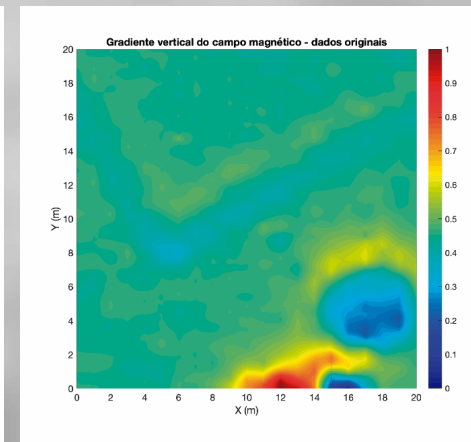
(Roman archaeological site: Cortijo de Quintos, Córdoba - Spain)

The fused data shows the alignments that corresponds to the buried structures (lines and circle in yellow and red colour). The sharpness and quality also increases with the data fusion.

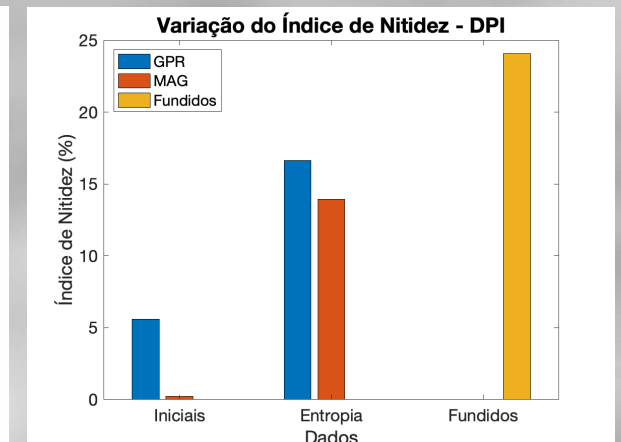
GPR data



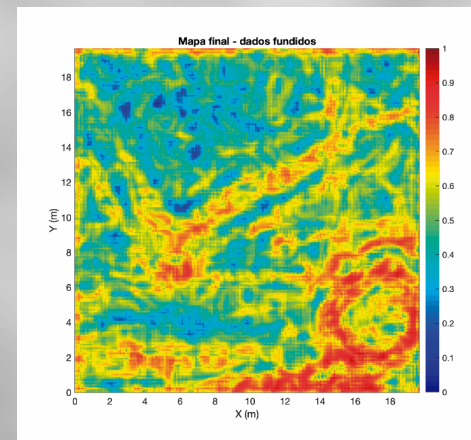
Magnetics data



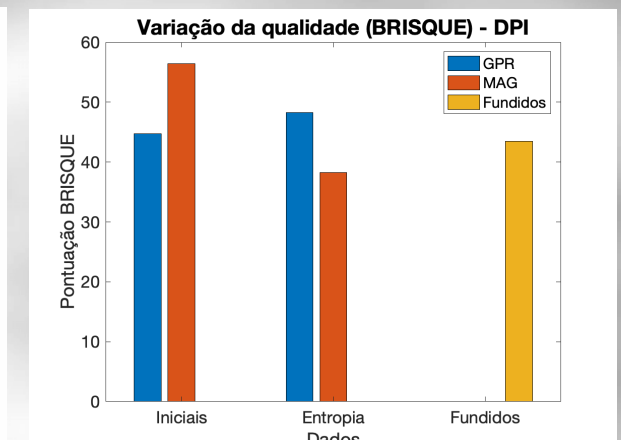
Sharpness Index



Fused data



BRISQUE Quality Index



Results

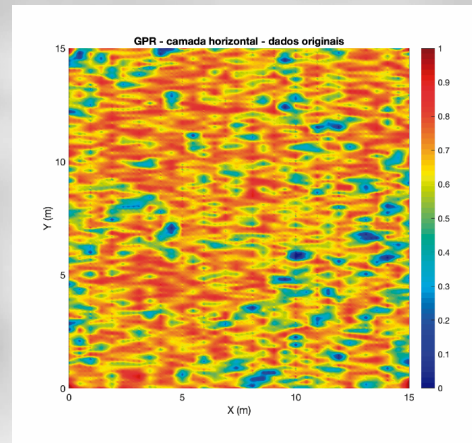
Low perceptibility data

(Roman archaeological site: Cortijo de Quintos,
Córdoba - Spain)

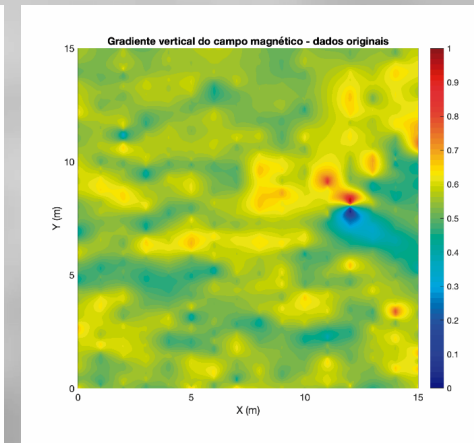
The fused data shows the
alignments that corresponds to
the buried structures (lines in
red colour).

The sharpness and quality also
increases with the data fusion.

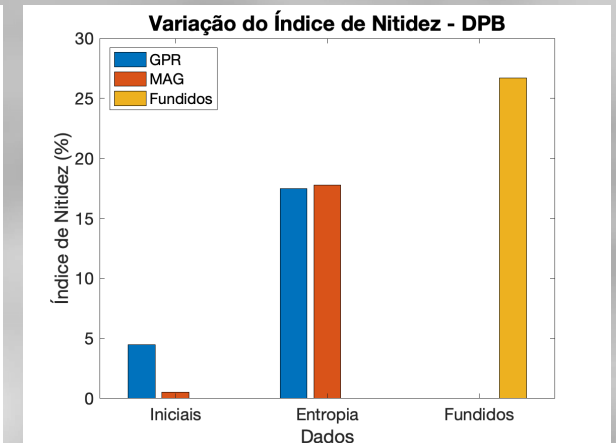
GPR data



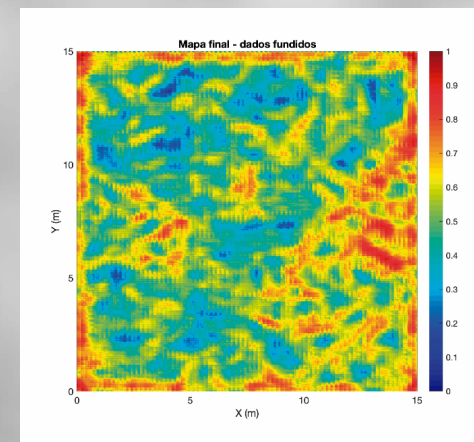
Magnetics data



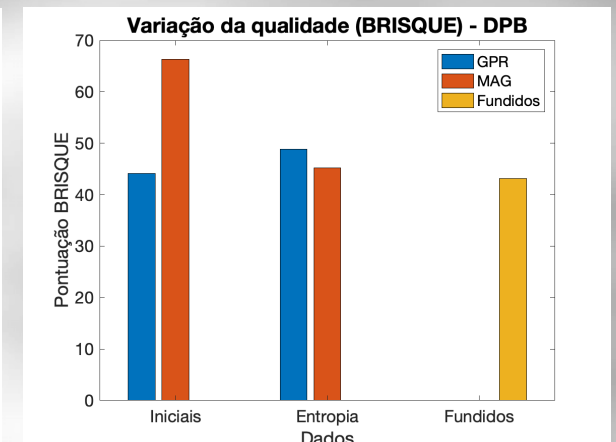
Sharpness Index



Fused data



BRISQUE Quality Index



Conclusions

The data fusion of geophysical datasets from different methods, like GPR and Magnetics, seems to reveal a better perceptibility about the buried structures than the input datasets individually.

The inputs, which apparently do not have information about buried structures, start to show alignments that show that there is useful information in the middle of the background noise. The image obtained by data fusion has higher quality than the input datasets.

The fusion applied in the spectral domain, associated with automatic data selection algorithms, can be a useful tool for detecting alignments of buried structures in data whose the perceptibility is low.

Acknowledgment

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