



1D geological modeling of the subsurface from geophysical data with Bayesian Evidential Learning

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Uncertainty appraisal is a key concern to geophysicists when imaging the subsurface. This issue is classically handled by stochastic inversion (costly CPU) or by error propagation (unrealistic uncertainty). However, those methods suffer from an important CPU cost, due to the need for many runs of inversions. Bayesian Evidential Learning (BEL) offers a real shift towards a fully stochastic framework for the optimization of acquisition and the interpretation of data in geophysics. Contrary to inversion methods, interpretation of geophysical data through BEL relies on the constitution of statistical relationships between model parameters (in the prior model space) and the corresponding data, in order to produce statistical distributions of model parameters constrained to the knowledge of field acquired data (the posterior model space). Hence, it does not require any inversion of the data but rather multiple, independent (and thus fully parallelizable) runs of the much more CPU efficient forward model. This new framework has been adapted to static 1D modelling of the subsurface constrained to geophysical data. The developed process has then been applied to both synthetic and field-acquired data, demonstrating the ability of the process to create consistent sets of probable posterior models, provided that the prior model space is defined wisely, even for noisy data sets. The method was tested for surface nuclear magnetic resonance and multi-channel analysis of surface wave. However, the framework and associated software package were developed such that it can be applied to any 1D problem as long as the forward code is available.