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3D velocity and interface reconstruction by joint inversion of refracted and reflected waves traveltimes and gravity data

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A new algorithm for the joint inversion of refracted and reflected waves traveltimes and gravity anomalies data has been developed. This algorithm adopts a realistic crustal model that includes sharp interfaces as well as continuous velocity and density variations inside layers. The main objective of the algorithm is the reconstruction of the interface position, 3D velocity and density variations above the interface as well as 2D velocity and density variations just below the interface. The multi-layered structure is reconstructed by the sequential stripping of the upper layers anomalies. The automatic parametrisation of the velocity and density fields by the multidimensional Haar wavelets helps to obtain an equally well resolved and stable solution for the problem. For the velocity field, the parametrisation adapts itself based on the ray coverage using the number of rays crossing a particular volume and their azimuthal coverage. This approach proved to be much faster as compared to the estimation of the resolution matrix while providing essentially the same quality results. The measure of the accordance between the velocity and density fields are based on the idea of their patterns similarity: anomalies of velocity should correspond to the anomalies of density and vice versa, while no particular relation between the anomalies amplitudes either linear or not is required. Mathematically this leads to the co-linearity of the gradient vectors of density and velocity fields that can be incorporated in the problem as the condition of the zero cross-product of the gradient vectors. Additional conditions might be optionally imposed on the solution, such as the minimum of the solution deviation from the a priory model or its maximum smoothness. The algorithm works either as a joint inversion algorithm or for traveltimes inversion only. First results of the algorithm on synthetic examples will be presented. This study is supported by

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