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Assessing reconstruction instabilities of deep-learning based LSRTM

Kristian Torres, Mauricio Sacchi

Signal Analysis and Imaging Group (SAIG), Department of Physics, University of Alberta

Summary

Two common issues of Least-squares Reverse Time Migration (LSRTM) consist in the large number of iterations required to produce notable subsurface imaging improvements and the difficulty of choosing adequate regularization strategies with optimal hyper-parameters. Aiming at mitigating these shortcomings, we adapt two supervised CNN-based strategies to the LSRTM problem. The first strategy mimics a projected gradient descent algorithm, wherein each iteration interlaces evaluations of the modelling and migration operators with projected updates that capture the prior information in the learning phase. The second strategy approximates the effect of the inverse Hessian with a single pass through a modified residual U-net, trained to improve RTM images. Additionally, we empirically investigate how these learned approaches respond to three crucial issues: 1) instabilities with respect to errors in the migration velocity field, 2) instabilities with respect to different noise levels, and 3) instabilities with respect to structural changes from off-distribution test samples.