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Eran Treister  
**Joint Full Waveform Inversion and Travel Time  
Tomography**

Dept of Earth and Ocean Sciences  
University of British Columbia  
2021 Main Mall  
Vancouver  
V6T-1Z4  
Canada  
`erantreister@gmail.com`  
Eldad Haber

The full waveform inversion (FWI) in heterogeneous media is a highly non-linear optimization problem. Using traditional methods like Gauss Newton, the solution is highly sensitive to the initialization point. The best results are often achieved by a frequency continuation strategy where the process is initially obtained with the low-frequency data only, and then gradually the high frequency data is added into the optimization. However, low frequency data is usually missing, and in its absence the FWI process reaches a local minimum. Travel time tomography, unlike FWI, is less sensitive to its initialization and contains low frequency features. In this work we propose a framework to jointly apply FWI and travel time tomography, so that the resulting model is faithful to both the waveform and travel time data. Using this approach we also aim to relieve the problem of missing low-frequency data. To this end, we minimize a sum of the FWI and travel time tomography misfit functions, with regularization. Synthetic examples show that this strategy leads to a better recovery of the underlying medium when low-frequency data is missing.