3D local-scale Square-Root Variable Metric based Elastic Full-Waveform Inversion & Uncertainty Estimation on a Supercomputing platform

Qiancheng Liu and Daniel Peter

King Abdullah University of Science and Technology, Physical Sciences and Engineering, Thuwal, Saudi Arabia
(qiancheng.liu@kaust.edu.sa)

In full-waveform inversion (FWI), the Hessian-related uncertainty estimation is very crucial but strictly prohibitive to the large-scale 3D problems. Here, we develop a vector-version Square-root Variable Metric (SRVM) algorithm, which only stores a vector and a scalar per iteration, and apply it to 3D local-scale elastic FWI. One SRVM vector is the same with the model size such that the SRVM vectors could be affordable in storage throughout elastic FWI even across different scales. In the 3D elastic FWI scenario, we take the state-of-the-art L-BFGS method as reference. After the SRVM-based FWI finishes, we have access to the posterior covariance via the stored SRVM vectors and scalars. Also, to make the posterior analysis and samplings more efficient, we combine the SRVM method with a randomised singular value decomposition (SVD) method. The 3D local-scale SRVM based elastic FWI & Uncertainty Estimation run on the Shaheen II supercomputing platform.