



SBGf Conference

18-20 NOV | Rio'25

Sustainable Geophysics at the Service of Society

In a world of energy diversification and social justice

Submission code: XJQGLK5QJ5

See this and other abstracts on our website: <https://home.sbgf.org.br/Pages/resumos.php>

Efficient Low-Rank Frequency-Domain Least-Squares Marchenko Imaging

DANIEL REVELO APRAEZ (SENAI CIMATEC), Reynam C. Pestana (UFBA)

Efficient Low-Rank Frequency-Domain Least-Squares Marchenko Imaging

Copyright 2025, SBGf - Sociedade Brasileira de Geofísica / Society of Exploration Geophysicist.

This paper was prepared for presentation during the 19th International Congress of the Brazilian Geophysical Society held in Rio de Janeiro, Brazil, 18-20 November 2025. Contents of this paper were reviewed by the Technical Committee of the 19th International Congress of the Brazilian Geophysical Society and do not necessarily represent any position of the SBGf, its officers or members. Electronic reproduction or storage of any part of this paper for commercial purposes without the written consent of the Brazilian Geophysical Society is prohibited.

Abstract

Reverse Time Migration (RTM) excels at imaging complex structures and steep dips but creates artifacts due to its single-scattering assumption and adjoint operator use, with internal multiples degrading image quality. Removing multiples while preserving primary reflections is challenging, and current methods often fail. Marchenko-based approaches handle internal multiples but require extensive preprocessing and high computational cost. Least-Squares Migration (LSM), particularly LSRTM, boosts resolution and amplitude fidelity but increases computational load. Frequency-domain LSRTM (FLSRTM) cuts cost by processing spectral subsets but requires large storage for Green's functions and struggles with accurate internal multiple modeling. In this work, we propose the frequency-domain least-squares Marchenko imaging (FLSMI) method, using a multiple-free migrated image from Marchenko imaging as the reflectivity starting point. Marchenko-derived Green's functions, capturing more wavefield data, act as propagation operators in FLSMI, incorporating internal multiples to reduce ill-posedness and enhance image quality over FLSRTM. Storing Green's functions is challenging, but the SVD algorithm enables compact formats, and randomized SVD (rSVD) and compressed SVD (cSVD) offer efficient options. Thus, FLSMI with low-rank Green's functions via rSVD/cSVD yields high-quality imaging at lower computational cost, and a synthetic test confirms improved artifact suppression and resolution.