



## **Highly-optimized TWSM software package for seismic diffraction modeling adapted for GPU-cluster**

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Oil producing companies concern to increase resolution capability of seismic data for complex oil-and-gas bearing deposits connected with salt domes, basalt traps, reefs, lenses, etc. Known methods of seismic wave theory define shape of hydrocarbon accumulation with nonsufficient resolution, since they do not account for multiple diffractions explicitly. We elaborate alternative seismic wave theory in terms of operators of propagation in layers and reflection-transmission at curved interfaces. Approximation of this theory is realized in the seismic frequency range as the Tip-Wave Superposition Method (TWSM). TWSM based on the operator theory allows to evaluate of wavefield in bounded domains/layers with geometrical shadow zones (in nature it can be: salt domes, basalt traps, reefs, lenses, etc.) accounting for so-called cascade diffraction. Cascade diffraction includes edge waves from sharp edges, creeping waves near concave parts of interfaces, waves of the whispering galleries near convex parts of interfaces, etc.

The basic algorithm of TWSM package is based on multiplication of large-size matrices (make hundreds of terabytes in size). We use advanced information technologies for effective realization of numerical procedures of the TWSM. In particular, we actively use NVIDIA CUDA technology and GPU accelerators allowing to significantly improve the performance of the TWSM software package, that is important in using it for direct and inverse problems.

The accuracy, stability and efficiency of the algorithm are justified by numerical examples with curved interfaces. TWSM package and its separate components can be used in different modeling tasks such as planning of acquisition systems, physical interpretation of laboratory modeling, modeling of individual waves of different types and in some inverse tasks such as imaging in case of laterally inhomogeneous overburden, AVO inversion.