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Guided Neural Network for Emplacement Classification and Yield and Depth of Burialof Estimations Using Time-Domain Source Functions - Algorithms

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This study aims to explore novel physics-guided neural network (PGNN) algorithms as applied to time-domain source functions (TDSF) of explosions for automated emplacement material classification as well as the estimation of yield (W) and depth of burial (DOB) in a regression formulation. We assume that explosions are detonated at the center of cavities embedded in an infinite homogeneous medium. TDSFs were constructed for different source emplacement conditions using analytical expressions at the elastic radius of each explosion source, where this elastic radius includes both the cavity radius and the non-linear zone created by each explosion. In addition, a tabular dataset for many combinations of W and DOBs was generated containing corner frequency (fc), halfwidth of the displacement wavefield in seconds, peak amplitudes of both broadband and filtered waveforms around 1 Hz, periodicity, and area under the peak pulse for each TDSFs. Note that these parameters follow a non-linear dependence on W and DOB. These TDSFs and tabular datasets are being used to explore the accuracy in the classification of emplacement conditions and post-processing validation of the physics-informed neural network (PINN) with and without governing laws and regularization of the PINN model. We are further evaluating the out of distribution network performance.

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Promotional text

Neural Network, Yield and Depth of Burial, Low-yield Explosions, Deep Learning and PINN algorthims

Oral preference format

in-person

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