Ground roll interpolation and attenuation

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Abstract

The performance of the ground-roll attenuation methods is limited due to the spatial aliasing. We adopt a convolutional neural network-based framework to interpolate the seismic data, including ground roll. The proposed approach can interpolate the strong ground roll and keep the weak reflections simultaneously. After the interpolation, a simple f-k filter is applied to both the synthetic and real data examples to attenuate the ground roll.

Introduction

This paper uses a convolutional neural network (CNN) based architecture called Residual dense Network (RDN) to interpolate spatial aliased seismic data. A set of data generated by the finite different method is used for training. Then we use the trained model to interpolate synthetic and real data examples with low-frequency intense ground roll noise.

Methods

We use the finite different method to create a training dataset. The dataset includes some strong ground-roll and weak reflections. The maximum amplitude of the ground roll is about 100 times the maximum amplitude of the reflections. The dataset consists of seven shot gathers, each containing 1436 receivers and 719 samples on the time axis. We use this dataset as our training labels. We then kill half of the traces regularly to make them our training input. After the training, we apply the trained model to interpolate the real data example. Then we apply a fk filter to remove the ground roll from the interpolated data.

Examples

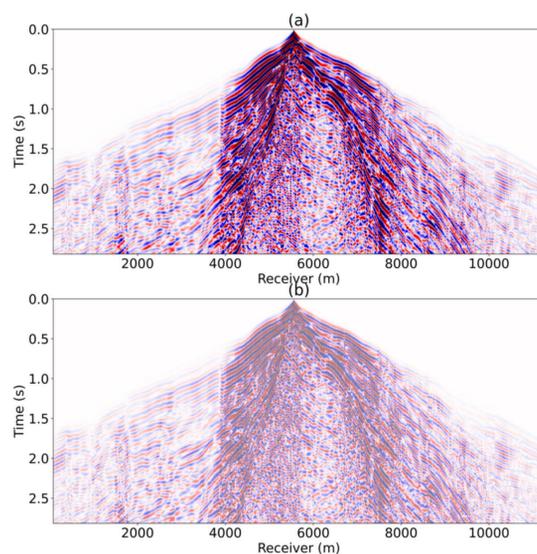Figure 1 shows the finite difference synthetic example used for training.

Figure 1: 2-D finite difference synthetic example used for training.
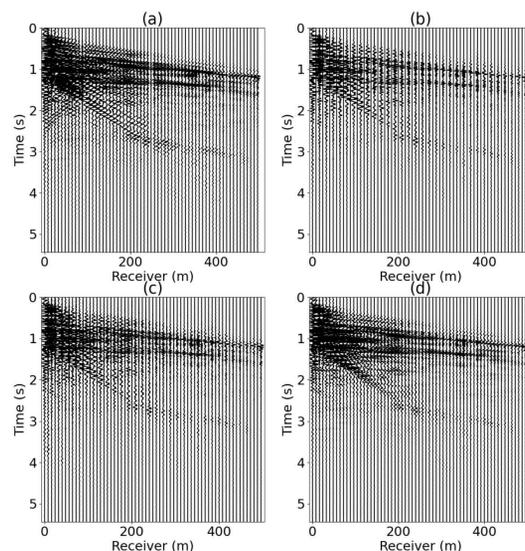
Figure 2 shows the real data example.

Figure 2: Real data example, (a) Original data. (b) Decimated data. (c) Interpolated by fx method. (d) Interpolated by Proposed ResNet.

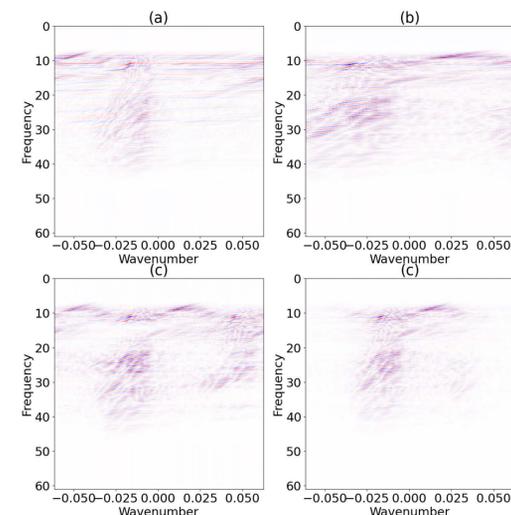Figure 3 shows the corresponding fk panels for this real data example.

Figure 3: Corresponding fk panels for real data example

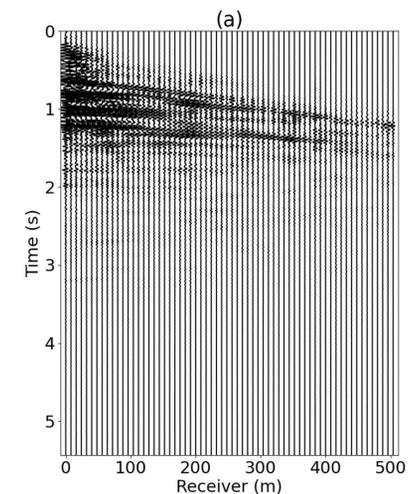Figure 4 shows the final result after the fk filter removes the ground roll.

Figure 4: Final result after the ground roll is removed.

Conclusions

We used residual dense network (RDN) to interpolate the seismic data with strong ground noise. The proposed method interpolated the seismic data with a strong ground roll successfully. Then a fk filter removes the ground roll from the interpolated seismic data.