Advancing in seismic data interpolation through Deep Convolutional Neural Network with Frame Interpolation technique

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Abstract

In order to enhance the volume of seismic data and improve the interpretation of stratigraphy, a cutting-edge methodology called Deep Convolutional Neural Network (DCNN) with Frame Interpolation technique was implemented. This methodology, originally developed for video applications and further extended to Ground Penetrating Radar (GPR) data, were adopted in this research to seismic interpolation data. Highlighting its versatility and broad applicability across different methods. To achieve this objective, the dataset employed in this study encompassed three distinct regions (designated as 1, 2, and 3), all situated within the same basin. Regions 1 and 3 exhibited a sparsity of 12.5 meters, while region 2 had a sparsity of 25 meters. Each region comprised a set of three consecutive real post-stack seismic sections labeled as A, B, and C, which were parallel and equidistant from each other. These well-defined regions, along with their corresponding data, provided the input data consisting of sections A and C, as well as section B, intermediate data, for comparison and validation of the interpolation data's similarity. In alignment with established it in the literature, the data were processed and exported standardized to have the same pixel density, length dimensions, and depth equivalents across the sections for each region. This ensured consistency and comparability in the quantification analysis. The frame interpolation technique employed involves the generation of an interpolated frame denoted as B' in this research. This frame was synthesized by combining seismic section images A and C, each consisting of pixels arranged in an m x n pixels size. The efficacy of the proposed methodology was evaluated by quantifying the similarity between the interpolated DCNN data (B') and the actual intermediate data (B) through the calculation of cross-correlation coefficients for each dataset. The obtained results revealed that the coefficient between these two sections were approximated equal to one, indicating a high degree of similarity. It validates the successful adaptation and implementation of the DCNN Frame Interpolation method and confirms the efficacy in reproduces seismic data.