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## Abstract

Here we propose a deep learning approach to the problem of first break picking. In contrast to existing techniques, which are often based on single trace measurements, the deep learning approach leverages tools from the field of machine vision to tackle the problem of identifying the first arrival time.

Since the first automated first break picking method - based on cross-correlation was proposed, numerous automated picking algorithms have been developed, aiming to compute feasible results in production applications. However, these algorithm-based methods tend to fail when the data are contaminated with noise, as is the case for the many field datasets. As such, automated first break picking remains a challenging problem. In recent years machine learning has become the most noticeable new direction in seismic data processing, utilizing new computation strategies and algorithms, together with increased computer power to address the challenges. We explore how machine vision tools can be utilized to address the issue of automated first break picking in low S/N environments. One of key challenges is to determine how the physical problem of first break picking can be translated into a framework that will allow algorithms to deduct solutions that can match human-picked solutions.

The method is based on supervised learning. This requires properly labelled data to train the neural network to identify first breaks. An enhanced first break picking approach tool was used to provide this training data. The neural network architecture we have used is based on the famous U-Net architecture by Ronneberger (2015), as shown in Figure 1. In addition, we have added residual block as introduced by He (2015). The method uses a conventional single trace picking tool to generate initial picks, which are then median filtered and fit with piece-wise linear events. This is then used to generate a mask of pre- and post-first break training data. The first break picking problem then reduces to a segmentation problem where we need to classify each sample of the shot gather and decide whether it occurs pre- or post-first break. A result is shown in Figure 2.

We propose a novel method for picking first breaks on seismic data. Traditional methods often rely on analyzing a variety of single trace attributes to determine the first arrival onset. These techniques can have difficulty with noisy traces. Our method aims to utilize techniques from the field of machine vision to interpret the gather as a whole and provide a more robust solution in the presence of noisy data.