CRS-based tau-p transform

German Garabito*[1], Paul Stoffa[2]; [1]UFRN-Brasil, [2]UTIG-USA

Abstract

The Common Reflection Surface (CRS) stacking operator has several applications in reflection seismic problems, such as zero-offset data simulation, prestack beam-type migration, prestack data regularization, among others. In 2D, this stacking operator depends on three kinematic wavefront attributes, also called CRS attributes, which are automatically extracted from the prestack data using global optimization algorithms. On the other hand, the tau-p transform or slant stack, is well established in seismic data processing and has several applications, such as beam-steering, multiple attenuation, velocity analysis, etc.

To perform the tau-p transform of seismic records in the common-shot (CS) configuration, we present a new approach of tau-p transform combined with local CRS stacking. In this new algorithm, the first step is to determine the three CRS attributes from the prestack data. The tau-p transform is then applied to the original prestack data, even with lost traces, gaps, irregular sampling, and low signal-to-noise ratio. This is possible because the CRS operator is used to apply local stacks of locally coherent events along the stacking lines defined for the ray parameters, i.e., a beam-stack is applied on-the-fly during the tau-p transformation.

To validate this new algorithm, we generated synthetic multi-coverage data from a simple layered model using a numerical finite difference solution of the acoustic wave equation. Since our goal is to analyze the reflection events, a first break mute was applied to the CS gathers. A gaussian random noise was added and, in the Figure 1a is shown a CS gather extracted from the data. The tau-p transformation was applied to this CS gather using the Seismic Unix package, and the result is shown in Figure 1b. Due to the noisy input data and its central gap, the data in the tau-p domain is also of poor quality, where the ellipses associated with the reflection event are obscured by the noise. Figure 1c shows the tau-p data obtained with the proposed algorithm directly from the prestack data for the same CS gather location. This result presents a good quality, with attenuated noise and enhanced coherent events in tau-p domain, making it suitable for applications in reflection seismic problems. This new algorithm will be applied to real data to prepare the input data for plane wave depth migration.

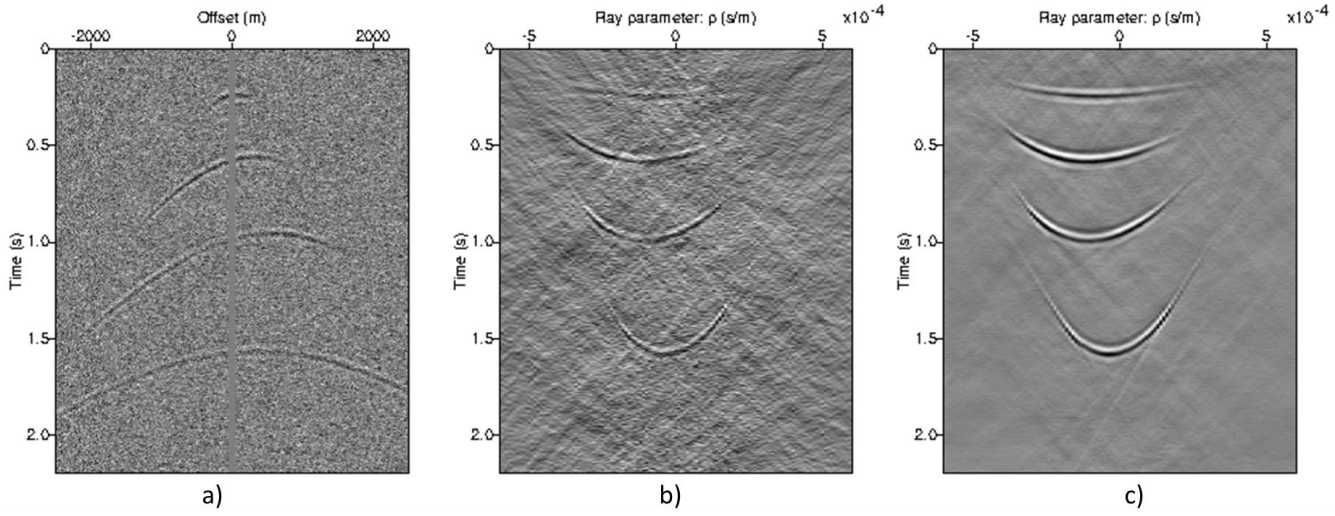

Figure 1 – Synthetic data: a) CS gather with a gap in the center and random noise added, b) tau-p section obtained from the CS gather shown in a) using the standard tau-p transform, and c) tau-p gather obtained from prestack noisy data applying the CRS-based tau-p transform.