SUMMARY

[0006] A summary of certain embodiments disclosed herein is set forth below. It should be understood that these aspects are presented merely to provide the reader with a brief summary of these certain embodiments and that these aspects are not intended to limit the scope of this disclosure. Indeed, this disclosure may encompass a variety of aspects that may not be set forth below.

[0006a] According to a first aspect of the present disclosure, there is provided a method, including: receiving a set of seismic data including a seismic signal generated over the course of a set period of time as a time scale; partitioning the seismic signal into a predetermined number of partitioned seismic signals each associated with a respective fixed position associated with a respective time interval as a portion of the time scale, wherein predetermined number includes an integer value greater than one; applying a pulse compression technique to each partitioned seismic signal of the predetermined number of partitioned seismic signals to generate a compressed partitioned seismic signal corresponding to each partitioned seismic signal of the predetermined number of partitioned seismic signals; and inserting the compressed partitioned seismic signal corresponding to each partitioned seismic signal of the predetermined number of partitioned seismic signals in parallel into a velocity model builder and summing generated results therefrom to model the seismic signal for the time scale.

[0006b] According to a fourth aspect of the present disclosure, there is provided a method, including: receiving a set of seismic data including a seismic signal generated over the course of a set period of time as a time scale; partitioning the seismic signal into a predetermined number of partitioned seismic signals each associated with a respective fixed position associated with a respective time interval as a portion of the time scale, wherein predetermined number includes an integer value greater than one; inserting a delta function at a first location into a velocity model builder and recording the resulting wavefield at each respective fixed position; convolving the resulting wavefield at each respective fixed position with its corresponding partitioned seismic signal of the predetermined number of partitioned seismic signals in parallel; and summing the generated results from the convolving of the resulting wavefield at each respective fixed position with its corresponding partitioned seismic signal of the predetermined number of partitioned seismic signals to model the seismic signal for the time scale.

[0006c] According to a third aspect of the present disclosure, there is provided a tangible, non-transitory, machine-readable media, including instructions that when executed cause a processor to: receive a set of seismic data including a seismic signal generated over the course of a set period of time as a time scale; partition the seismic signal into a predetermined number of partitioned seismic signals each associated with a respective fixed position associated with a respective time interval as a portion of the time scale, wherein predetermined number includes an integer value greater than one; apply a pulse compression technique to each partitioned seismic signal of the predetermined number of partitioned seismic signals to generate a compressed partitioned seismic signal corresponding to each partitioned seismic signal of the predetermined number of partitioned seismic signals; insert the compressed partitioned seismic signal corresponding to each partitioned seismic signal of the predetermined number of partitioned seismic signals in parallel into a velocity model builder and sum generated results therefrom to generate first summed results; insert a delta function at a first location into the velocity model builder and record the resulting wavefield at each respective fixed position; convolve the resulting wavefield at each respective fixed position with its corresponding partitioned seismic signal of the predetermined number of partitioned seismic signals in parallel; sum the generated results from the convolving of the resulting wavefield at each respective fixed position with its corresponding partitioned seismic signal of the predetermined number of partitioned seismic signals to generate second summed results; and model the seismic signal for the time scale utilizing the first summed results and the second summed results.

[0007] Vibratory marine seismic sources are a topic of renewed interest in seismic acquisition. Marine sources are generally moving while sourcing, so a vibratory source's "shot point" will generally be spread out along the source's path, introducing a new complication for processing compared to traditional impulsive sources. If the source signature duration is relatively short, or the data are acquired with the sources and receivers moving together (e.g. streamer acquisition), or the moving sources or receivers are densely sampled, then there are existing methods for pre-processing the data to correct for the motion. After the correction, traditional processing (which assumes the sources and receivers are stationary) will then be applied to process the seismic data.

[0008] However, data generated from extended-duration or continuous sources shooting into stationary receivers, especially when the sources are sparsely sampled, may not be amenable to the pre-processing approach outlined above. In such cases, the sources' motion may instead be included in the wavefield extrapolation step of the processing algorithm (e.g. modeling, migration, inversion, etc.). However, inclusion of the motion of the sources may cause the processing to be less efficient.

[0009] For example, if the vibratory source's signature lasts for 100 seconds, but the waves of interest traverse the model in 20 seconds, their sum (120 seconds of propagation time) is modeled to capture the desired output. However, if the source were a traditional impulsive source instead of a vibratory source, modeling 20 seconds of propagation time would be sufficient to capture the desired result. Thus, brute-force modeling of the vibratory source's signature is 6 times more costly in view of the additional propagation time that is modeled.

[0010] For the case of a non-moving vibratory source, deconvolution or pulse compression can be utilized to cause the signature of the source to be more impulsive prior to injecting it into the numerical model to improve efficiency (similar to techniques for processing data from land vibratory sources). However, direct application of this technique may not yield accurate results when the seismic source is moving while sounding.