application.

## SUMMARY

**[0008]** 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.

**[0008a]** According to a first aspect of the present disclosure, there is provided a method of seismic exploration above a region of subsurface containing structural or stratigraphic features conducive to determining a presence, migration, or accumulation of hydrocarbons, the method including: accessing a seismic dataset of a seismic survey that images at least a portion of a predetermined volume of Earth; sorting the seismic dataset into a time or depth and space domain such that the seismic response by the Earth is coherent in the sorted domain to generate a sorted seismic dataset; splitting the seismic dataset in time or depth and space domain into smaller overlapping windows of at least one sub-dataset; calculating a multi-dimension Fourier transform spectrum from each sub-dataset to produce multi-dimension Fourier transformed data; determining a plurality of maximum frequency spectral values from the multi-dimension Fourier transformed data, wherein each maximum frequency spectral value of the plurality of maximum frequency spectral values corresponds to a maximum energy value at a particular frequency of a set of frequencies of a seismic frequency spectrum; selecting a plurality of threshold values, wherein each threshold value of the plurality of threshold values corresponds to one frequency of the set of frequencies; decrementing each threshold value of the plurality of threshold values iteratively to generate a decremented threshold value corresponding to each frequency of the set of frequencies; generating a modified Fourier transformed dataset, wherein the modified Fourier transformed dataset is modified by setting Fourier samples of the multi-dimension Fourier transform spectrum having an energy magnitude less than the decremented threshold value at each frequency of the set of frequencies to zero; inverse transforming the modified Fourier transformed dataset to generate a plurality of interpolated traces; substituting each interpolated trace of the plurality of interpolated traces into originally empty traces of the seismic dataset where no seismic energy is acquired in data acquisition; repeating a Fourier transform, thresholding and inverse transform until the threshold value is sufficiently small to create a modified sub-dataset as an interpolated seismic sub-dataset; and merging all overlapping windows of the interpolated seismic sub-dataset to create an interpolated seismic data to be utilized to explore for hydrocarbons within at least the portion of the predetermined volume of the Earth.

**[0008b]** According to a second aspect of the present disclosure, there is provided a tangible, non-transitory, machine readable media, including instructions configured to cause a processor to: access a seismic dataset of a seismic survey that images at least a portion of a predetermined volume of Earth, sort the seismic dataset into a time or depth and space domain such that the seismic response by the Earth is coherent in the sorted domain to generate a sorted seismic dataset, splitting the seismic dataset in time or depth and space domain into smaller overlapping windows of at least one sub-dataset; calculate a multi-dimension Fourier transform spectrum from each sub-dataset to produce multi-dimension Fourier transformed data; determine a plurality of maximum frequency spectral values from the multi-dimension

Fourier transformed data, wherein each maximum frequency spectral value of the plurality of maximum frequency spectral values corresponds to a maximum energy value at a particular frequency of a set of frequencies of a seismic frequency spectrum; select a plurality of threshold values, wherein each threshold value of the plurality of threshold values corresponds to one frequency of the set of frequencies; decrement each threshold value of the plurality of threshold values iteratively to generate a decremented threshold value corresponding to each frequency of the set of frequencies; generate a modified Fourier transformed dataset, wherein the modified Fourier transformed dataset is modified by setting Fourier samples of the multi-dimension Fourier transform spectrum having an energy magnitude less than the decremented threshold value at each frequency of the set of frequencies to zero; inverse transform the modified Fourier transformed dataset to generate a plurality of interpolated traces; and substitute each interpolated trace of the plurality of interpolated traces into the empty traces of the seismic dataset where no seismic energy is acquired in data acquisition; repeat a Fourier transform, thresholding and inverse transform until the threshold value is sufficiently small to create a modified sub-dataset as an interpolated seismic sub-dataset; and merge all overlapping windows of the interpolated seismic sub-dataset to create an interpolated seismic data to be utilized to explore for hydrocarbons within at least the portion of the predetermined volume of the Earth.

**[0008c]** According to a third aspect of the present disclosure, there is provided a method of seismic exploration above a region of subsurface containing structural or stratigraphic features conducive to determining a presence, migration, or accumulation of hydrocarbons, the method including: accessing a seismic dataset of a seismic survey that images at least a portion of a predetermined volume of Earth, setting a residual to the seismic dataset; combing the residual into a common receiver gather; splitting the common receiver gather into smaller overlapping windows of at least one sub-dataset; calculating a multi-dimension Fourier transform spectrum from each sub-dataset to produce multi-dimension Fourier transformed data; determining a plurality of maximum frequency spectral values from the multi-dimension Fourier transformed data, wherein each maximum frequency spectral value of the plurality of maximum frequency spectral values corresponds to a maximum energy value at a particular frequency of a set of frequencies of a seismic frequency spectrum; selecting a plurality of threshold values, wherein each threshold value of the plurality of threshold values corresponds to one frequency of the set of frequencies; decrementing each threshold value of the plurality of threshold values iteratively to generate a decremented threshold value corresponding to each frequency of the set of frequencies; generating a modified Fourier transformed dataset, wherein the modified Fourier transformed dataset is modified by setting Fourier samples of the multi-dimension Fourier transform spectrum having an energy magnitude less than the decremented threshold value at each frequency of the set of frequencies to zero; inverse transforming the modified Fourier transformed dataset to generate a plurality of deblended traces; merging all windows of the at least one sub-dataset from the inverse Fourier transform to create a deblended common receiver gather; updating a primary signal estimate utilizing the deblended gather to generate an updated primary signal estimate; updating the residual based upon the updated primary signal estimate to generate an updated residual; repeating the primary signal estimate by combing the updated residual and continuing the processing steps above until the residual is sufficiently small; outputting the updated primary signal estimate as a deblended result to be utilized to explore for hydrocarbons within at least the portion of the predetermined volume of the Earth.

**[0009]** Seismic acquisition utilizing sources and receivers may be useful in the generation of, for example, seismic images. Seismic images may be used, for example, in the determination of hydrocarbon deposits (e.g., areas within a subsurface that contain hydrocarbons) and/or subsurface drilling hazards. Seismic images are generally produced using seismic waveforms produced by a source, reflected off regions within a subsurface, and received by one or more receivers. However, gaps in received seismic data may limit the accuracy of the generated seismic images.

**[0010]** A Projection Onto Convex Sets ("POCS") interpolation algorithm interpolation scheme may be implemented that utilizes existing trace data to construct new data points in the skips or gaps of the received seismic data. However, the implemented POCS interpolation algorithm described herein includes parallelization of thresholding across all frequency bands, beginning with maximum threshold values generated from every individual frequency or frequency band. In this manner, the reconstruction/interpolation/deblending will work on all frequency bands based on the events' coherence relative to other events' coherence within every frequency band. An advantage of this technique can be that there may be a significant reduction on the number of iterations, i.e., by a factor of 10 or more, relative to a implementation of other POCS interpolation algorithms, which reduces the cost and/or time needed to implement interpolation using the POCS interpolation algorithm while simultaneously providing for greater accuracy in seismic data generated with respect to certain frequencies of a seismic frequency spectrum, allowing for greater availability of the present POCS interpolation algorithm to be applied to datasets.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0011]** Various aspects of this disclosure may be better understood upon reading the following detailed description and upon reference to the drawings in which:

**[0012]** FIG. 1 illustrates a flow chart of various processes that may be performed based on analysis of seismic data acquired via a seismic survey system, in accordance with embodiments presented herein;

**[0013]** FIG. 2 illustrates a marine survey system in a marine environment, in accordance with embodiments presented herein;

**[0014]** FIG. 2A illustrates a second marine survey system in a marine environment, in accordance with embodiments presented herein;

**[0015]** FIG. 3 illustrates a land survey system in a land environment, in accordance with embodiments presented herein;

**[0016]** FIG. 4 illustrates a computing system that may perform operations described herein based on data acquired via the marine survey systems of FIG. 2, FIG. 2A, and/or the land survey system of FIG. 3, in accordance with embodiments presented herein;