reflected, and, upon its return, is recorded using one or more receivers disposed on or above the subsurface region of the Earth. The seismic data recorded by the receivers may then be used to create an image or profile of the corresponding subsurface region.

[0005] Over time, as hydrocarbons are being extracted from the subsurface region of the Earth, the location, saturation, and other characteristics of the hydrocarbon reservoir within the subsurface region may change. As such, it may be useful to determine how the image or map of the subsurface region changes over time, such that the operations related to extracting the hydrocarbons may be modified to more efficiently extract the hydrocarbons from the subsurface region of the Earth.

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: determining a residual associated with input seismic data, wherein the residual indicates a difference between an expected input seismic data and the input seismic data, wherein the expected input seismic data is determined by blending estimated primary signals with time shifts applied to the estimated primary signals based on a time of seismic source excitations that generated primary signals, and wherein a primary signal estimate is initialized; iteratively updating a value of the residual based at least in part on separation operations, wherein the separation operations are configured to filter coherent signals, associated with either residual data a sum of the residual data and a current primary signal estimate, into a first subset of signals, and wherein the separation operations are configured to filter non-coherent signals associated with the residual data into a second subset of signals; generating additional coherent signals with correct timing from misplaced signals within the first subset of signals, at least in part by iteratively extracting and re-allocating a non-coherent part or a less-coherent part of the first subset of signals; and in response to satisfying an end condition, transmitting a deblended output that is determined based at least in part on the first subset of signals and the additional coherent signals and that is for use in generating a seismic image, wherein the seismic image represents hydrocarbons in a subsurface region of Earth or subsurface drilling hazards**.**

[0006b] 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: determine a residual associated with input seismic data, wherein the residual indicates a difference between expected input seismic data and the input seismic data; determine a deblended output based at least in part on the residual; update the deblended output based at least in part on a result from performing one or more recovery operations configured to recover coherent signals from a less-coherent part of the deblended output, wherein the coherent signals comprise a matching parameter; and transmit the deblended output for use in generating a seismic image, wherein the seismic image represents hydrocarbons in a subsurface region of Earth or subsurface drilling hazards.

[0006c] According to a third aspect of the present disclosure, there is provided a device including: a memory configured to store instructions; and a first processor coupled to the memory and configured to execute the instructions, which cause the processor to be configured to: determine a residual associated with input seismic data, wherein the residual indicates a difference between expected input seismic data and the input seismic data; update a value of the residual based at least in part on a separation operation that separates coherent signals from noise signals in an output associated with the residual, wherein the output associated with the residual is a remaining energy for separation or a sum of the residual and a primary signal estimate; extract non-coherent or weak-coherent energy from the coherent signals; generate additional coherent signals with correct timing based at least in part on a re-allocation of the non-coherent or the weak-coherent energy; in response to satisfying an end condition, determine a deblended output comprising the re-allocated non-coherent or weak-coherent energy from the output; and transmit the deblended output for use in generating a seismic image, wherein the seismic image represents hydrocarbons in a subsurface region of Earth or subsurface drilling hazards.

[0007] 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 based on seismic waveforms produced by a source that reflect off regions within a subsurface and are received by receivers. The seismic image may be constructed using a high resolution seismic velocity model, such as full waveform inversion (FWI) model a tomography model or the like applied, for example, via a

CLAIMS

1. A method, comprising:

determining a residual associated with input seismic data, wherein the residual indicates a difference between an expected input seismic data and the input seismic data, wherein the expected input seismic data is determined by blending estimated primary signals with time shifts applied to the estimated primary signals based on a time of seismic source excitations that generated primary signals, and wherein a primary signal estimate is initialized;

iteratively updating a value of the residual based at least in part on separation operations, wherein the separation operations are configured to filter coherent signals, associated with either residual data or a sum of the residual data and a current primary signal estimate, into a first subset of signals, and wherein the separation operations are configured to filter non-coherent signals associated with the residual data into a second subset of signals;

generating additional coherent signals with correct timing from misplaced signals within the first subset of signals, at least in part by iteratively extracting and re-allocating a non-coherent part or a less-coherent part of the first subset of signals; and

in response to satisfying an end condition, transmitting a deblended output that is determined based at least in part on the first subset of signals and the additional coherent signals and that is for use in generating a seismic image, wherein the seismic image represents hydrocarbons in a subsurface region of Earth or subsurface drilling hazards.

2. The method of claim 1, wherein iteratively updating the value of the residual based at least in part on the separation operations, comprises:

separating the residual or the sum of the residual data and the current primary signal estimate via the separation operations to generate the first subset of signals and the second subset of signals;

determining an updated primary signal estimate based at least in part on a current iteration count, wherein the updated primary signal estimate is configured to identify a coherent energy for a particular input seismic data collection period; and

generating the deblended output based at least in part on the updated primary signal estimate.

3. The method of claim 2, wherein the deblended output is the updated primary signal estimate, or a weighted sum of the updated primary signal estimate and a primary signal estimate from previous iterations.

4. The method of claim 1, wherein iteratively updating the value of the residual based at least in part on the separation operations comprises:

receiving the first subset of signals used to estimate a coherent energy for a particular input seismic data collection period; and

separating the first subset of signals into a third subset of signals and a fourth subset of signals, wherein the third subset of signals corresponds to coherent energy of the first subset of signals, and wherein the fourth subset of signals comprises noncoherent or less-coherent energy of the first subset of signals indicative of misallocated primary signals,

wherein the deblended output is generated based at least in part on combining the first subset of signals, the third subset of signals, and a fifth subset of signals, wherein the fifth subset of signals are extracted from the misallocated primary signals of the fourth subset of signals.

5. The method of claim 4, wherein the deblended output is generated based at least in part on combining the first subset of signals, the third subset of signals, and a fifth subset of signals, wherein the fifth subset of signals are extracted from the misallocated primary signals of the fourth subset of signals.

6. The method of claim 4, further comprising extracting the fifth subset of signals from the misallocated primary signals in the fourth subset of signals by:

blending the fourth subset of signals into a continuous data recording with time shifts applied to the signals based on the time of seismic source excitations to generate the signals;

combing the blended continuous data into a gather of data collection periods to generate combed gather data;

subtracting the fourth subset of signals from the combed gather data, wherein coherent signals are leaked into the fourth subset of signals to generate subtracted gather data; and

performing the separation operations on the combed gather data or the subtracted gather data to obtain the re-allocated coherent energy as the fifth subset of signals,

wherein updating the value of the residual comprises performing blending operations that use an updated primary signal estimate comprising the third subset of signals, the fourth subset of signals, and the fifth subset of signals.

7. The method of claim 5, wherein updating the value of the residual comprises performing blending operations that use an updated primary signal estimate comprising the third subset of signals, the fourth subset of signals, and the fifth subset of signals.

8. The method of claim 1, wherein the end condition comprises exceeding an iteration threshold associated with a maximum number of times the value of the residual is iteratively updated, and wherein the deblended output comprises a third subset of signals, a fourth subset of signals, and a fifth subset of signals, wherein the fifth subset of signals correspond to misplaced coherent signals recovered from the fourth subset of signals.

9. The method of claim 1, wherein the deblended output comprises a third subset of signals, a fourth subset of signals, and a fifth subset of signals, wherein the fifth subset of signals correspond to misplaced coherent signals recovered from the fourth subset of signals.

10. A tangible, non-transitory, machine-readable media, comprising instructions configured to cause a processor to:

determine a residual associated with input seismic data, wherein the residual indicates a difference between expected input seismic data and the input seismic data;

determine a deblended output based at least in part on the residual;

update the deblended output based at least in part on a result from performing one or more recovery operations configured to recover coherent signals from a less-coherent part of the deblended output, wherein the coherent signals comprise a matching parameter; and

transmit the deblended output for use in generating a seismic image, wherein the seismic image represents hydrocarbons in a subsurface region of Earth or subsurface drilling hazards.

11. The tangible, non-transitory, machine-readable media of claim 10, wherein the instructions further configured to cause the processor to, as part of the one or more recovery operations:

perform a separation operation on the deblended output to generate a first subset of signals associated with coherent signals of the deblended output and a second subset of signals associated with non-coherent signals of the deblended output;

recover a third subset of signals from the second subset of signals, wherein the third subset of signals comprises the coherent signals of the non-coherent signals of the deblended output; and

update the deblended output based at least in part on the third subset of signals resulting from performing one or more recovery operations.

12. The tangible, non-transitory, machine-readable media of claim 11**,** wherein the instructions configured to cause the processor to, as part of the one or more recovery operations:

perform blending and combing operations on the second subset of signals to generate combed gather data;

subtract the second subset of signals from the combed gather data, wherein coherent signals are leaked into the second subset of signals to generate subtracted gather data; and

after the blending, combing, and subtraction operations, perform an additional separation operation on the combed gather data or the subtracted gather data to generate the third subset of signals and a fourth subset of signals, wherein the third subset of signals are considered recovered coherent signals, and wherein the fourth subset of signals are considered non-coherent signals.

13. The tangible, non-transitory, machine-readable media of claim 11, wherein the instructions for updating the deblended output further comprise instructions configured to cause the processor to:

generate a primary signal estimate based at least in part on the third subset of signals, the second subset of signals and the first subset of signals;

compute the expected input seismic data by blending the primary signal estimate with time shifts applied to the primary signals before blending based on a time of seismic source excitations to generate the signals;

generate the residual based at least in part on a difference between the expected input seismic data and original input data;

perform deblending operations on the residual, or divide the residual by a blending fold; and

after performing the deblending operations or the division operations, update the deblended output based on the primary signal estimate and the results from the deblending operations or the division operations.

14. The tangible, non-transitory, machine-readable media of claim 13, wherein the primary signal estimate is generated by additively combining the third subset of signals, the second subset of signals, and the first subset of signals, and wherein the results from the deblending operations or the division operations on the residual.

15. The tangible, non-transitory, machine-readable media of claim 10, wherein the deblended output comprises one or more previously misplaced signals that have been captured and recombined with initially identified coherent signals associated with a primary signal estimate.

16. The tangible, non-transitory, machine-readable media of claim 10, wherein the one or more recovery operations are performed after the deblended output is determined.

17. The tangible, non-transitory, machine-readable media of claim 10, wherein the one or more recovery operations are associated with instructions to cause the processor to:

separate the deblended output into the coherent signals and non-coherent signals;

separate the non-coherent signals into additional coherent signals and additional non-coherent signals;

combine the additional coherent signals, and the coherent signals or the previously deblended output to update a value of the residual; and

update the deblended output based at least in part on the coherent signals or the previously deblended output, the additional coherent signals, and the updated value of the residual.

18. A device comprising:

a memory configured to store instructions; and

a first processor coupled to the memory and configured to execute the instructions, which cause the processor to be configured to:

determine a residual associated with input seismic data, wherein the residual indicates a difference between expected input seismic data and the input seismic data;

update a value of the residual based at least in part on a separation operation that separates coherent signals from noise signals in an output associated with the residual, wherein the output associated with the residual is a remaining energy for separation or a sum of the residual and a primary signal estimate;

extract non-coherent or weak-coherent energy from the coherent signals;

generate additional coherent signals with correct timing based at least in part on a re-allocation of the non-coherent or the weak-coherent energy;

in response to satisfying an end condition, determine a deblended output comprising the re-allocated non-coherent or weak-coherent energy from the output; and

transmit the deblended output for use in generating a seismic image, wherein the seismic image represents hydrocarbons in a subsurface region of Earth or subsurface drilling hazards.

19. The device of claim 18, wherein the instructions further cause the first processor, as part of the generating of the additional coherent signals with correct timing, to be configured to:

extract misallocated energy from the primary signal estimate; and

generate coherent signals associated with suitable timing from the misallocated energy at least in part by re-allocating the misallocated energy to the primary signal, wherein updating the value of the residual is configured to be part of an iterative process performed before determining the deblended output, and wherein the iterative process comprises updating, at each iteration, the primary signal estimate to include the additional coherent signals from previously determined coherent but misallocated signals.

20. The device of claim 18, further comprising a second processor configured to update the value of the residual after determining a final deblended output as part of retrofitted operations performed in addition to operations configured to be preexisting, such that the final deblended output is improved, and wherein the second processor is configured to output an improved deblended output as the deblended output, wherein the improved deblended output comprises at

least some recovered coherent signals from the noise signals associated with the final deblended output.