source is activated, the source generates a seismic (e.g., sound wave) signal that travels downward through the Earth, is 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 and (e.g., overburden) 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 invention, there is provided a method for determining a displacement seismic image between a first seismic image and a second seismic image, including: receiving, via a processor, the first seismic image and the second seismic image, wherein the first seismic image and the second seismic image are representative of one or more geological formations within a subsurface region of the Earth; generating, via the processor, a first scaled image based on the first seismic image and a second scaled image based on the second seismic image; obtaining, via the processor, a scaled displacement volume between the first scaled seismic image and the second scaled image; determining, via the processor, a displacement volume based on the scaled displacement volume and a scaling function used to generate the first and second scaled images based on the first and second seismic images; generating, via the processor, a third seismic image by applying the displacement volume to the

second seismic image, wherein one or more seismic events depicted in the third seismic image are aligned with one or more seismic events depicted in the first seismic image; and determining, via the processor, an image of a difference volume between the first seismic image and the third seismic image for display on a display or other tangible element, wherein the image represents how production of hydrocarbons in the subsurface region of the Earth has affected the subsurface region of the Earth over time.

[0006b] According to a second aspect of the present invention, there is provided a non-transitory computer-readable medium, including computer-executable instructions configured to cause a processor to: receive a first seismic image and a second seismic image, wherein the first seismic image and the second seismic image are representative of one or more geological formations within a subsurface region of the Earth; determine an displacement volume between the first seismic image and the second seismic image using an optical flow algorithm; iteratively refine the displacement volume between the first seismic image and the second seismic image based on the optical flow algorithm; and generate a third seismic image by applying the iteratively refined displacement volume to the second seismic image, wherein one or more seismic events depicted in the third seismic image are aligned with one or more seismic events depicted in the first seismic image.

[0006c] According to a third aspect of the present invention, there is provided a method for drilling into a subsurface region of the Earth, including: analyzing a displacement volume between a first seismic image and a second seismic image associated with the subsurface region; and performing one or more drilling operations or one or more production operations into the subsurface region based on an analysis of a displacement seismic image, wherein the displacement seismic image is determined by: receiving, via a processor, the first seismic image and the second seismic image; generating, via the processor, a first scaled image based on the first seismic image and a second scaled image based on the second seismic image; obtaining, via the processor, a scaled displacement volume between the first scaled seismic image and the second scaled image; determining, via the processor, a displacement volume based on the scaled displacement volume and a scaling function used to generate the first and second scaled images based on the first and second seismic images; iteratively refining, via the processor, the

displacement volume between the first and second images based on an optical flow algorithm; generating, via the processor, a third seismic image by applying the iteratively refined displacement volume to the second seismic image, wherein one or more seismic events depicted in the third seismic image are aligned with one or more seismic events depicted in the first seismic image; and determining, via the processor, the image of the difference volume based on the first seismic image and the third seismic image.

[0006d] According to a fourth aspect of the present invention, there is provided a method for determining a displacement seismic image between a first seismic image and a second seismic image, including: receiving, via a processor, the first seismic image and the second seismic image, wherein the first seismic image and the second seismic image are representative of one or more geological formations within a subsurface region of the Earth; generating, via the processor, a first scaled image based on the first seismic image and a second scaled image based on the second seismic image; obtaining, via the processor, a scaled displacement volume between the first scaled seismic image and the second scaled image; determining, via the processor, a displacement volume based on the scaled displacement volume and a scaling function used to generate the first and second scaled images based on the first and second seismic images; generating, via the processor, a third seismic image by applying the displacement volume to the second seismic image, wherein one or more seismic events depicted in the third seismic image are aligned with one or more seismic events depicted in the first seismic image; and determining, via the processor, an image of a difference volume between the first seismic image and the third seismic image for display on a display or other tangible element, wherein the image represents how production of hydrocarbons in the subsurface region of the Earth has affected the subsurface region of the Earth over time.

[0006e] According to a fifth aspect of the present invention, there is provided a non-transitory computer-readable medium, including computer-executable instructions configured to cause a processor to: receive a first seismic image and a second seismic image, wherein the first seismic image and the second seismic image are representative of one or more geological formations within a subsurface region of the Earth; determine an displacement volume between the first seismic image and the second seismic image using an optical flow algorithm; iteratively refine

the displacement volume between the first seismic image and the second seismic image based on the optical flow algorithm; and generate a third seismic image by applying the iteratively refined displacement volume to the second seismic image, wherein one or more seismic events depicted in the third seismic image are aligned with one or more seismic events depicted in the first seismic image.

[0007] Seismic data processing, such as seismic data registration, may involve determining a multi-dimensional displacement volume (which may be a shift solution indicative of position differences between corresponding events in two seismic images or datasets). Generally, the two seismic images may be acquired at two different times, but it should be noted that the seismic data registration techniques may also be performed