

CLAIMS

1. An exploration-seismology computer system that corrects for streamer-depth bias in a fluid-surface profile, the exploration-seismology computer system comprising:
 - 5 one or more processors;
 - one or more data-storage devices; and
 - a routine stored in one or more of the one or more data-storage devices and to be executed by the one or more processors, the routine directed to
 - determining a set of image points associated with the fluid-surface
 - 10 profile of a fluid located above a streamer based on pressure and velocity wavefields measured at dual sensors of the streamer, and
 - determining an elevation parameter of the image points that reduces a DC offset in a spectral domain of the image points, the elevation parameter to correspond to the streamer-depth bias.
- 15 2. The computer system of claim 1, further comprising the routine stored in the one or more of the one or more data-storage devices further directed to:
 - receiving seismic data from the dual sensors, the seismic data representative of pressure wavefields and velocity wavefields;
 - 20 measuring hydrostatic pressures at depth controllers spaced along the streamer;
 - estimating a streamer depth at one or more depth controllers, based on the hydrostatic pressures; and
 - generating an interpolated streamer that approximates the wave-like configuration of the streamer based on the estimated streamer depths.
- 25 3. The computer system of claim 1, wherein determining a set of image points associated with the fluid-surface profile further comprises:
 - decomposing the wavefield into an up-going component and a down-going component at an arbitrary observation level located between an estimated streamer
 - 30 depth and a geoid;

for each dual sensor of the streamer,

extrapolating the up-going and down-going components from the observation level toward the geoid by computing a series of extrapolation points that extend from the arbitrary observation level toward the geoid;

5 applying an imaging condition to each extrapolation point; and
 determining an image point that corresponds to a maximum image value of the imaging condition.

4. The computer system of claim 3, wherein decomposing the wavefield into an
10 up-going component and a down-going component further comprises decomposing the pressure wavefield in a space-time domain into an up-going pressure component and a down-going pressure component in a wavenumber-frequency domain.

5. The computer system of claim 3, wherein decomposing the wavefield into an
15 up-going component and a down-going component further comprises decomposing the velocity wavefield in a space-time domain into an up-going vertical velocity component and a down-going vertical velocity component in a wavenumber-frequency domain.

6. The computer system of claim 3, wherein extrapolating the up-going and down-
20 going components further comprises iteratively extrapolating the up-going and down-going components from the arbitrary observation level upwards through the fluid toward the geoid at each dual sensor location.

7. The computer system of claim 3, wherein the imaging condition further
25 comprises a cross correlation of the up-going component and the down-going component in a space-frequency domain.

8. The computer system of claim 1, wherein determining the elevation parameter of the image points that reduces a DC offset in the spectral domain further comprises:

applying a shift factor that vertically displaces the image points in a spatial domain;

transforming the image points from the spatial domain to a spectral domain to obtain a spectrum in the spectral domain;

5 identifying the DC offset in the spectrum; and

repeatedly applying the shift factor, transforming the image points and identifying the DC offset until a minimum DC offset is obtained, wherein the total amount by which the image points are vertically displaced is the elevation parameter.

10 9. The computer system of claim 8, wherein transforming the image points from the spatial domain to a spectral domain further comprises applying a discrete Fast Fourier-transform computational operator to each of the image points in the spatial domain to obtain a point in the spectral domain.

15 10. The computer system of claim 8, wherein the spectral domain further comprises a horizontal-wavenumber domain.

11. A method to be carried out by a computer system that includes one or more processors and one or more data-storage devices to correct streamer-depth bias in a fluid-surface profile, the method comprising:

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determining a set of image points associated with the fluid-surface profile of a fluid located above a streamer based on pressure and velocity wavefields measured at dual sensors of the streamer;

determining an elevation parameter of the image points that reduces a DC offset in a spectral domain of the image points, the elevation parameter to correspond to the streamer-depth bias; and

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storing the elevation parameter in a data storage device.

12. The method of claim 11, further comprising:

receiving seismic data from the dual sensors, the seismic data representative of pressure wavefields and velocity wavefields;

measuring hydrostatic pressures at depth controllers spaced along the streamer;

5 estimating a streamer depth at one or more depth controllers, based on the hydrostatic pressures; and

generating an interpolated streamer that approximates the wave-like configuration of the streamer based on the estimated streamer depths.

13. The method of claim 11, wherein determining a set of image points associated
10 with the fluid-surface profile further comprises

decomposing the wavefield into an up-going component and a down-going component at an arbitrary observation level located between an estimated streamer depth and a geoid;

for each dual sensor of the streamer,

15 extrapolating the up-going and down-going components from the arbitrary observation level toward the geoid by computing a series of extrapolation points that extend from the arbitrary observation level toward the geoid;

applying an imaging condition to each extrapolation point; and

20 determining an image point that corresponds to a maximum image value of the imaging condition.

14. The method of claim 13, wherein decomposing the wavefield into an up-going component and a down-going component further comprises decomposing the pressure
25 wavefield in a space-time domain into an up-going pressure component and a down-going pressure component in a wavenumber-frequency domain.

15. The method of claim 13, wherein decomposing the wavefield into an up-going component and a down-going component further comprises decomposing the velocity

wavefield in a space-time domain into an up-going vertical velocity component and a down-going vertical velocity component in a wavenumber-frequency domain.

16. The method of claim 13, wherein extrapolating the up-going and down-going components further comprises iteratively extrapolating the up-going and down-going components from the arbitrary observation level upwards through the fluid toward the geoid at each dual sensor location.

17. The method of claim 13, wherein the imaging condition further comprises a cross correlation of the up-going component and the down-going component in the space-frequency domain.

18. The method of claim 11, wherein determining the elevation parameter of the image points that reduces a DC offset in the spectral domain further comprises:

15 applying a shift factor that vertically displaces the image points in a spatial domain;

transforming the image points from the spatial domain to a spectral domain to obtain a spectrum in the spectral domain;

identifying the DC offset in the spectrum; and

20 repeatedly applying the shift factor, transforming the image points and identifying the DC offset until a minimum DC offset is obtained, wherein the total amount by which the image points are vertically displaced is the elevation parameter.

19. The method of claim 18, wherein transforming the image points from the spatial domain to a spectral domain further comprises applying a discrete Fourier-transform computational operator to each of the image points in the spatial domain to obtain a point in the spectral domain.

20. The method of claim 18, wherein the spectral domain further comprises a horizontal-wavenumber domain.