Seismic Modeling, Migration and Inversion

Questions

Bee Bednar

Panorama Technologies, Inc.
14811 St Marys Lane, Suite 150
Houston TX 77079

May 16, 2011

Outline

Outline

Questions

- 1. A chief cause of anisotropy in rocks is due to
  - a. Rock texture such as lamination, fractures or cracks
  - b. The volume of absorbed fluids
  - c. Sub-areal exposure
  - d. Metamorphosis
- 2. Exposed shales are easily recognize by
  - a. Lamination
  - b. Talus slopes
  - c. Their characteristic black color
  - d. The number of fossils
- 3. Shear velocities in rocks are
  - a. A function of their compressional modulus
  - b. A function of the shear modulus
  - c. Both a and b
  - d. None of the above
- 4. Orthorhombic isotropy is characterized by
  - a. Five independent volumes
  - b. Twenty-one independent volumes
  - c. Nine independent volumes
  - d. Eighteen independent volumes

Panorama Technologies

Questions

- 5. Tilted Transverse Isotropy refers to
  - a. Orthorhombic isotropy with a vertical symmetry axis
  - b. Vertical Transverse Isotropy with a tilted axis of symmetry
  - c. An isotropic elastic medium with a horizontal symmetry axis
  - d. None of the above
- 6. Beam migrations are based on
  - a. Ray tracing light beams in constant velocity
  - b. Estimates of the local subsurface dip
  - c. Estimates of apparent dip
  - d. Smearing trace amplitudes over equal travel time curves
- 7. The difference between time and depth migration is
  - a. None
  - b. Time migration image along image rays while depth migration images along vertical rays
  - c. Time migration images along vertical trays while depth migration images along image rays
  - d. Time migration uses a full 3D velocity volume while depth migration uses a different velocity for each output location
- 8. The migration approach that is closest to true amplitude is
  - a. Full two-way (reverse time migration)
  - b. Kirchhoff prestack time migration
  - c. Gaussian Beam migration
  - d. One-way phase screen with one additional bounce

Panorama Technologies

Questions

- 9. Two distinct rays arriving at a fixed subsurface point
  - a. Can have identical take-off angles
  - b. Can have identical incident angles
  - c. Can have different take-off angles but identical incidence angles
  - d. None of the above
- 10. The full wave-equation is based on
  - a. NewtonÕs second law of motion and HookeÕs law
  - b. HookeÕs law
  - c. NewtonÕs second law of motion
  - d. NewtonÕs law of gravitational attraction
- 11. Forward modeling
  - a. Has no part in seismic migration
  - b. ItÕs the basis for all migration algorithms
  - c. Is used to forward propagate time-reversed trace
  - d. Both b and c
- 12. The aliasing of dipping events
  - a. Is related only to dip
  - b. Is related to dip and frequency
  - c. Is a relationship between surface spacing, dip, and frequency
  - d. None of the above

Panorama Technologies

Questions

- 13. Mathematically, wave equation based migration algorithms
  - a. Assume that the Earth consists of flat layers
  - b. Assume that the sources and receivers are actually arrays
  - c. Assume that sources and receivers are point sources and receivers
  - d. Assume that the source is a line source and the receivers are point receivers
- 14. Kirchhoff migration
  - a. Is not wave equation based
  - b. Is based on an approximation to the wave equation
  - c. Cannot resolve steeply dipping events
  - d. Both b and c
- 15. Phase Screen migration
  - a. Is a full two-way method
  - b. Is not based on factorization of the wave equation into two one-way equations
  - c. Correctly handles dips steeper than 90 degrees
  - d. Cannot images turning rays
- 16. Gaussian Beam migration
  - a. Is misnamed. Its not really a beam based method
  - b. Is a beam based method that images only on the central ray
  - c. Is a beam based method that images only off the central ray
  - d. Is a beam based method that images along and off the central ray

Panorama Technologies

Questions

- 17. When properly implemented, Gaussian Beam migration
  - a. Is very close to a true two-way method
  - b. Is the best one-way method available
  - c. Images up to 108 degrees but no higher
  - d. Is based on factorization of the wave equation into two one-way equations
- 18. Full waveform inversion
  - a. Computes AVO slope and intercept to estimate subsurface velocities
  - b. Had nothing to do with modeling or migration
  - c. Is a method utilizing both full waveform (two-way) modeling and migration to directly estimate Earth models
  - d. Can be applied only to marine data
- 19. Full waveform inversion
  - a. Can only be used in 2D
  - b. Is an iterative optimization scheme that uses reverse-time-migration to calculate the velocity model update
  - c. Can only be used in 3D
  - d. Calculates the velocity model update through tomographic raytracing
- 20. According to mathematical theory
  - a. Migration is independent of acquisition geometry and design
  - b. Migration requires acquisition at the largest possible spacings
  - c. Wide azimuth densely spaced acquisition is optimum
  - d. None of the above

Panorama Technologies

Questions

- 21. Acquisition design
  - a. Has no affect on frequency content
  - b. Is independent of sample increments
  - c. Is optimum when the spacing is as large as possible
  - d. Is optimum when the spacing is as small as possible
- 22. V_{nmo} velocity is defined to be
  - a. The best estimate of vertical or well velocity
  - b. When divided by two is a good estimate of horizontal shear velocity
  - c. The best estimate of horizontal velocity
  - d. That velocity which produces the best image when used in an isotropic migration algorithm
- 23. The anisotropic parameter δ
  - a. Can be thought of as governing horizontal wave speed
  - b. Can be thought of as governing percentage depth misties
  - c. Is given by the ratio of the horizontal velocity to the vertical velocity minus 1
  - d. Is a function of the two shear velocities in anisotropic propagation
- 24. The anisotropic parameter ϵ
  - a. Can be thought of as governing horizontal wave speed
  - b. Can be thought of as governing percentage depth misties
  - c. Is given by the formula $.5(\frac{V_{nmo}}{V_{vert}} - 1)$
  - d. Is a function of the two shear velocities in anisotropic propagation

Panorama Technologies

Questions

- 25. Anisotropic waves
  - a. Consists of a compressional wave and two shear waves, one of which is faster than the other
  - b. Propagate with velocities that are angle dependent
  - c. Constantly convert from on type to the other depending on the local rock properties
  - d. All of the above
- 26. Based on theory and case studies
  - a. Single linear array of receivers produces the best results
  - b. Wide azimuth acquisition is better than all other methods
  - c. Optimal acquisition is independent of receiver placement
  - d. None of the above
- 27. Theoretical analysis, case studies, and synthetic tests
  - a. Have shown that full waveform inversion does not work
  - b. Have shown that inversion requires very high frequency acquisition to be effective
  - c. Have shown that full wave form always performs perfectly
  - d. Have shown that low frequencies are more important than high frequencies
- 28. Migration algorithms
  - a. Cannot provide information about velocity errors
  - b. Provide algorithm dependent indicators of velocity errors
  - c. Are insensitive to velocity errors
  - d. Work best when applied in the time domain

Panorama Technologies

Questions

- 29. All depth migration algorithms can be thought of as working in the following manner
  - a. Forward propagation of a source and backward propagation of recorded data followed by application of an imaging condition
  - b. Laterally shifting dipping events to the proper subsurface position followed by a shift to the proper depth
  - c. Moving a an event with an apparent dip at a given recorded time to its true location at the termination or a ray whose take-off angle is determined by its dip
  - d. All of the above
- 30. Raytracing is an integral part of
  - a. Gaussian Beam Migration
  - b. Classical Beam Migration
  - c. Kirchhoff Migration
  - d. All of the above