Glossary

acoustic impedance: A rock property equal to the product of the rock density with its compressional-wave velocity. Acoustic impedance is the resistance offered to propagating compressional waves. Acoustic impedance serves as a rough inverse indicator of porosity in young clastic sequences.

amplitude: The magnitude of the seismic trace values. Amplitude is the most important seismic property and is quantified by many attributes including reflection strength, rms amplitude, and average absolute amplitude.

amplitude acceleration: The second derivative of the logarithm of the instantaneous amplitude. It reveals discontinuities and fine details but appears noisy.

apparent polarity: The sign of the trace at envelope maxima, held constant in each interval bounded by envelope minima, and scaled by the reflection strength. Apparent polarity is a response attribute.

arc length: Arc length L is the total length of the wiggles of a waveform, and is approximated by

$$L = \frac{1}{N-1} \sum_{n=1}^{N-1} |x_{n+1} - x_n|, \tag{G-1}$$

where x_n is the nth data sample, and N is the number of samples. This idea only makes sense on a wiggle-trace display. Arc length is driven by amplitude and frequency.

attenuation: The progressive loss of high frequencies with time in propagating seismic waves. Attenuation is caused by absorption or scattering of seismic energy as it passes through the earth. The degree to which rock absorbs seismic energy is inversely quantified by the quality factor. Attenuation is difficult to quantify with poststack seismic data.

attribute: See *seismic attribute*.

attribute space: In multiattribute analysis, a coordinate space defined by a set of seismic attributes, each of which defines an axis in the space.

average frequency: The average Fourier spectral frequency weighted by the amplitude or power spectrum; the average instantaneous frequency weighted by the instantaneous amplitude or power. Average frequency attributes are derived in a short running interval and are applied to detect spectral changes or to characterize the reflection spacing.

azimuth: The downdip direction of a 3D reflection surface.

bandwidth: The breadth of an amplitude spectrum. Often quantified as the standard deviation of the frequency spectrum about the mean frequency.

broadband: A bandwidth of more than about 2 octaves, typically 3 octaves or more.

classification: A method of automatic pattern recognition that assigns each data value or data vector to one of a small set of template classes. Classification is applied to identify regions in seismic data that are characterized by similar attribute values.

coefficient of variation: A statistical measure C of strictly positive data, defined as the standard deviation σ divided by the mean μ:

$$C = \frac{\sigma}{\mu}. \tag{G-2}$$

The coefficient of variation acts as a relative standard deviation. It is applied in amplitude variance attributes that are comparable between different seismic data sets.

coherence: The degree of consistency in the amplitude and phase along seismic reflections; the degree to which neighboring traces are similar. In attribute analysis, coherence is treated as synonymous with continuity and similarity. See *discontinuity*.

complex seismic trace: A seismic trace $z(t)$ whose values are complex and formed by the combination of a seismic trace $x(t)$ and its quadrature trace $y(t)$ according to

$$z(t) = x(t) + iy(t). \tag{G-3}$$

In polar form, the complex trace is expressed in terms of reflection strength $a(t)$ and instantaneous phase $\theta_i(t)$:

$$z(t) = a(t)\exp[i\theta_i(t)]. \tag{G-4}$$

The complex trace is the basis of complex seismic trace analysis.

complex seismic trace analysis: An important method for generating seismic attributes. Complex seismic trace analysis extracts the amplitude and phase information of a seismic trace as separate attributes from which other attributes are derived through differentiation or averaging.

continuity: A measure of the similarity of the amplitude and phase along a seismic reflection; the degree of similarity between neighboring traces. Continuity is usually treated as the opposite of discontinuity, and as synonymous with coherence. Continuity attributes reveal faults and channels.

correlation: A method that quantifies the degree of similarity between two traces or signals. Normalized correlations produce correlation coefficients. Correlation is employed in several discontinuity attributes.

correlation coefficient: A normalized measure of the similarity of two traces defined as the value of the zero-lag correlation between two zero-mean traces normalized by the square root of the product of their energies. It is equal to the covariance of the traces normalized by their standard deviations. Correlation coefficient C between traces $\mathbf{x}_1$ and $\mathbf{x}_2$ with N samples is

$$C = \frac{\mathbf{x}_1 \cdot \mathbf{x}_2}{|\mathbf{x}_1| \cdot |\mathbf{x}_2|} = \frac{\sum_{n=1}^{N} x_{1n} x_{2n}}{\sqrt{\sum_{n=1}^{N} x_{1n}^2} \cdot \sqrt{\sum_{n=1}^{N} x_{2n}^2}}. \tag{G-5}$$

The correlation coefficient is sensitive only to the shape of the trace waveforms and is independent of overall trace magnitudes. Its value varies from -1 to $+1$. A value of 1 indicates the two traces have identical shape, 0 indicates they are completely unrelated, and -1 indicates their shapes differ only in polarity.

cosine of the phase: A complex seismic trace attribute equal to the cosine of the instantaneous phase. Cosine of the phase acts as the perfect automatic gain control because it removes all amplitude information from a trace, making reflection continuity easier to follow.

covariance: A nonnormalized measure of the similarity of two traces. The covariance σ_{ij} of traces x_i and x_j, with N samples, and with means μ_i and μ_j, is defined as

$$\sigma_{ij} = \frac{1}{N} \sum_{k=1}^{N} (x_{ik} - \mu_i)(x_{jk} - \mu_j). \tag{G-6}$$

Covariance is used in principal component analysis and in some attribute computations.

curvature: The rate of change of dip and azimuth on a reflection surface. Curvature attributes reveal finer detail than dip or azimuth but appear noisier. There are many curvature attributes, but only most positive and most negative curvatures are applied widely. Strong curvature suggests where fractures are most likely to occur.

dip: The angle that a planar reflection makes with the horizontal. It is sometimes called dip magnitude. Slope is the tangent of the dip, but the distinction is often ignored and slope is referred to as dip.

dip-azimuth: Reflection dip and reflection azimuth combined so that azimuth controls color and dip controls shading. Slope is often employed in place of dip. Dip-azimuth presents the same information as seismic shaded relief.

dip variance: The degree to which the dips along reflections vary from the average dip. Used as a measure of reflection parallelism.

direct hydrocarbon indicator: A seismic attribute that is sensitive to effects in the seismic data caused by hydrocarbons.

directional attribute: An attribute derived from a directional operator, usually a spatial derivative. Directional attributes include apparent dip, seismic shaded relief, and relative amplitude change. They resemble illuminated topography when displayed in monochrome.

discontinuity: A measure of how much the amplitude and phase vary along seismic reflections; the degree of dissimilarity between neighboring traces. Discontinuity attributes reveal faults and channels.

divergence: The degree to which succeeding reflections in a sequence diverge downdip. Divergent reflections are characterized by constant azimuth and increasing dip with depth. Divergence identifies sequence margins and the sides of large channels.

dominant frequency: An imprecise term, variously used to refer to the average frequency of a signal, or to its largest or most significant frequency component.

edge detection: A method that highlights the outlines of features in an image. Edge detection is applied to interpreted seismic horizons to identify faults and places where dips change abruptly, but it is generally unsuitable for application to standard seismic data.

effective bandwidth: An empirical measure of bandwidth derived from the autocorrelation of the seismic data in an interval. Effective bandwidth is applied chiefly as a map attribute.

energy: The integral of the trace instantaneous power; the integral of the power spectrum of the trace. Sometimes referred to as total energy. As a map attribute, energy E is defined by

$$E = \sum_{n=1}^{N} x_n^2, \tag{G-7}$$

where x_n is the nth data sample, and N is the number of samples. In the context of a complex trace with instantaneous amplitude $a(t)$, energy is defined as

$$E = \int_{-\infty}^{\infty} a^2(t)dt. \tag{G-8}$$

energy half-time: An interval attribute that records where in the interval the seismic energy is concentrated. Computed as a trace attribute, energy half-time measures relative amplitude changes.

envelope: An amplitude measure that envelops the seismic trace, often referred to as trace envelope or as signal envelope. In common usage, envelope is synonymous with reflection strength and instantaneous amplitude. See *reflection strength*.

filter bank: An ordered set of narrowband filters with different passbands. Spectral decomposition employs filter banks.

first moment formula: A formula that equates the average instantaneous frequency of a seismic trace in time to its average Fourier spectral frequency.

frequency: The number of cycles on a seismic waveform that occur within a period of time. Frequency attributes include instantaneous frequency, average frequency, and tuning frequency. They identify zones of anomalous seismic attenuation and serve as rough measures of reflection spacing.

Gabor wavelet: A wavelet formed as the product of a Gaussian window with a sinusoid. Commonly used in filter banks for spectral decomposition. Gabor wavelets in a filter bank have the same envelope, length, and bandwidth measured in hertz.

Gaussian window: An analysis window whose shape is a Gaussian function.

geobody: A distinct 3D feature, extracted from seismic data, that has geological or geophysical significance. Geobodies are defined in terms of attribute values. Bright spots, channels, diapirs, and gas chimneys are extracted as geobodies to aid their interpretation.

geobody extraction: An interpretive process that sculpts geobodies from seismic data given a definition of the geobodies in terms of their attribute values and spatial distribution.

group vector: The 3D gradient of the logarithm of the instantaneous amplitude. The horizontal components of the group vector highlight faults and other discontinuities.

Hamming window: A type of tapered window of finite length with the shape of a cosine function from -90° to $+90^\circ$, raised by a small value. Sometimes referred to as a raised cosine window.

Hilbert transform: The process of applying a quadrature filter that subtracts 90° of phase from a seismic trace without changing its amplitude spectrum. Some authors define the Hilbert transform so that it adds 90° of phase, which reverses the polarity of the filter operator. See *quadrature filter*.

horizon: A surface that represents a stratigraphic level in a seismic line or volume. Horizons tend to follow continuous reflections characterized by relatively consistent phase and amplitude.

horizon attribute: An attribute of a seismic horizon. Horizon attributes are necessarily structural and include dip, azimuth, curvature, and discontinuity.

imaginary trace: The imaginary part of a complex trace; synonymous with quadrature trace. The imaginary trace is derived as the Hilbert transform of a seismic trace, or real trace.

instantaneous: With regard to attribute computations, computed at a point instead of in a window.

instantaneous amplitude: Synonymous with reflection strength and trace envelope. See *reflection strength*.

instantaneous bandwidth: A complex seismic trace attribute $b(t)$, defined as the absolute value of the time derivative of the logarithm of the instantaneous amplitude $a(t)$, scaled to have units of hertz:

$$b(t) = \frac{1}{2\pi}\left|\frac{d}{dt}\ln a(t)\right|. \tag{G-9}$$

Instantaneous bandwidth is closely related to relative amplitude change in time.

instantaneous frequency: A complex seismic trace attribute $f_i(t)$, defined as the time derivative of the instantaneous phase $\theta_i(t)$ scaled to have units of hertz:

$$f_i(t) = \frac{1}{2\pi}\frac{d}{dt}\theta_i(t). \tag{G-10}$$

Instantaneous frequency is highly variable and prone to spikes.

instantaneous phase: A complex seismic trace attribute defined as the argument of the complex trace. Instantaneous phase has a sawtooth appearance because its values are constrained to the range of $+180^\circ$ to -180°.

instantaneous power: Envelope squared. See *power*.

instantaneous quality factor: A complex seismic trace attribute defined as instantaneous frequency divided by twice the instantaneous bandwidth. Instantaneous quality factor is dimensionless and unrelated to rock quality factor.

instantaneous rms frequency: A complex seismic trace attribute defined as the square root of the sum of the squares of instantaneous frequency and instantaneous bandwidth.

instantaneous wavenumber: A spatial derivative of the instantaneous phase or of the logarithm of the instantaneous amplitude.

interval: A window with constant length in time or depth that follows a horizon in a seismic volume; the region between two selected horizons. Intervals define the seismic data to use for deriving map attributes.

interval attributes: Map attributes computed in a narrow horizon-guided interval through a seismic volume; trace attributes computed in a window that runs down the trace. Common interval attributes include rms amplitude, largest value, average frequency, and number of peaks.

K-means clustering: A method of unsupervised pattern recognition that is sometimes applied in waveform mapping and attribute classification. K-means clustering orders its classes randomly.

Kohonen self-organizing feature map (Kohonen SOFM): A method of unsupervised pattern recognition that is commonly applied in waveform mapping and attribute classification. The Kohonen SOFM orders its classes by similarity.

kurtosis: The relative sharpness or flatness of a distribution relative to a Gaussian distribution. Kurtosis is occasionally employed as an interval attribute.

Laplacian filter: A linear image processing filter that is applied along horizontal slices or along reflections to sharpen lineations. Laplacian filters are chiefly applied to discontinuity attributes to enhance faults and channels.

local: With regard to seismic attribute computations, computed in a small window instead of at a point.

low-frequency shadow: An anomalous drop in average frequency, observed on seismic data, that is produced by locally strong signal attenuation. Gas is a primary cause of seismic attenuation, so low-frequency shadows serve as possible direct hydrocarbon indicators. Prospective low-frequency shadows are rare.

mean: The average of a set of data values, often called sample mean; the expected value of a random variable. The distinction between sample mean and expected value is important mathematically but often is ignored in attribute analysis.

median filter: A nonlinear filter that replaces the data value in the center of an analysis window with the median of the data values in the window. Median filters are applied to remove outliers or spikes from seismic attributes, such as instantaneous frequency.

mode filter: A nonlinear filter designed for quantized data that replaces the data value in the center of an analysis window with the mode of the data values in the window, which is the value that occurs most often. Mode filters are applied to smooth classified waveform maps or classified attribute volumes.

Morlet wavelet: A Gabor wavelet whose length is inversely proportional to its center frequency, commonly used in filter banks for spectral decomposition. The Morlet wavelets in a filter bank look the same except for scale, and they have the same length measured in cycles and the same bandwidth measured in octaves.

narrowband: A bandwidth of less than about 2 octaves, typically 1 octave or less.

one-dimensional (1D) attribute: Trace attribute. One-dimensional attributes are computed down individual seismic traces. Examples include reflection strength, rms amplitude, instantaneous phase, average frequency, and relative acoustic impedance computed through recursive inversion.

parallelism: A measure of how parallel reflections in a sequence are to each other.

Parseval's theorem: A theorem that equates the energy of a seismic trace in the time domain to its energy in the frequency domain.

peak frequency: The frequency of the spectral component that has the largest magnitude.

perigram: Reflection strength minus its low-frequency content.

phase: The relative position along a sinusoid; the average value of the phase spectrum of a signal.

phase vector: The 3D gradient of the instantaneous phase. The phase vector is the basis of much of 3D complex seismic trace analysis and provides measures of wavelength, dip, and azimuth.

polarity: The sign of the seismic data with respect to a standard. Polarity is described as being either normal or reverse. In seismic attribute analysis, it is convenient to define normal polarity so that a positive reflection corresponds to a positive reflection coefficient, which implies an increase in acoustic impedance.

power: The rate of change of energy. For a seismic trace, power refers to the square of the original trace values, or to the square of the envelope (see *instantaneous power*). In the frequency domain, power refers to the square of the amplitude spectrum. In either domain, the integral of the power is the energy.

power spectrum: The square of the amplitude spectrum.

principal component analysis: A general least-squares method to find linear relationships between the various components of multidimensional data. Principal component analysis is applied in discontinuity attributes, in coherency filters, and in multiattribute analysis for attribute space reduction.

principal components: Measures of data variance derived through principal component analysis, arranged in order of largest to smallest. The first principal component of a set of seismic traces measures the continuity of the reflections.

***Q*:** See *quality factor*.

quadrature filter: A filter that subtracts 90° of phase from a seismic trace without altering the amplitude spectrum. In common usage, synonymous with Hilbert transform.

quadrature trace: The Hilbert transform of a seismic trace; a seismic trace rotated in phase −90°; synonymous with imaginary trace.

quality factor: A measure of the degree to which rocks pass acoustic energy without attenuation. Often called *Q*, it is sensitive to the presence of gas. Quality factor attributes quantify overall spectral change, but their relationship to rock quality factor is tenuous.

rank correlation: A nonlinear method for estimating how closely two signals or attributes are related. The rank correlation coefficient is a more robust measure of similarity than the correlation coefficient.

real trace: The real part of a complex trace; the original seismic trace.

recursive inversion: A recursive method for inverting a seismic trace to produce an estimate of the relative acoustic impedance. Recursive inversion assumes that the trace approximates a reflection coefficient series. It closely resembles an integration of the trace.

reflection orientation: The dip and azimuth of a reflection; a unit vector normal to a reflection surface.

reflection spacing: The distance between two successive reflections measured perpendicularly to the reflections. Reflection spacing is difficult to quantify as an attribute. It is estimated roughly by frequency or wavelength attributes.

reflection strength: A complex seismic trace attribute that measures seismic amplitude independently of its phase or polarity. Reflection strength is defined as the magnitude of the complex seismic trace and is the most important amplitude attribute. Synonymous with instantaneous amplitude and with trace envelope.

reflection surface: A surface in a seismic volume that follows a seismic reflection and has relatively consistent amplitude and phase. The concept of reflection surfaces underlies the computation of many 3D seismic attributes.

relative acoustic impedance: Acoustic impedance minus the background trend; acoustic impedance derived only from poststack seismic data. Relative acoustic impedance is restricted to the bandwidth of the seismic signal and lacks the low-frequency and high-frequency components of a full acoustic impedance.

relative amplitude change: The rate of change of the logarithm of the instantaneous amplitude in a given direction. Relative amplitude change in time $\sigma(t)$ is defined as

$$\sigma(t) = \frac{d}{dt} \ln a(t) = \frac{a'(t)}{a(t)}, \tag{G-11}$$

where $a(t)$ is instantaneous amplitude.

response amplitude: A response attribute that records the values of the envelope peaks.

response attributes: A set of attributes derived from instantaneous complex seismic trace attributes through selection at envelope peaks. Response attributes have a blocky appearance and are free of spikes. They include amplitude, phase, frequency, apparent polarity, and sweetness.

response frequency: A response attribute that records instantaneous frequencies at envelope peaks. Response frequency equals an average spectral frequency of the seismic wavelet if the reflections are free of noise and interference.

response phase: A response attribute that records instantaneous phases at envelope peaks. Response phase equals the phase of the seismic wavelet if the reflections are free of noise and interference.

RGB blending: Red-green-blue color blending. A method of volume blending whereby three seismic data volumes are combined graphically so that one volume controls the intensity of red, the second controls the intensity of green, and the third controls the intensity of blue. Commonly employed in spectral decomposition with low-, mid-, and high-frequency spectral volumes.

rms: Root-mean-square; a procedure for finding a representative value of a set of data values. The rms value x_{rms} of a seismic trace x_n with N samples is

$$x_{\mathrm{rms}} = \sqrt{\frac{1}{N} \sum_{n=1}^{N} x_n^2}. \tag{G-12}$$

Like the average absolute value, the rms value is independent of the sign of the data values, but it is more influenced by larger values.

rms amplitude: An amplitude attribute equal to the square root of the average trace energy. Root-mean-square (rms) amplitude roughly resembles the trace envelope but is always smaller.

rms spectral frequency: The square root of the average frequency squared of the power spectrum.

seismic attribute: A measure of a seismic property. Seismic attributes represent subsets of the information in seismic data.

seismic facies: A recognizable pattern in seismic data that has geological or geophysical significance. Seismic facies are often characterized by seismic attributes.

seismic property: A characteristic of seismic reflection data. Key seismic properties include amplitude, amplitude change, phase, frequency, dip, curvature, continuity, and parallelism.

seismic shaded relief: A directional seismic attribute that combines reflection dip and azimuth to make horizontal slices look like illuminated topography.

semblance: A measure of the degree of similarity between the traces in a set. Semblance is defined as the energy of the average of the traces divided by the average of the trace energies. Given M traces with total energy E, and average trace energy E_a, semblance S is

$$S = \frac{ME_a}{E}. \qquad \text{(G-13)}$$

Semblance is employed in the computation of dip, azimuth, and discontinuity.

short time-window Fourier transform: See *STFT*.

signal length: The effective length of a signal or waveform in time, sometimes measured as the standard deviation of the instantaneous power around the center of the signal.

similarity: The degree to which the traces in a set resemble each other. Similarity lacks a precise definition and is sometimes used as a synonym for continuity.

skew: A nondimensional measure of the degree of asymmetry of a set of data values. Skew is occasionally employed as an interval attribute.

slope: The tangent of the dip; the ratio of the change in depth or time of a reflection over a horizontal distance. For depth data, slope is dimensionless. For time data, slope has units of milliseconds per trace or meter. In common usage, slope is referred to as dip.

spectral decomposition: A method that decomposes a waveform into a set of sinusoidal components or wavelets with different center frequencies and bandwidths. Spectral decomposition is accomplished through filter banks and is applied in tuning analysis.

spectral ratio method: A method for estimating the quality factor from seismic data based on changes in the amplitude spectra between consecutive windows on a trace.

STFT: Short time-window Fourier transform; a basic method of time-frequency analysis, sometimes applied in spectral decomposition.

structurally guided: In reference to a seismic process, guided by the reflection slopes to proceed along reflections. Also called dip guided. Coherency filters are structurally guided, as are some discontinuity attributes, stratigraphic attributes, and 3D filters.

sweetness: An empirical measure designed to highlight "sweet spots," places that are oil and gas prone. Sweetness is defined either as response amplitude divided by the square root of response frequency, or more commonly as reflection strength divided by the square root of instantaneous or average frequency.

thin bed: A rock layer, imaged by seismic data, whose thickness is small with respect to the wavelengths of the seismic wavelet. Reflections from the upper and lower surfaces of a thin bed interfere and are difficult to distinguish so that the thickness cannot be estimated reliably.

thin-bed indicator: A complex seismic trace attribute defined as instantaneous frequency minus average frequency. Despite its name, the thin-bed indicator does not indicate thin beds.

three-dimensional (3D) attribute: Volume attribute. Three-dimensional attributes are computed down traces as well as across traces in both the x and y directions. Examples include discontinuity, dip, curvature, and parallelism.

time-frequency analysis: The study of local spectral properties as a function of time for a signal or seismic trace. Key methods of time-frequency analysis include the short time-window Fourier transform and the wavelet transform. Time-frequency analysis is applied in spectral decomposition, Q estimation, and the computation of spectral attributes.

tuning: The strong constructive or destructive interference of two or more reflected seismic wavelets. Tuning depends on the frequency content of the wavelets and the spacing of the reflectors.

tuning analysis: The study of the frequency content of interfering reflections. Tuning analysis is applied to estimate thin-bed thicknesses.

tuning thickness: For a particular seismic wavelet, the thickness of a thin bed that produces the maximum peak amplitude or maximum total energy in the composite reflection.

two-dimensional (2D) attribute: Line attribute. Two-dimensional attributes are computed both down and across traces along a seismic line. Examples include slope components, directional dip, and horizontal relative amplitude changes. Horizon attributes are also 2D attributes, but are computed on a surface across inlines and crosslines.

uncertainty principle: In the context of signals, a fundamental property that states that the product of signal length with signal bandwidth is greater than or equal to a constant. The constant depends on the exact definitions of length t_l and bandwidth f_b; setting t_l and f_b equal to standard deviations, the uncertainty principle becomes

$$t_l \cdot f_b \geq 1/4\pi. \tag{G-14}$$

This implies that the length and bandwidth of a signal or waveform cannot both be made arbitrarily small at the same time. The name *uncertainty principle* is misleading because it quantifies a definite property of signals.

variance: A measure of the degree to which the values in a set vary from their mean. The variance V of seismic trace x_n with mean μ is defined as

$$V = \frac{1}{N}\sum_{n=1}^{N}(x_n - \mu)^2, \tag{G-15}$$

where x_n is the nth data sample, and N is the number of samples. Variance is employed in many attributes, including bandwidth, amplitude variance, dip variance, and discontinuity.

volume blending: A method of computer graphics to display simultaneously two or more seismic volumes by adjusting their opacity and overlaying them. Volume blending enables different seismic volumes to be compared readily.

waveform: A segment of a seismic trace that encompasses one or several lobes. In seismic attribute analysis, a waveform typically represents a seismic wavelet or a composite of interfering reflections.

waveform classification: A method for creating attribute maps that identifies regions of similar waveform along horizons. Waveform classification reveals details in channel systems and other stratigraphic features.

wavelength: The length of one cycle of a sinusoidal waveform.

wavenumber: Inverse of wavelength. In attribute analysis, wavenumber is derived as the rate of change of instantaneous phase along a spatial axis.

weighted average: The average of a set of values scaled by a set of weights. Weighted averaging is employed in spectral attributes, discontinuity attributes, and average complex trace attributes. In the time domain, the weighting function is usually instantaneous power; in the frequency domain, it is usually spectral power.

Widess limit of resolution: An empirical limit on how thin a rock layer can be before seismic reflections from its top and bottom are no longer distinguishable. For depth data, the Widess limit of resolution is one eighth of the dominant wavelength of the seismic wavelet. For time data, it is more conveniently expressed as a two-way time thickness t_w equal to one quarter of the period of the average frequency f_a of the seismic data:

$$t_w = \frac{1}{4f_a}. \tag{G-16}$$

The Widess limit of resolution is important in spectral decomposition and waveform classification.

window: A small 1D or 3D operator for selecting data for attribute computations. Tapered windows, such as Hamming and Gaussian windows, reduce Gibbs' effects. The size and shape of the window set the resolution of the attribute.

zero-crossing frequency: A crude measure of average frequency f_{zc} defined as half the number of zero-crossings N_{zc} in an interval divided by the interval length in time t_l:

$$f_{zc} = \frac{N_{zc}}{2t_l}. \tag{G-17}$$

Zero-crossing frequency is usually offered as a map attribute.