Seismic discontinuity is the most important reflection pattern attribute. Discontinuity quantifies the degree to which a seismic trace differs from its neighbors, and identifies breaks in the continuity of seismic reflections that are due to faults, diapers, channels, stratigraphic pinchouts, processing artifacts, or noise. Discontinuity attributes have become essential aids in the interpretation of seismic data for structure as well as stratigraphy.

Though continuity computations have a long history in seismic data processing, it was only in 1995 when the first practical discontinuity (or continuity or coherence) attribute was introduced for 3D seismic data interpretation. The original discontinuity method employed two orthogonal cross-correlations with a 3 trace operator. Other methods soon appeared based on semblance, covariance, and image processing edge detection. Enthusiastic claims have been made for the superiority of one particular method over competing methods, but the differences between them owe as much or more to algorithmic details as to fundamentals of the discontinuity computation. In particular, the analysis window size and shape has a large influence on both the quality of the attribute and the computation time. For the same analysis window, methods based on correlation, semblance, principal components, and weighted correlation produce discontinuity attributes that are often indistinguishable. This is not surprising, as these common methods all treat discontinuity as a ratio of discontinuous energy to total energy, and differ only in how they define discontinuous energy.

Most methods for discontinuity computation implicitly assume flat data and so tend to perform poorly in areas of steep dip. The standard solution is to determine the dominant dip in the analysis window first, and then to compute discontinuity along this dominant dip. This step often involves considerably more effort than the discontinuity computation itself. While it successfully reduces noise in the discontinuity attributes caused by reflection dip, it also degrades the imaging of small discontinuities to the extent that these discontinuities influence the dip estimation. Nonlinear methods show promise for better estimating the reflection dip in the presence of faults and other discontinuities, but their computational cost is so much greater that at present they are often impractical for routine application.

Current efforts to improve discontinuity attributes involve either pre-processing of the seismic data to better condition it for attribute computations, or post-processing of the discontinuity attributes themselves. The methods used are primarily 2D and 3D filters that remove noise and sharpen the seismic data or discontinuity attribute. Postprocessing methods are general in that they can be applied to any discontinuity attribute, though they may be tailored to enhance fault or stratigraphic discontinuities at the expense of other discontinuities. Computationally inexpensive 2D image processing techniques, such as Laplacian operators or Kuwahara filters applied along time slices or along the reflection dip are effective at enhancing the resolution of discontinuity attributes, though they may perform poorly on standard seismic data. Three-dimensional filters employing principal component analysis or some other transform method are more powerful and produce superior results, but require much more computation time. Post-processing with 3D filters is likely to yield the greatest improvement in discontinuity attributes in the near future.