Fault detection and reconstruction from scattered data

Cesare Bracco
Department of Mathematics and Computer Science - University of Florence (Italy)
cesare.bracco@unifi.it

The detection and reconstruction of discontinuities curves for bivariate functions, usually called faults (or gradient faults when gradient discontinuities are considered), is an important issue in several application, including image processing and geophysics (see, e.g., [1, 2, 3]). We present a method to detect and reconstruct a (gradient) fault from a set of scattered data. The scheme first determines a subset of points close to the fault from the full data set. This selection of the data is based on the estimate of the Laplacian, obtained by using numerical differentiation formulas with irregular centers, which can be directly applied to the set of scattered data (see [4]). The local regression lines computation and quadratic least squares approximations for the point cloud surrounding the discontinuity allow us to recover the fault shape (see [5]). More precisely, we obtain a set of points describing the fault, which can be then thinned and ordered, and subsequently used to get the approximation of the fault by applying a suitable curve fitting algorithm.

Joint work with: Oleg Davydov, Carlotta Giannelli, Alessandra Sestini.

References

[1] R. Archibald, A. Gelb and J. Yoon. Polynomial fitting for edge detection in irregularly sampled signals and images. *SIAM J. Numer. Anal.* 43(1): 259–279, 2005.

[2] M. Bozzini and M. Rossini. The detection and recovery of discontinuity curves from scattered data. *J. Comput. Appl. Math.* Volume 240: 48–162 (2013).

[3] A. Crampton and J.C. Mason. Detecting and approximating fault lines from randomly scattered data. *Numer. Algorithms* 39(13): 15–130, 2005.

[4] O. Davydov and R. Schaback. Minimal Numerical Differentiation Formulas. *preprint*, 2016.

[5] In-Kwon Lee. Curve reconstruction from unorganized points. *Comput. Aided Geom. D.* 17: 161–177, 2000.