



## Variational models for discontinuity detection

Alfonso Vitti and G. Battista Benciolini

Dept. of Civil and Environmental Engineering, University of Trento, Trento, Italy (alfonso.vitti@ing.unitn.it)

The Mumford-Shah variational model produces a smooth approximation of the data and detects data discontinuities by solving a minimum problem involving an energy functional.

The Blake-Zisserman model permits also the detection of discontinuities in the first derivative of the approximation. This model can result in a quasi piece-wise linear approximation, whereas the Mumford-Shah can result in a quasi piece-wise constant approximation.

The two models are well known in the mathematical literature and are widely adopted in computer vision for image segmentation. In Geodesy the Blake-Zisserman model has been applied successfully to the detection of cycle-slips in linear combinations of GPS measurements. Few attempts to apply the model to time series of coordinates have been done so far.

The problem of detecting discontinuities in time series of GNSS coordinates is well known and its relevance increases as the quality of geodetic measurements, analysis techniques, models and products improves. The application of the Blake-Zisserman model appears reasonable and promising due to the model characteristic to detect both position and velocity discontinuities in the same time series. The detection of position and velocity changes is of great interest in geophysics where the discontinuity itself can be the very relevant object. In the work for the realization of reference frames, detecting position and velocity discontinuities may help to define models that can handle non-linear motions.

In this work the Mumford-Shah and the Blake-Zisserman models are briefly presented, the treatment is carried out from a practical viewpoint rather than from a theoretical one. A set of time series of GNSS coordinates has been processed and the results are presented in order to highlight the capabilities and the weakness of the variational approach. A first attempt to derive some indication for the automatic set up of the model parameters has been done. The underlying relation that could link the parameter values to the statistical properties of the data has been investigated.