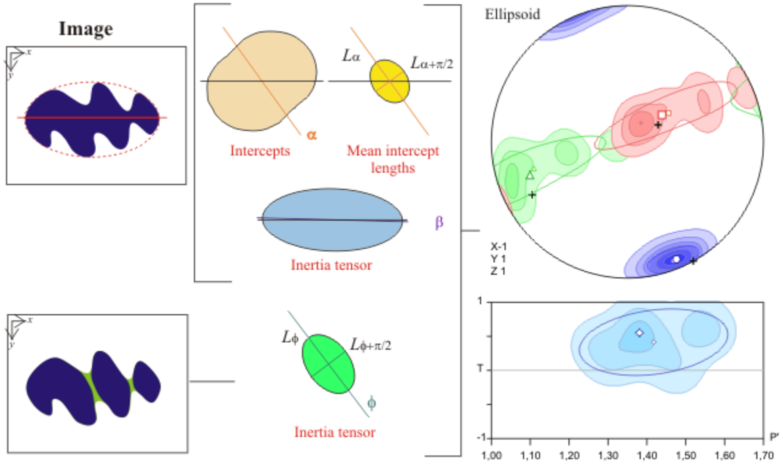
# Shape Preferred Orientation (OCW-UN-SPO) Launeau P. 2017




The quantification of the shape preferred orientation (SPO) of minerals by digital image analysis is a useful tool of structural geology. This is particularly the case of magma flow studies characterized by weak anisotropy quite difficult to measure by eyes. But this can be used also in sedimentology and fault studies.

The SPO use the basic principle of stereology linking a count in n-1 dimension to a measurement in n dimensions. It starts at a pixel size n0 to explore a material along lines n1 forming a surface area n2 stacked in a volume n3. It can work on classified images or even more quickly on grey levels images (with some limitations).

The present course is dedicated to geologist and any other people interested in the measurement of material anisotropy formed by a population of objects with easy-to-use methods. The aim is to give all simplest basic concepts necessary to extract meaningful results from image analysis.
A set of applications illustrate the course and a set of free programs and open spreadsheet are provided to facilitate the assimilation of the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## 01 - Introduction SPO

## 02 - Orientation and Preferred Orientation

This chapter homogenizes the notations of line and plane orientations in a clockwise coordinate system including the case of a core and the case of a XY image taken with a camera lens aligned on a perpendicular Z axis. It also defines the notion of Preferred Orientation in 2D and 3D with the association of eigenvector and eigenvalue calculation with simple rotations.

## 03 - Passive active deformation implications on Shape Preferred Orientation

This chapter first define the passive deformation of all object borders towards a direction of material flow without viscosity contrast. In a second time it considers the case of rigid body rotation of crystals or grains in a magma or any other viscous matrix carrying automorphic objects recording a part of the so called active deformation with an intensity of shape preferred orientation.

## 04 - 2D Shape Preferred Orientation 1) of classified images

This chapter start with the definition of an object on a digital image and shows how to measure its anisotropy with the inertia tensor method. It also presents the interest of different shape averaging in 2D.

It continues with the presentation of the intercepts method exploring objects in images with the help of parallel scanlines allowing the calculation of mean length intercepts rose diagram as 2D ellipses of interest for the calculation of ellipsoid. It details successive stages of noise filtering along scanlines while counting intercepts and post Fourier series analysis of the intercepts rose diagrams.

Theoretical passive and active deformation simulations are finally used to highlight the limitations of both methods. The invariance of the results by translation is also approached with two examples of gabbronorites.

Finally comparison with center to center diagrams and other methods are presented.

## 05 - 2D Shape Preferred Orientation 2) of greyscale images

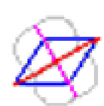
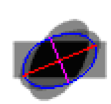
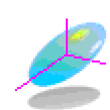
This chapter concerns the intercepts method in grey levels which can works on raw images without any processing of mineral classification. The development of the intercepts counting in two steps necessary for the grey level analysis is also applicable to the classified images at higher resolution on smaller objects.

Theoretical passive and active deformation simulations are also used to test the limitations of the methods. The invariance of the results by translation is also approached with two examples, a SEM image of a synthetized magma and a distribution of faults or lineaments.

## 06 - 3D Shape Preferred Orientation

The transition from 2D SPO to 3D SPO can only be done with at least 3 mutually perpendicular images giving 2D ellipse inverse tensors which can be combined in 3D ellipsoid inverse tensors. The P.Y. Robin (2002) method generalize the process to any set of images with the introduction of a scale factor determination allowing the adjustment between ellipses of different sections with the unique resulting ellipsoid.

Theoretical passive and active deformation simulations are used again to test the limitations of the methods with a particular focus on the shape cutting effect. The invariance of the results by translation is also approached with examples of applications to gabbronorite, analog modeling, undeformed sandstone looking for basin paleo slopes and diabase dikes. The two last examples are core sections.

**Intercepts and inertia tensor method**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**Applications**


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