



Mathematical morphology

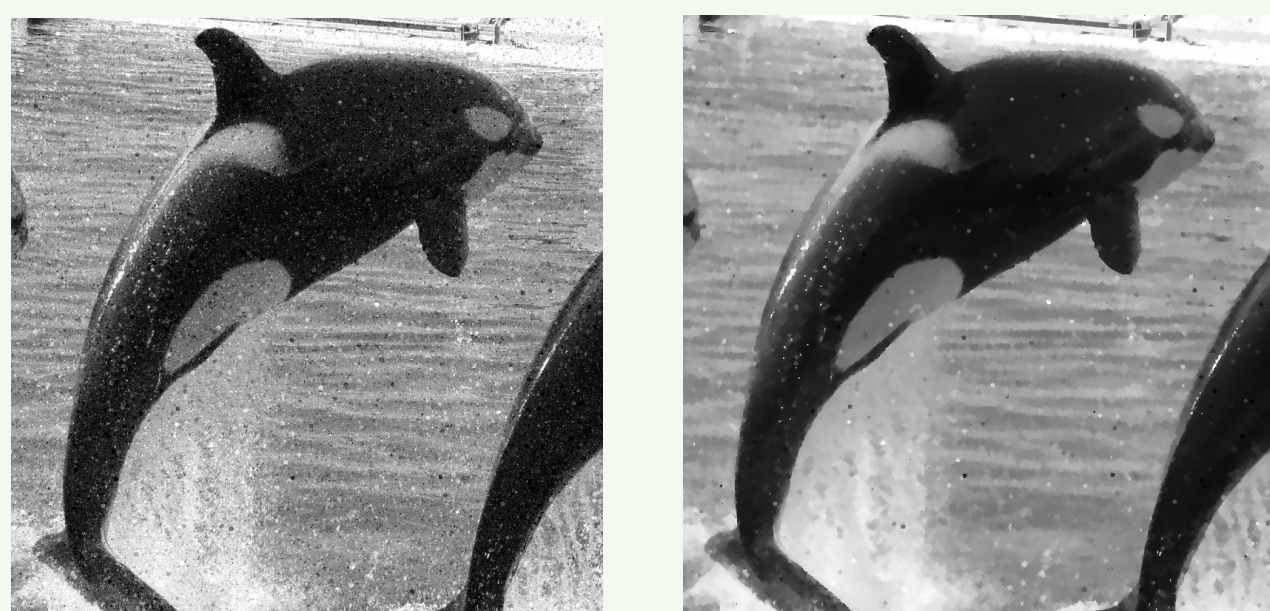
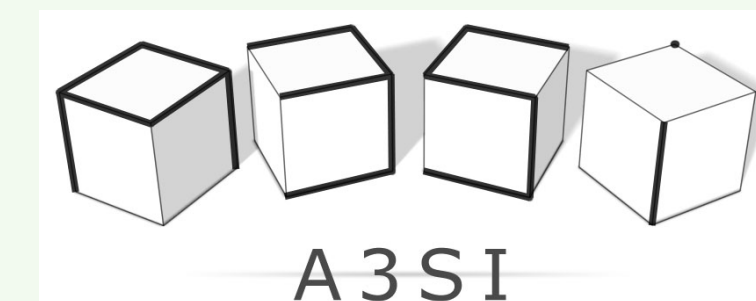


Illustration 1: impulse noise reduction by alternating sequential morphological filters.
The right picture is obtained by applying a filter acting on a spatially variant graph (whose neighborhoods differ at each point) that locally correspond to the image.

Mathematical morphology was introduced during the 60s by Georges Matheron and Jean Serra to realise non-linear analysis and processing of images.

Many of the operators studied in mathematical morphology can be classified according to two criteria: adjunctions (illustrations 1, 2) and connections (illustrations 3, 4, 5).

The A3SI team contributes to its development by proposing new filtering and segmentation methods.

An important effort is devoted to validation in collaboration with experts from the different fields of application.

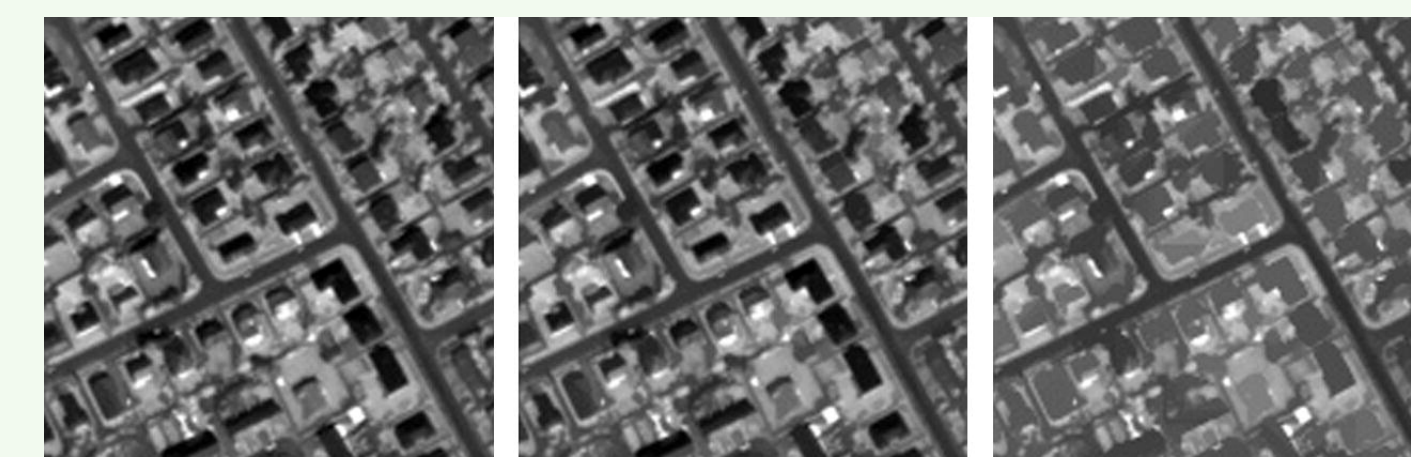


Illustration 2: enhancement of linear structures in order to detect roads in remote sensing.

The results are obtained by applying morphological path openings and closings. The filtered images are then used to classify the pixels that correspond to roads.

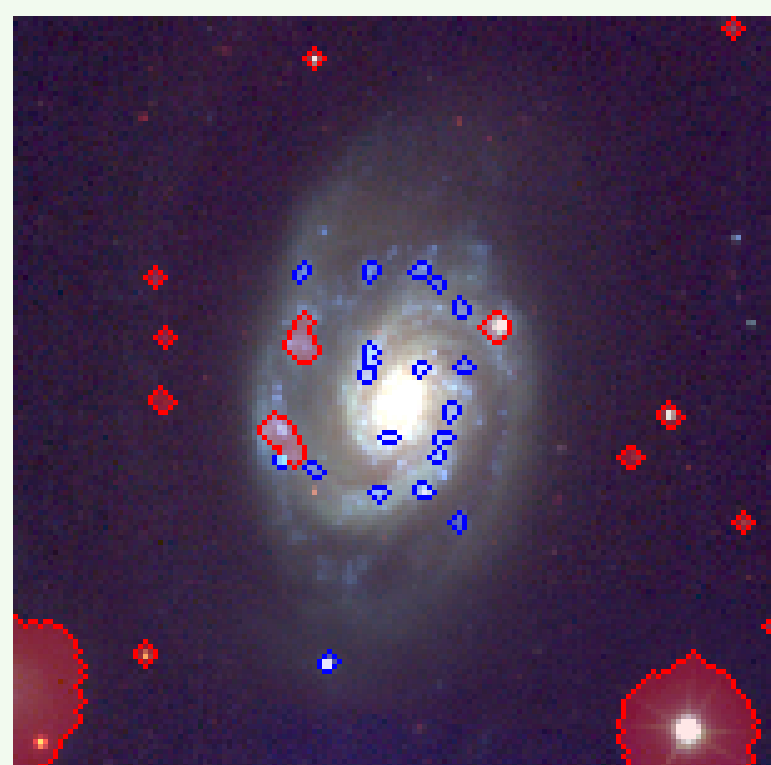


Illustration 3: segmentation of multispectral astronomical images from the (hyper-) connected component tree.

The blue sources are star formation regions in the galaxy containing short-lived massive stars. These are important markers of the spiral structure of the galaxy. The red sources are external sources (foreground stars, satellite galaxies) that can overlap with the main galaxy.

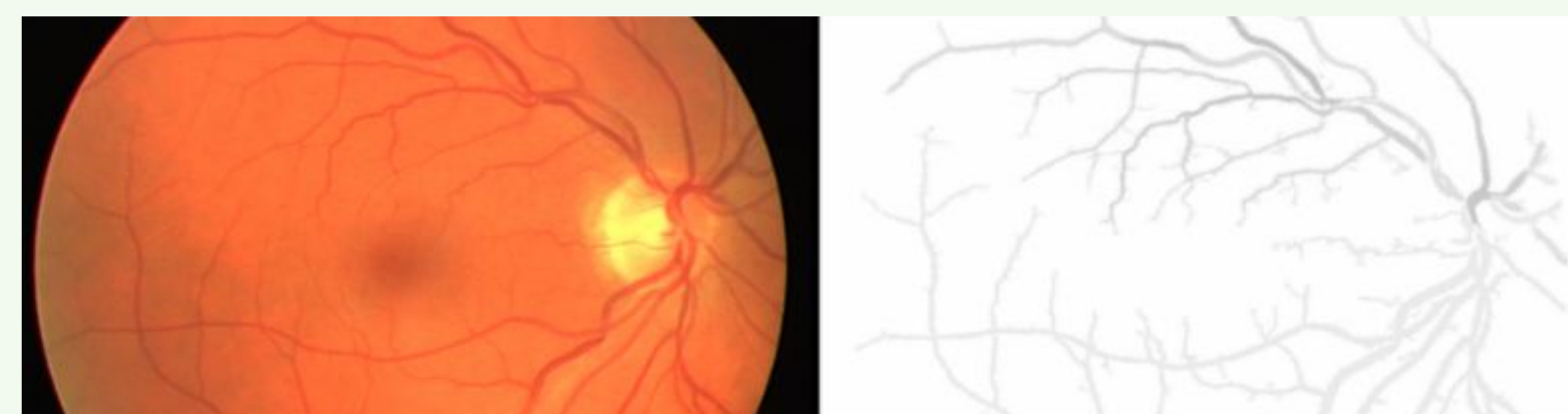
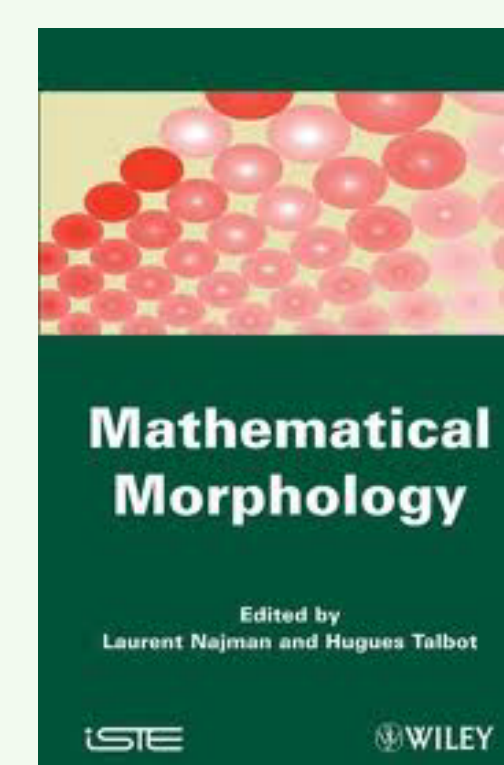
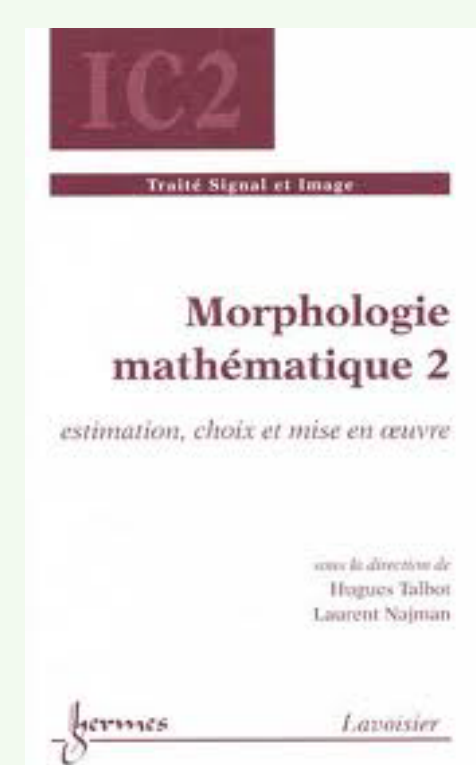
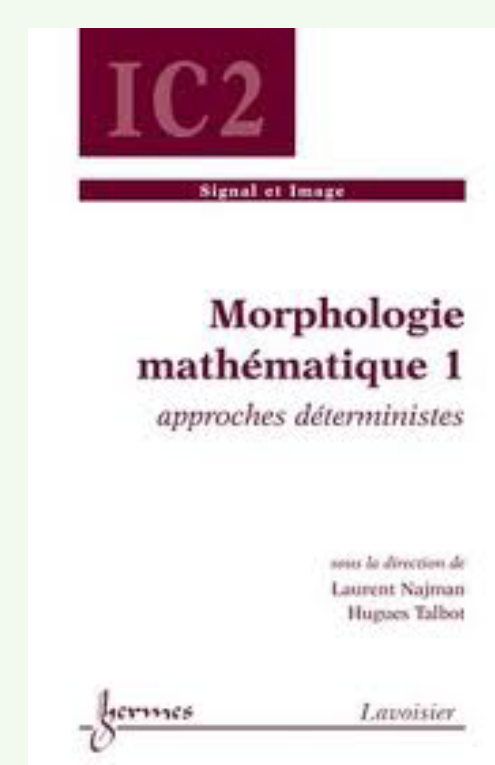


Illustration 5: enhancement of vessels in retinal angiograms.

The right image is obtained by applying a connected operator to a shape space (the tree of level lines) of the left image.

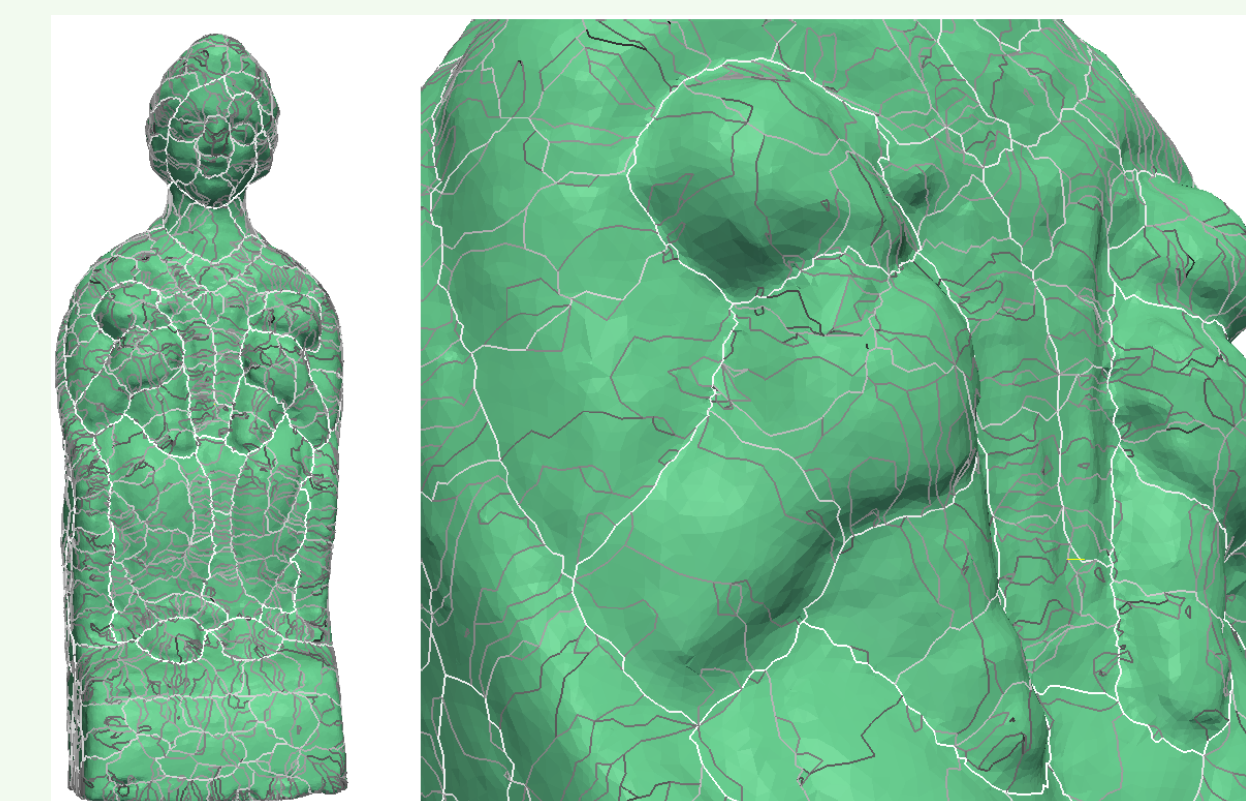


Illustration 4: a hierarchical segmentation of the surface of a statue (a 3D mesh).

The saliency map of a hierarchy of watershed segmentations is superimposed to the original mesh. This result is used as the entry point of a method for the classification and retrieval of artwork objects.

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