Case Study: Problem Overview

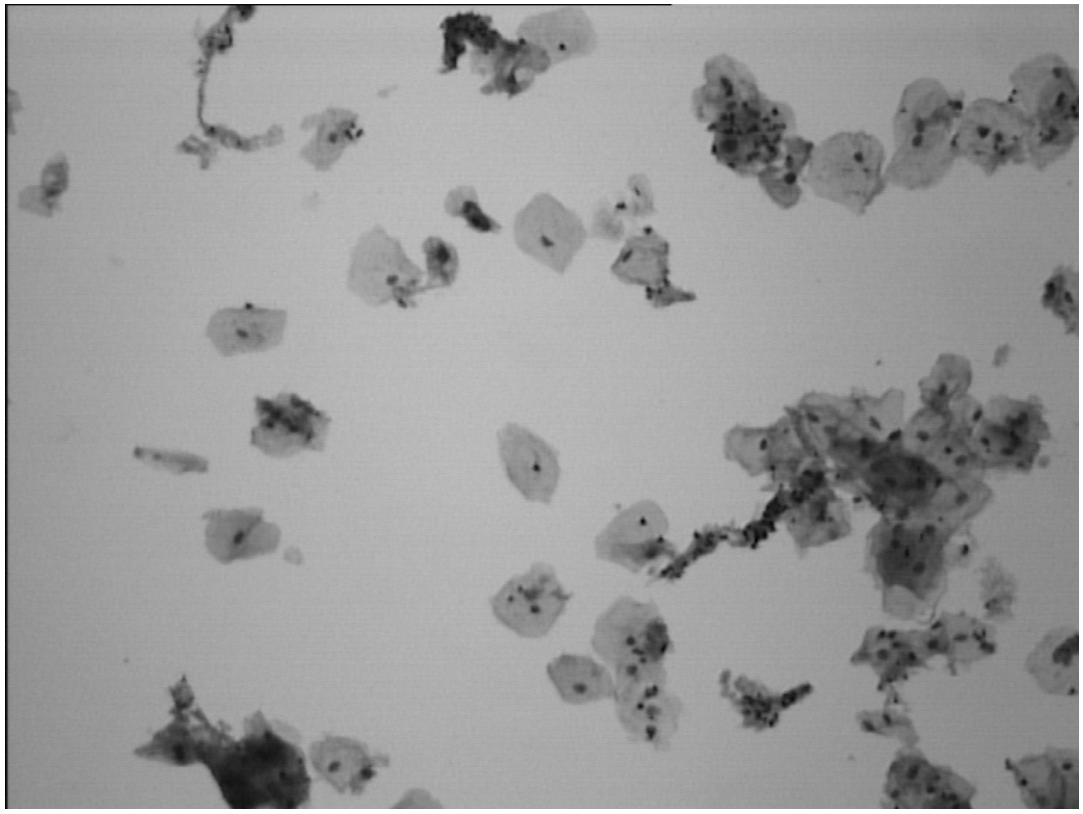
Aim:

To develop a robust segmentation scheme, optimised for Pap. smear slides, for the application of an automatic cervical cancer pre-screener.

Present focus:

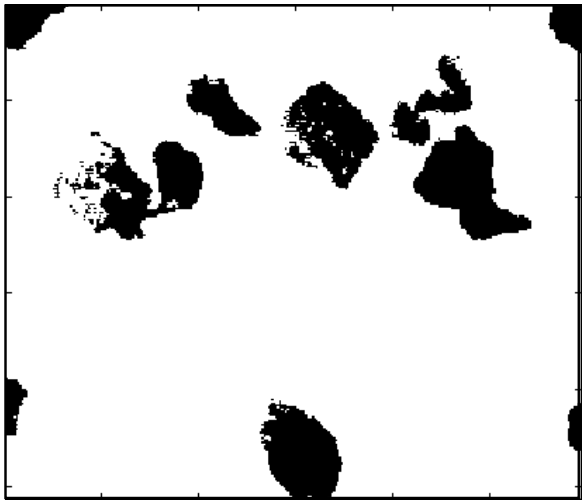
Evaluation of a water immersion algorithm developed by Jeacock and Bamford.

Example Scene



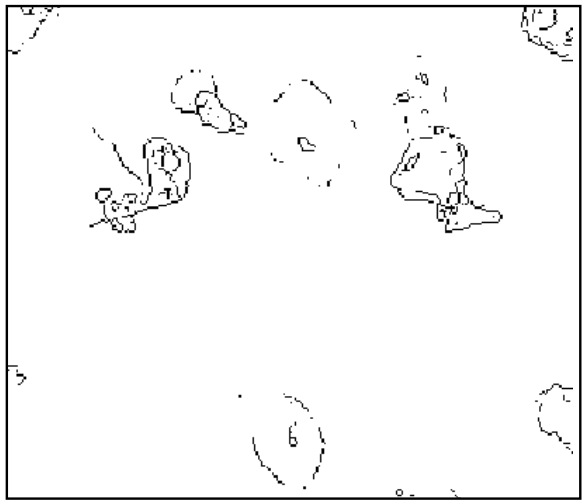
Motivation

Thresholding difficulties



Voids

Edge Detection Difficulties



Incomplete Boundaries

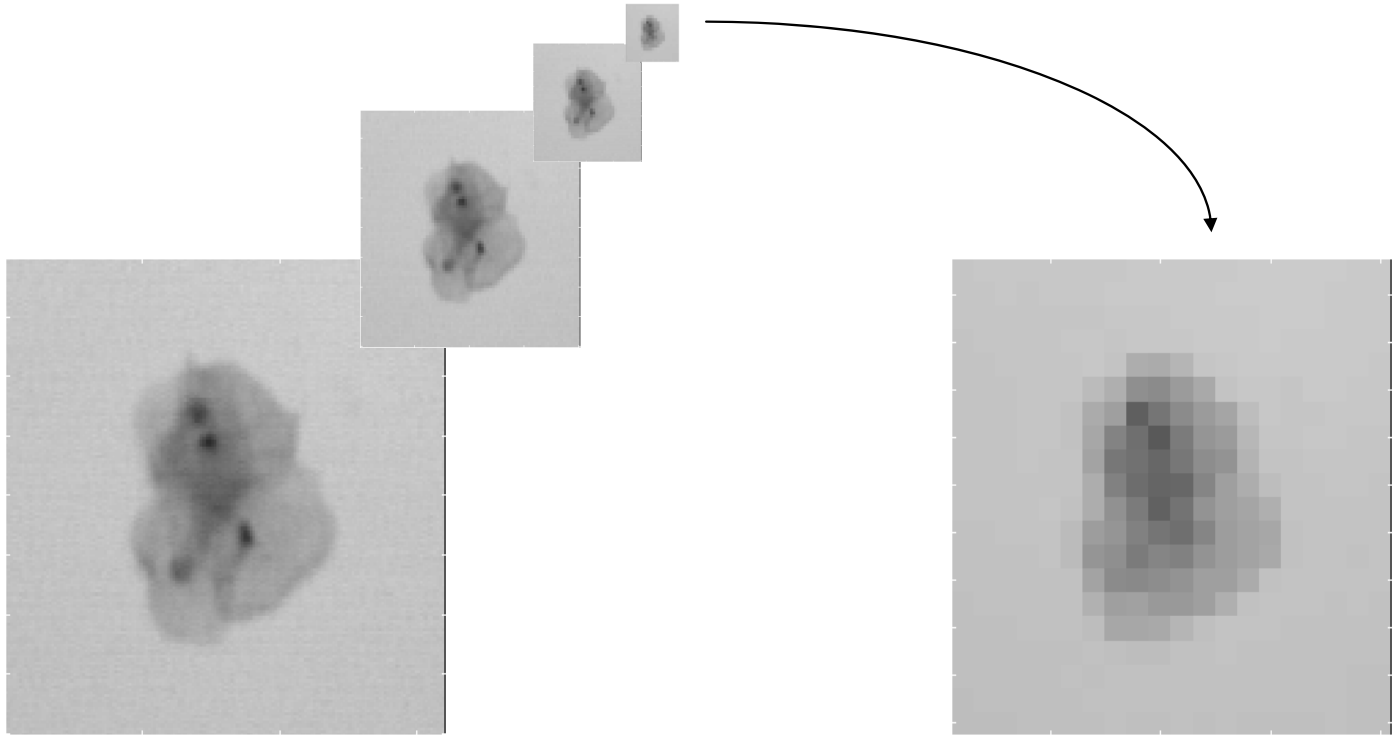
Algorithm Outline

- The algorithm consists of three stages:
  - Quadtree smoothing (Multiresolution technique, Pyramids)
  - Water immersion for lowest level classification
  - Boundary re-estimation

The image is first reduced by quadtree smoothing. This has the advantages of:

- Decreasing the number of pixels that require processing, increasing the speed of the algorithm.
- Causing background artefacts, such as blood cells, to become less significant compared to the objects of interest.
- Producing a series of images, each of a lower resolution than the previous.

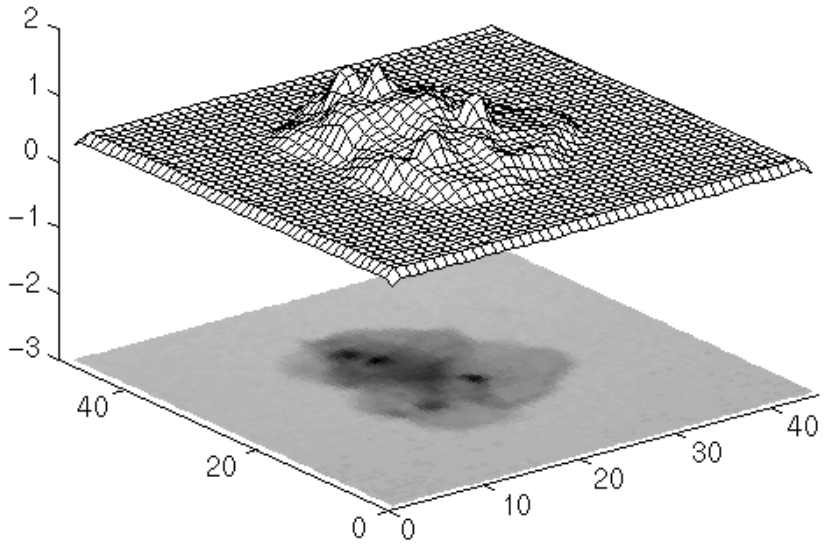
Quadtree Smoothing (Pyramid Processing)



Visualization of Water Immersion

- The gray-level image is treated as a topographical map.
- The surface can be imagined to be lowered into water, causing air to be trapped in the elevated areas.
- The air pockets mark the position of the cells.

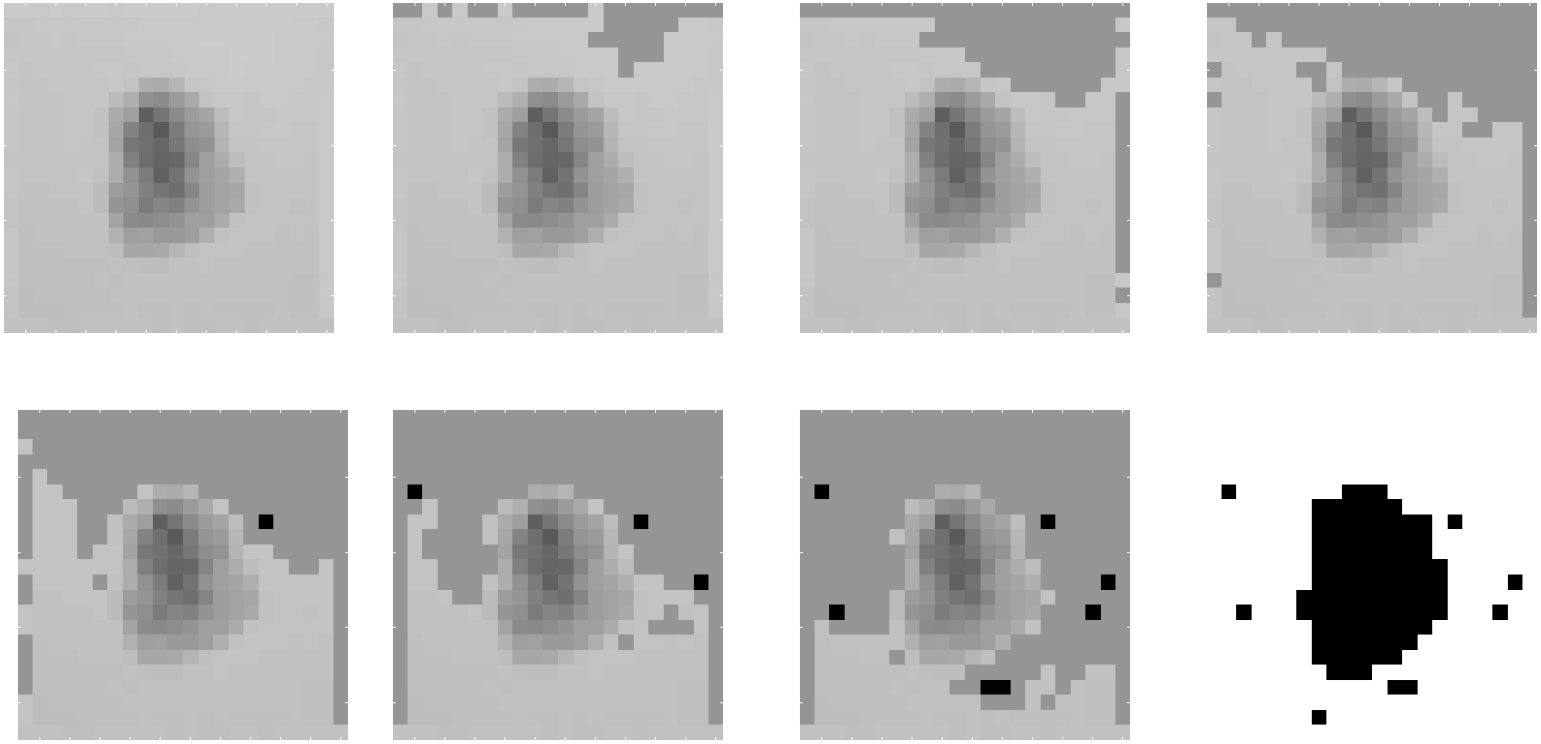
Gray-level image as a topographical map



Method

- The subsampled image is now flooded.
- The lighter pixels, being of lower elevation, become flooded first.
- Areas that become completely surrounded by water are considered to be possible cells and are marked (black in diagram).
- Occasionally, rogue pixels will be marked (as seen). These are possibly the remains of smoothed artifacts and can be removed later. Artifacts tend to be much smaller than cells.

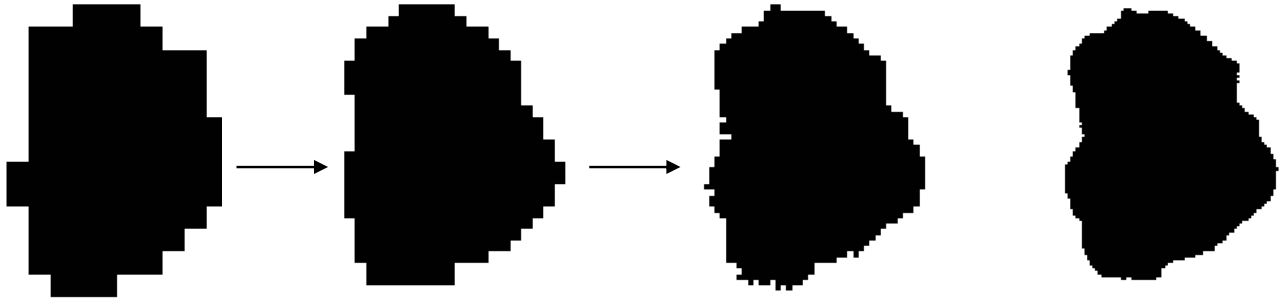
Water Immersion



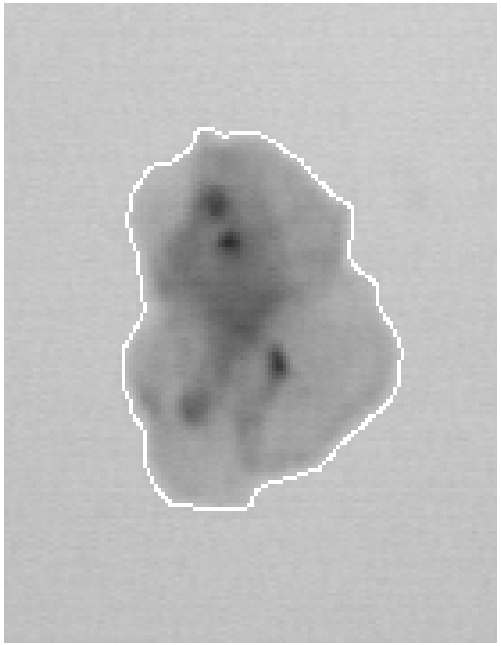
Boundary Re-estimation

- The boundary now requires refining.
- The border pixels are selected for processing and are re-flooded as before at the next resolution (more detail).
- This is repeated until the original image resolution is reached.

Boundary Re-estimation



Final Segmentation



Full Scene Segmentation