Histogram of Oriented Gradients

A picture analysis method

Histogram of Oriented Gradients (HOG)

- The basic purpose of this analysis method is feature extraction from a picture

- The method is very good at detecting shapes

- It is not locally oriented, but extracts features for the whole picture

HOG algorithm

- The picture is analysed by dividing the pictures into subsections

- **Cells** are usually defined as groups of 8×8 pixels

- They are then combined into **blocks** of 4×4 cells

- These values are not fixed, but established as general guidelines
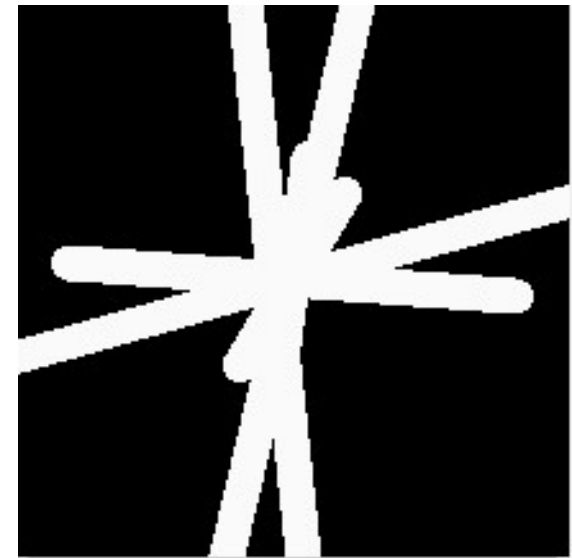
HOG algorithm

- For each cell a polar coordinate system is defined with the pole at the center of the cell

- A fixed number of orientation bins is selected (usually 9)

- The bins represent discrete directions for lines from 0°-180°

- Each pixel in the cell adds weight to a corresponding direction, depending on it's magnitude (intensity for simple greyscale picture)

- The value of a pixel influences of the 4 nighbouing cells as well with a reduced weight

HOG algorithm

- The result of this algorithm is a snowflake like shape positioned at the center of each cell

- The snowflake consists of 9 lines (for as many bins) crossing at the cell center

- The length of the lines determines the dominance of the shape direction for a certain cell (and the 4 neighbouring cells with a reduced weight)

- In variation to the basic approach the line intensity can be proportionate to it's length so that the dominance of diretction is doubly accentuated
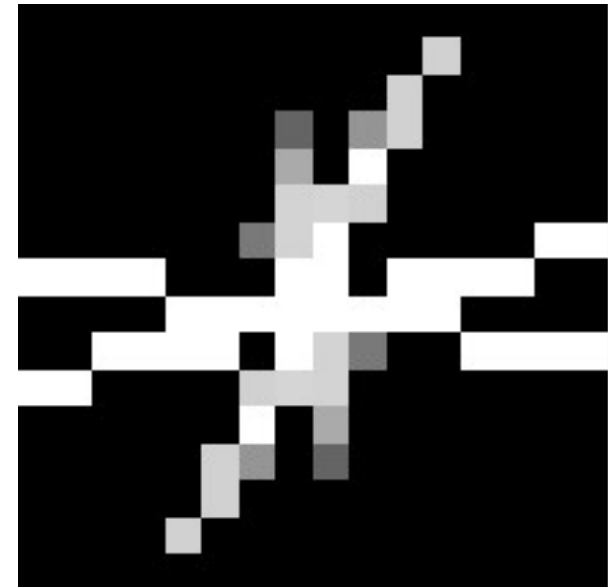
HOG algorithm cell results

- A single cell HOG result is displayed to the right

- This variant establishes dominance through line length, not intensity

- It follows from the picture that for this cell the dominant directions were close to the horizontal and vertical, while other directions are not significantly represented
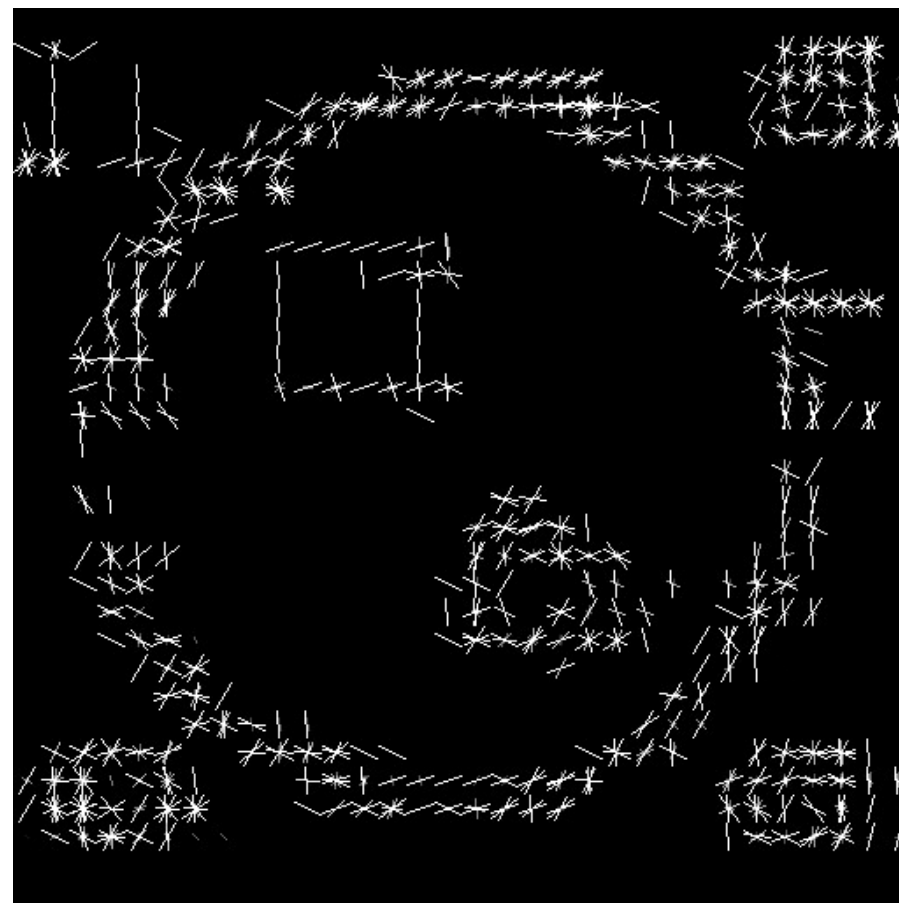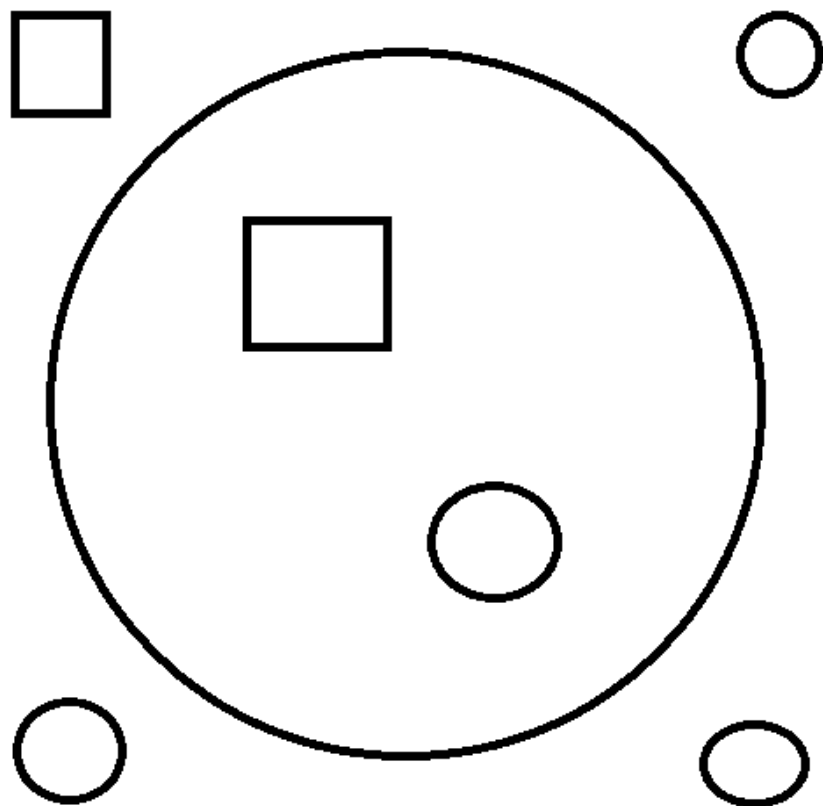

HOG flake

HOG algorithm cell results

- A single cell HOG result is displayed to the right

- In this case the direction dominance is emphasized by the intensity of the line (longer lines are *whiter*)
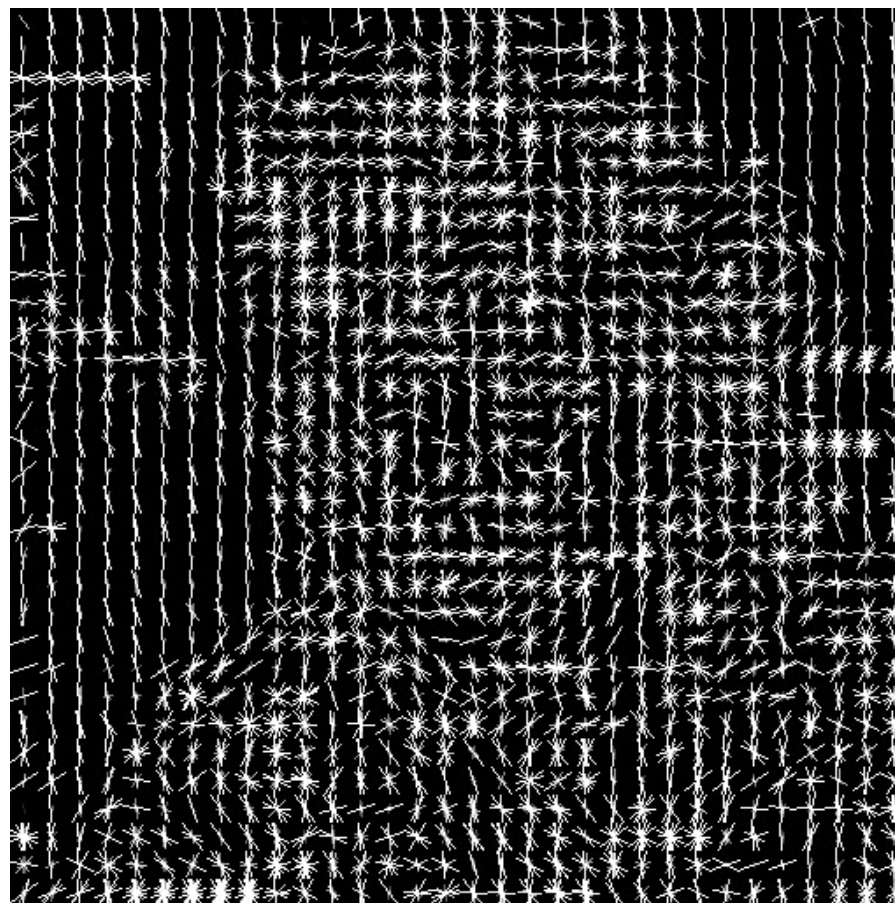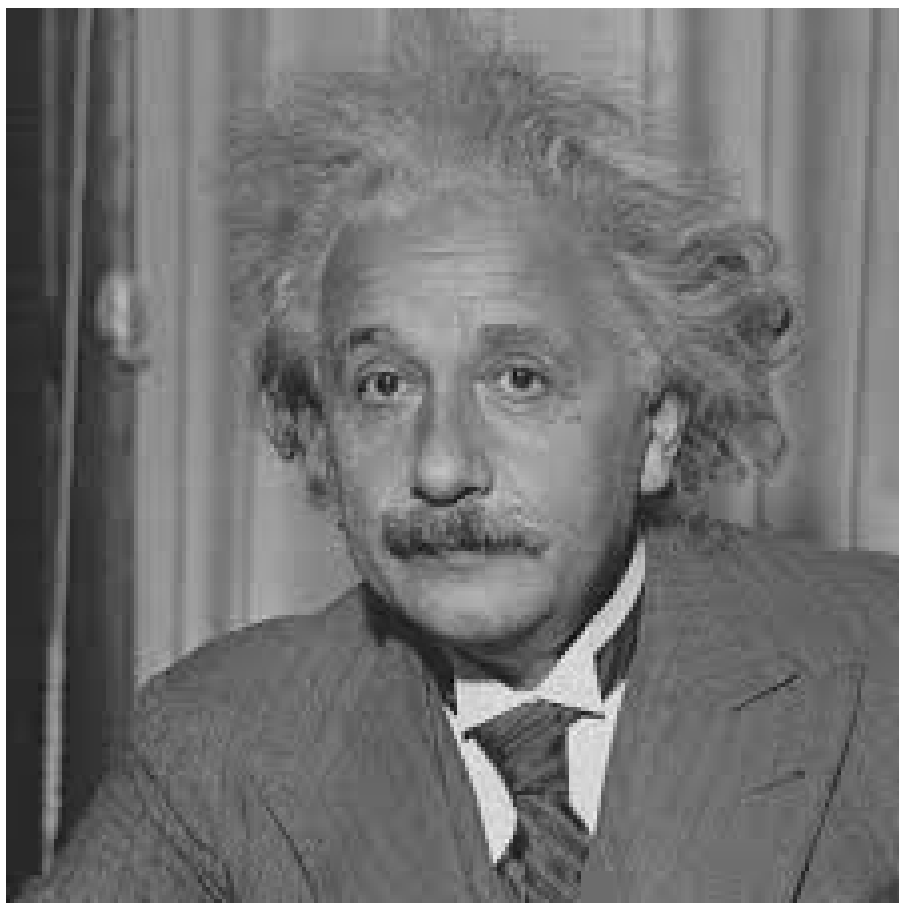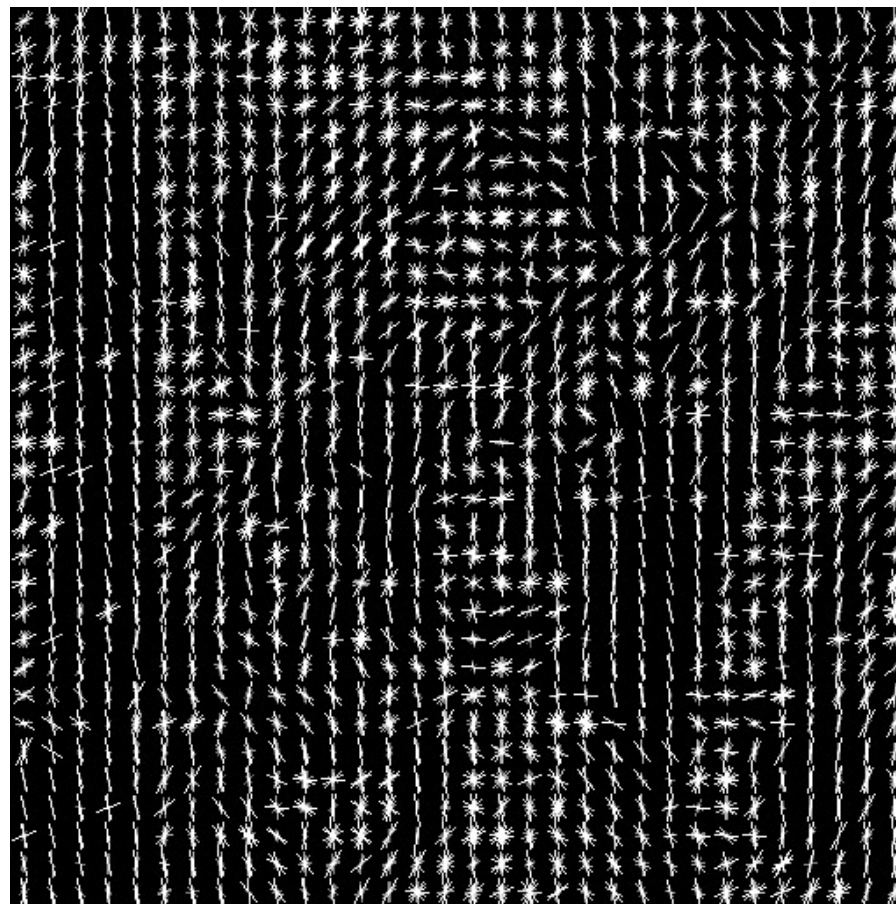

Intensity HOG flake

HOG algorithm full picture results

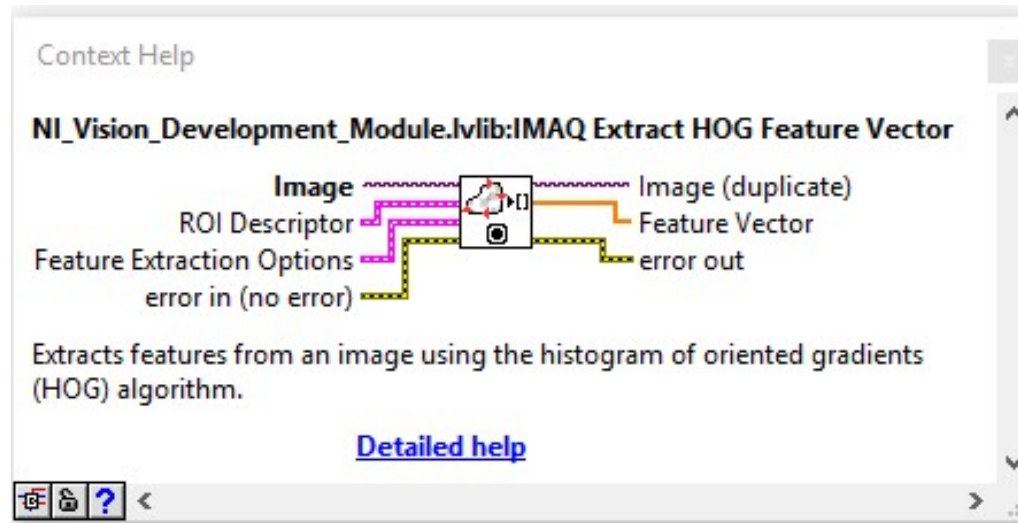# HOG algorithm full picture results

HOG algorithm full picture results

HOG method in LabVIEW

- The algorithm is implemented in Vision module in LabVIEW
- It is very badly documented
- There is little instruction other than those available in Context Help

HOG method in LabVIEW inputs

- The algorithm can be applied on the whole picture (*Default*) or a Region Of Interest can be defined through input cluster *ROI Descriptor*
- *Feature Extraction Options* input cluster defines cell size (X×Y) and the number of direction bins
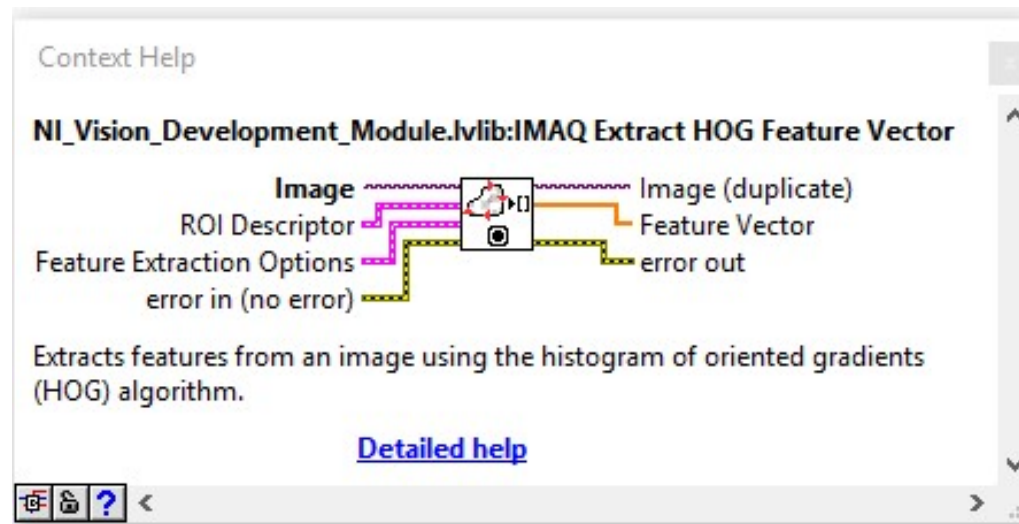
HOG method in LabVIEW output

- *Feature Vector* is a 1D array of doubles that includes line lengths for different bins consecutively for all the cells consecutively
    - If you have 20 × 30 cells image and 9 bines the array will contain 5400 elements
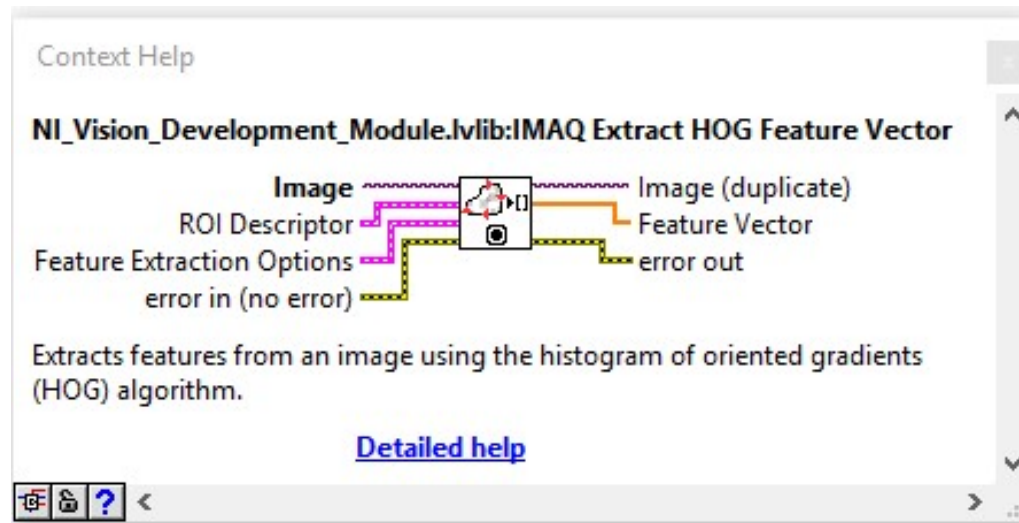
HOG method in LabVIEW bin order

- Taking the standard compass orientation (North as *up*) the first position bin value for each cell is North following by bin (direction) values over West toward South

- This is very important when trying to visualize HOG method results properly

- This presentation is accompanied with a LabVIEW example program for testing the HOG method and experimenting with different method parametrization