



# Computer Vision

## Contrast manipulation

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## Contrast manipulation

### Overview:

- Contrast stretch
- Histogram equalisation
- Pixel clipping (\*)
- Gamma correction

### Usage:

pre-processing in order to make segmentation easier

### Contrast Stretch

**ContrastStretch (image, low, high)**

**ContrastStretchLUT (image, low, high)**

**The contrast stretch operator stretches, in a linear fashion, the pixel values in the image to the range [low..high].**

**The pixels with the lowest value in the original image will get the value low.**

**The pixels with the highest value in the original image will get the value high.**

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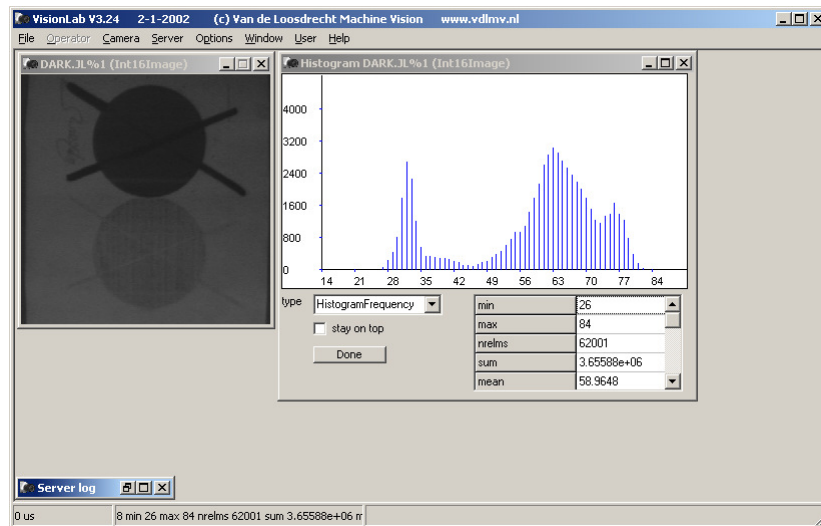
### Demonstration Contrast Stretch

- Set default LUT for Int16Image to clip
- Open image dark.jl (under exposed image)
- Show histogram
- Contrast stretch 0 255
- Show histogram
- Compare histograms
- ContrastStretchLUT has same effect but is faster for 'normal' IntxxxImages

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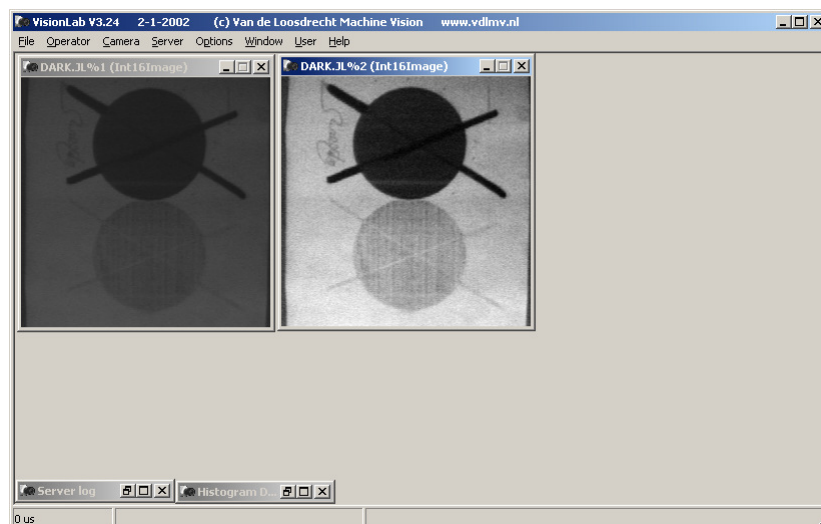
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**Image dark.jl (under exposed image) and histogram**

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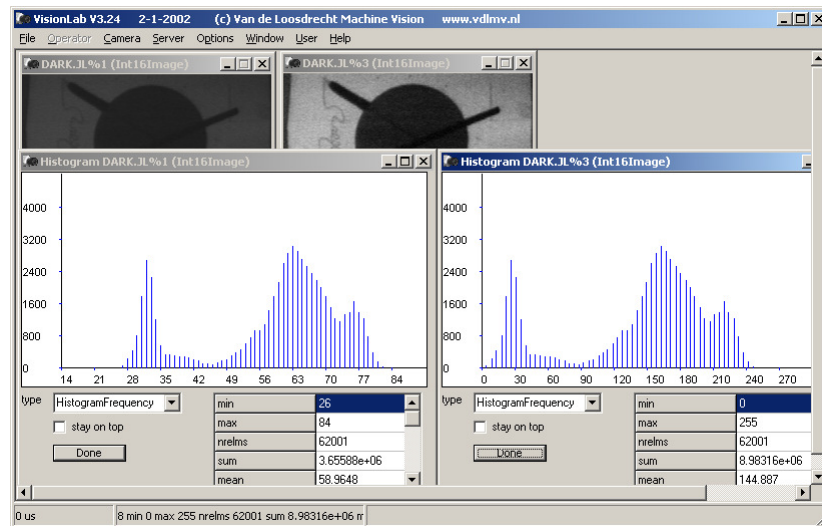
**Contrast Stretch 0 255**

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### Compare histograms



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### Histogram Equalisation

#### HistogramEqualise (image)

The histogram equalise operator equalises the distribution of the pixel values in the image. In each bin in the histogram there should be an equal number of pixels

The values of the pixels are reassigned based on the histogram of the image.

Individual pixels retain their value order but the values are shifted, so that as far as possible, an equal number of pixels have each possible value.

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### Demonstration Histogram Equalisation

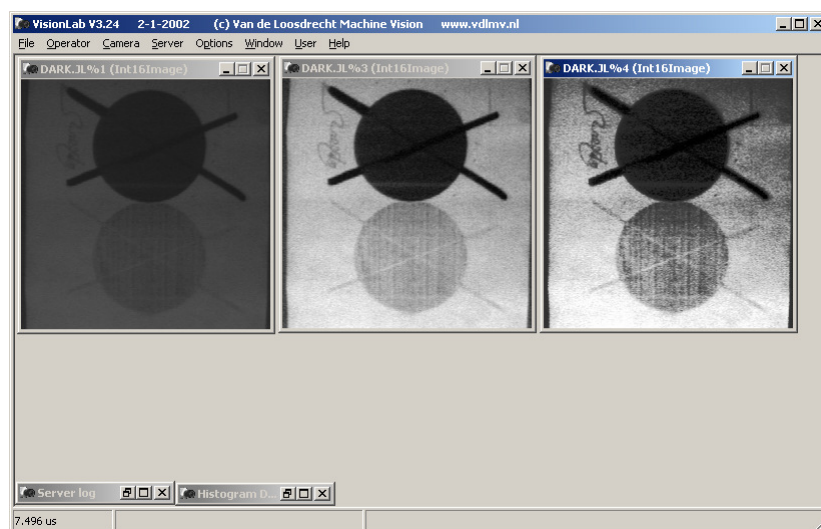
- Apply histogram equalisation on contrast stretched image (and not on the original image)
- Show histogram, demonstrate partial sum is almost linear
- Close all images

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### Histogram equalisation on contrast stretched image

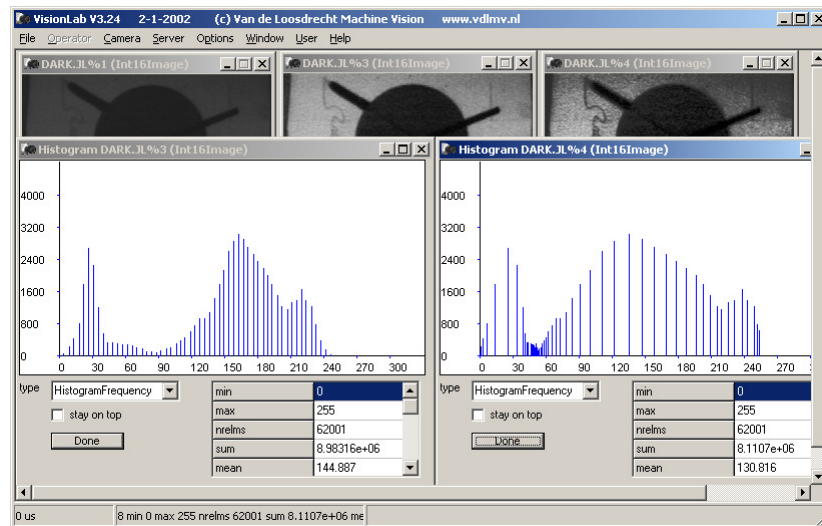


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## Compare histograms

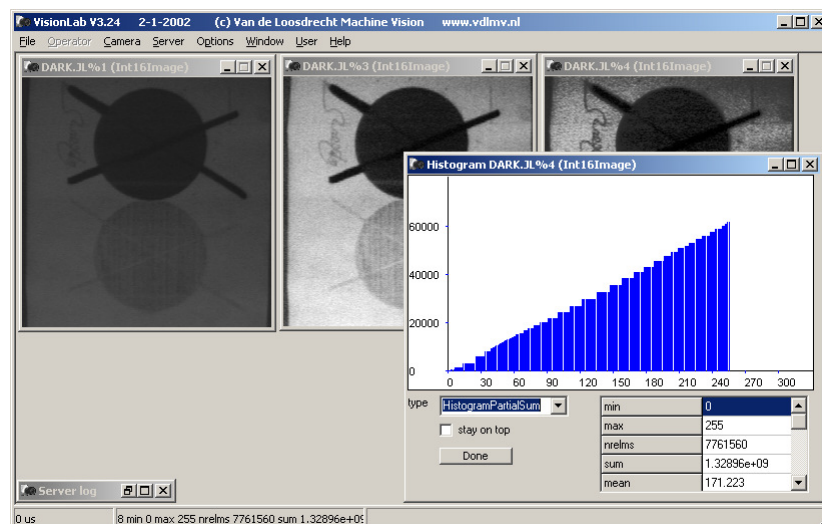


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## Histogram partial sum is almost linear



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### Demonstration Histogram Equalisation

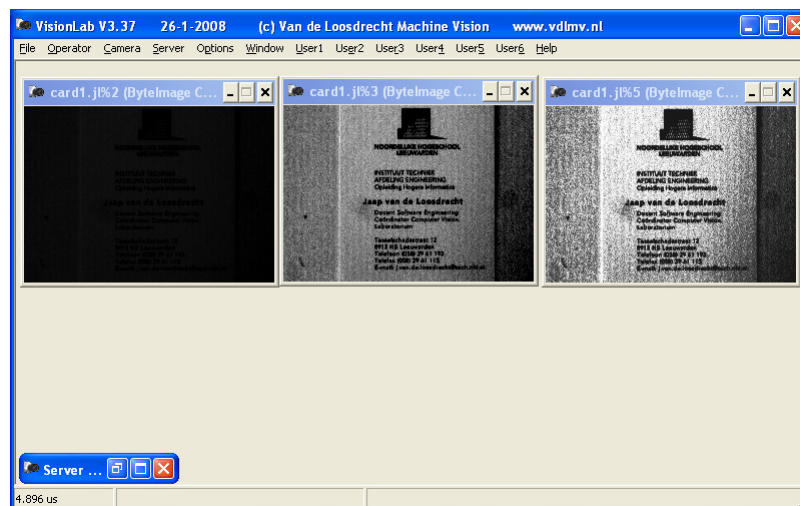
- Open image card1.jl (under exposed image)
- Contrast stretch
- Histogram equalise

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### Histogram equalisation on contrast stretched image



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### Local Histogram Equalisation

**LocalHistogramEqualize** imageName nrRsX nrRsY nrBins clipLimit

**Only for ByteImage and Int16Image**

The **LocalHistogramEqualize** enhances the contrast of the image. The image is divided in nrRsX \* nrRsY regions for which the local histogram is calculated. Based on the local histograms, the pixel values are redistributed in the whole image.

In order to avoid overamplifying noise in relatively homogeneous regions of an image, the local histograms are clipped using the clipLimit parameter. This parameter is normalized for the size of the region. Common values are between 3 and 4, higher values give more contrast and noise. A value of 1 means no equalization (= copy of image).

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### Local Histogram Equalisation

The nrBins parameter specifies the number of greybins used for histogram (= dynamic range). The complete dynamic range is always used. Lower values give lower dynamic resolution and faster computation.

**Note:** the height of the image must be a multiple of nrRsY and the width of the image must be a multiple of nrRsX.

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### Demonstration Local Histogram Equalisation

- Run script `localHisEqual.jls`:
  - Open `dark_flower.jl`
  - Convert to `Int16Image` and ROI 256 256
- // effect of size of region
  - `LocalHistogramEqualize r2x2_4 2 2 256 4`
  - `LocalHistogramEqualize r16x16_4 16 16 256 4`
  - `LocalHistogramEqualize r32x32_4 32 32 256 4`
- // effect of clipLimit
  - `LocalHistogramEqualize r16x16_4 16 16 256 4`
  - `LocalHistogramEqualize r16x16_8 16 16 256 8`
  - `LocalHistogramEqualize r16x16_32 16 16 256 32`

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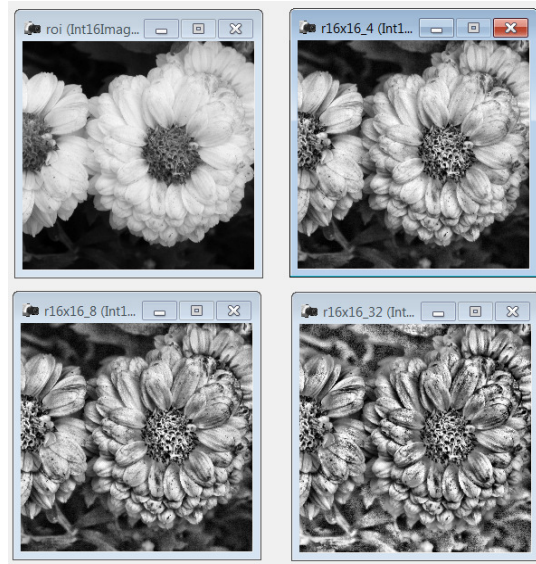
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### Local Histogram Equalisation, effect of size region



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**Local Histogram Equalisation, effect of clipLimit**

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**Pixel Clipping (\*)****ClippixelValue (image, low, high)**

The clippixelvalue operator restricts the pixel values in the image to the range [low..high].

**Pixels with a value lower then low will get the value low.**

**Pixels with a value higher then high will get the value high.**

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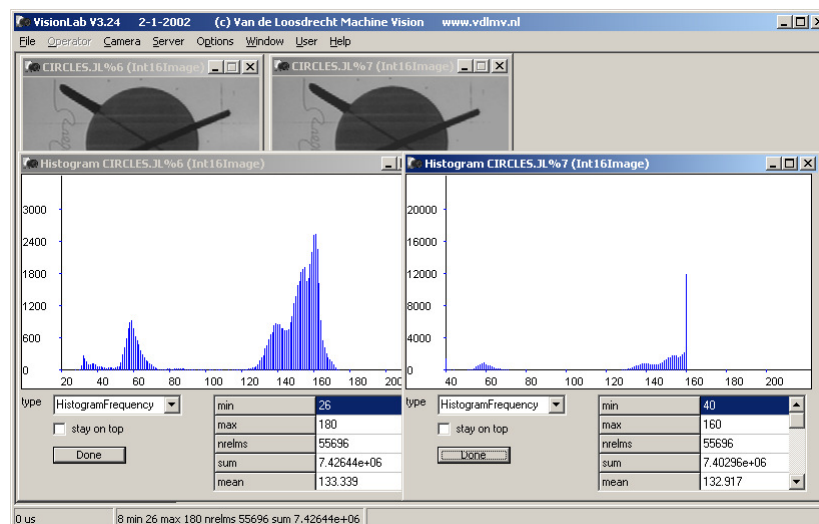
**Demonstration Pixel Clipping (\*)**

- Open file circles.jl
- Show histogram
- Clip pixel value 40 160
- Show histogram, note peak at pixel value 40 and 160
- Compare histograms

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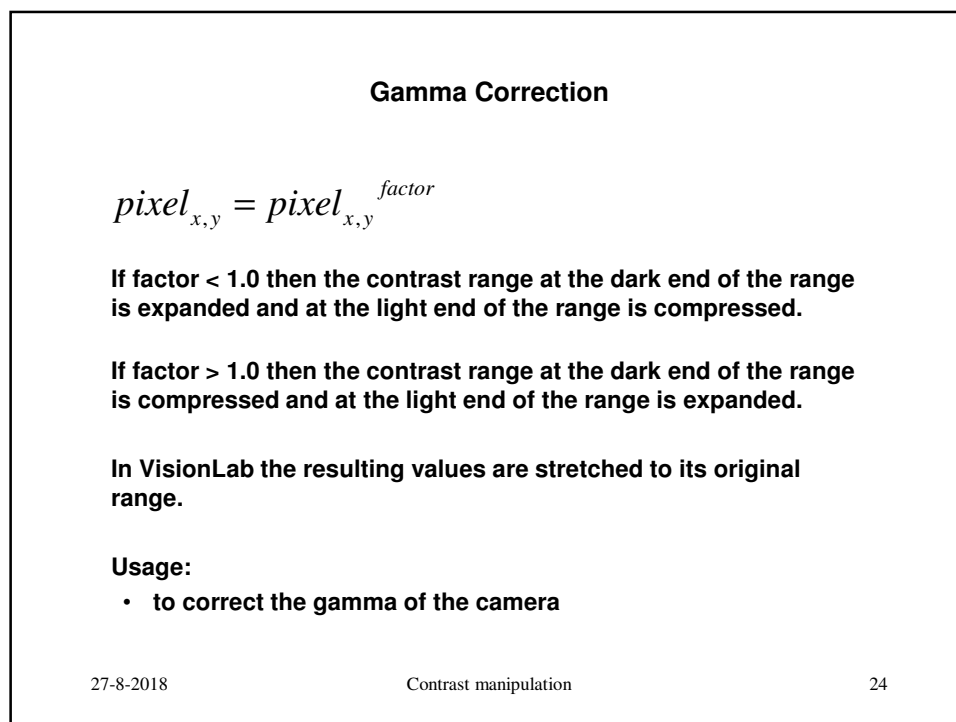
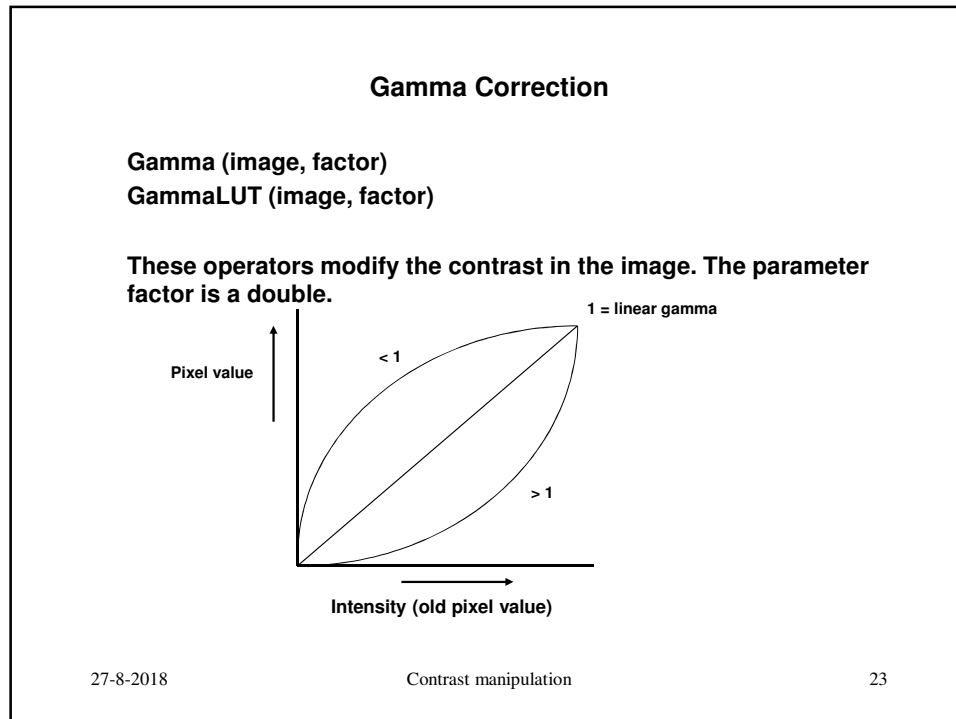
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**Compare histograms after Clip pixel value 40 160 (\*)**

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### Demonstration Gamma Correction

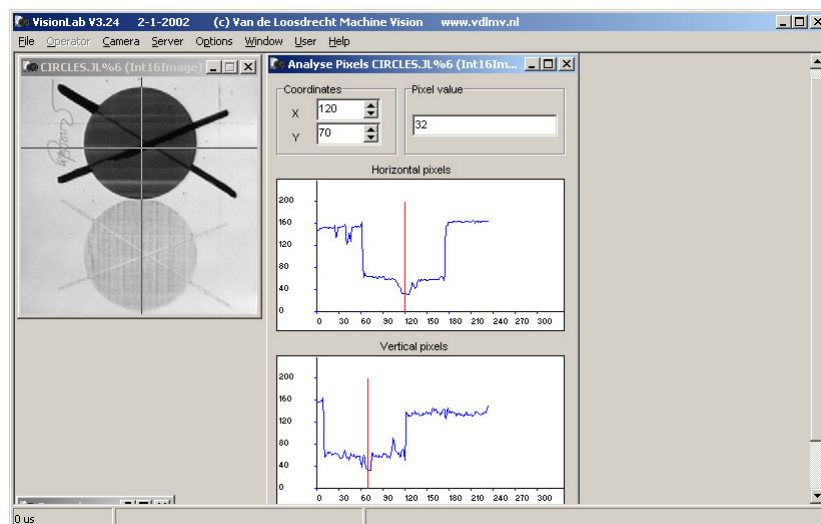
- Open image circles.jl
- Analyse pixels in middle of dark circle (120,70)
- Gamma 4.0
- Analyse pixels in middle of dark circle, high pixel values higher contrast, low pixel values lower contrast
- Gamma 0.25
- Analyse pixels in middle of dark circle, high pixel values lower contrast, low pixel values higher contrast
- NOTE: set default LUT for Int16Image back to stretch

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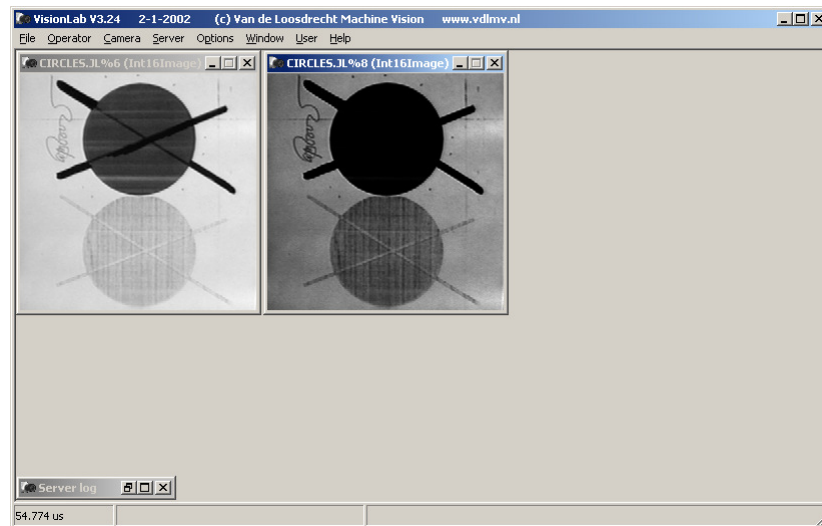
### Analyse image



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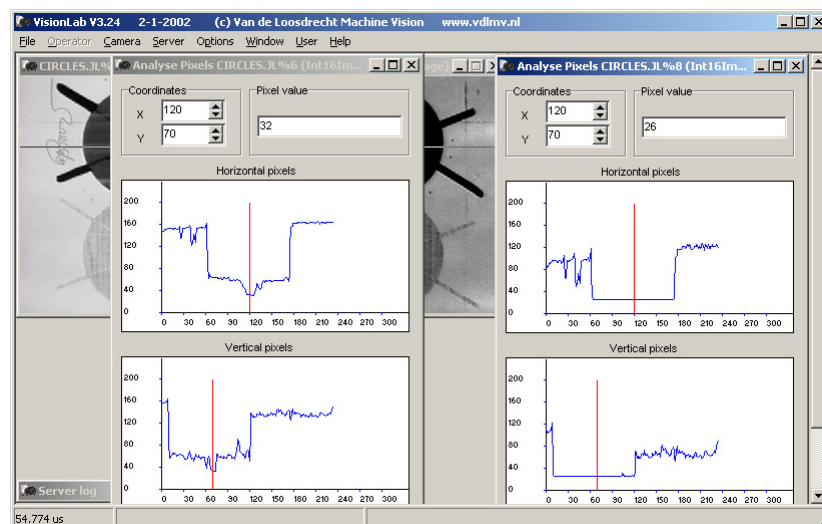
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**Gamma 4.0**

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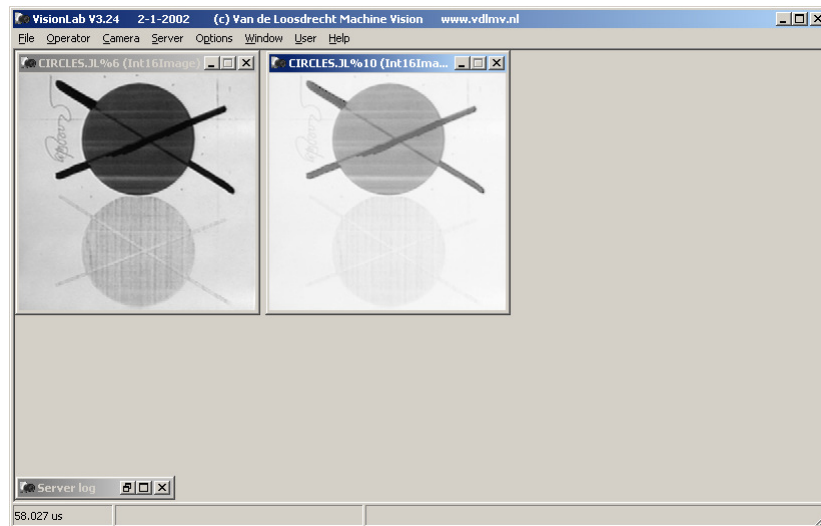
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**High pixel values higher contrast, low pixel values lower contrast**

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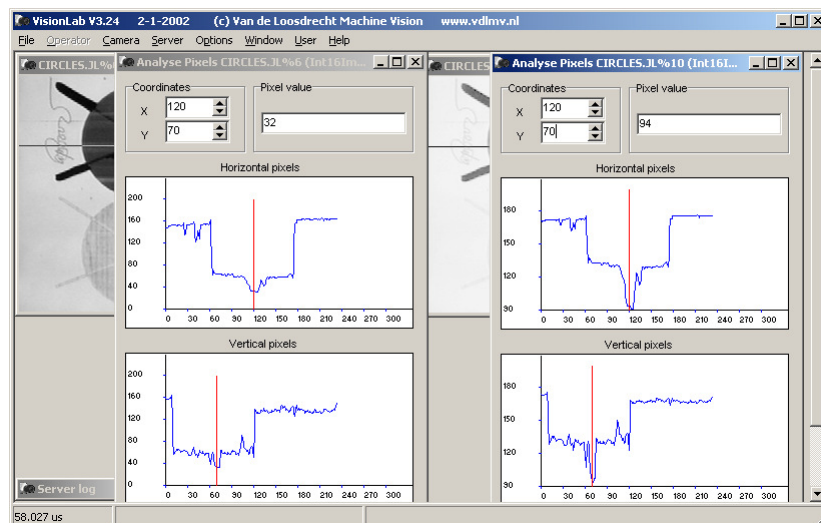
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**Gamma 0.25**

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**High pixel values lower contrast, low pixel values higher contrast**

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### Exercise

- Experiment with the contrast manipulation operators
- The contrast manipulation operators will be needed in other exercises

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