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**
- **ConstrastStretchLUT has same effect but is faster for 'normal' IntxxxImages**

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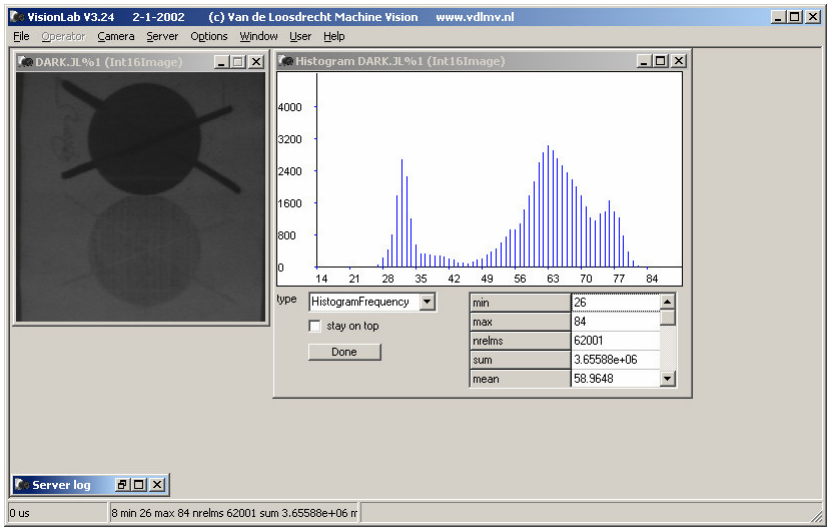
Image dark.jl (under exposed image) and histogram



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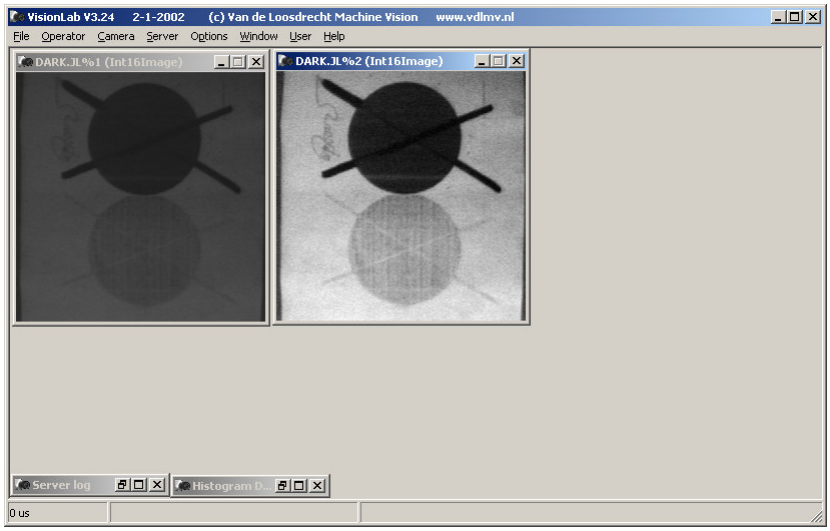
Contrast Stretch 0 255



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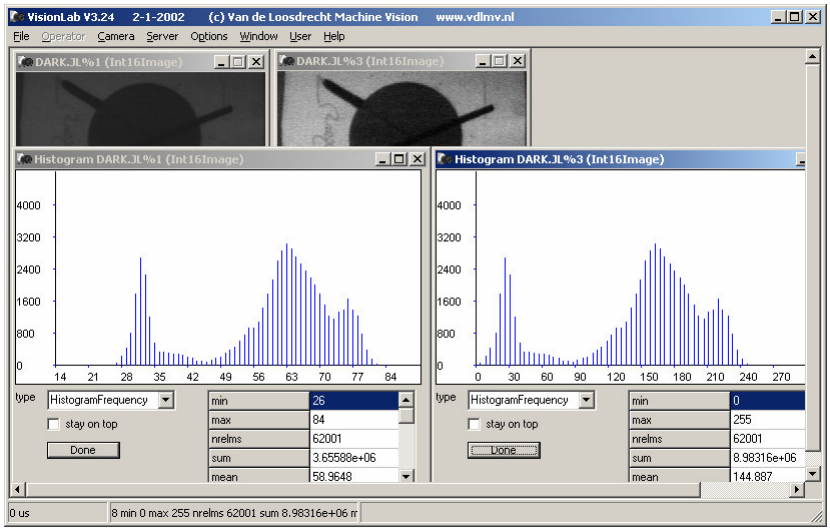
Compare histograms



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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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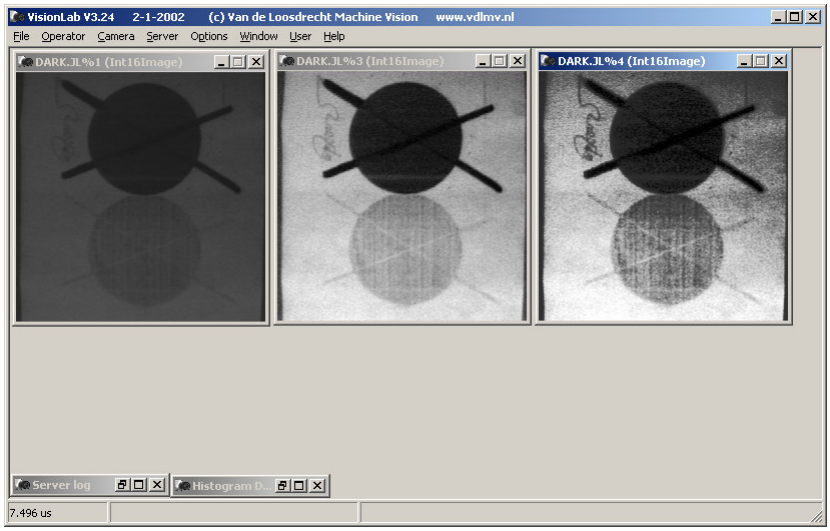
Histogram equalisation on contrast stretched image



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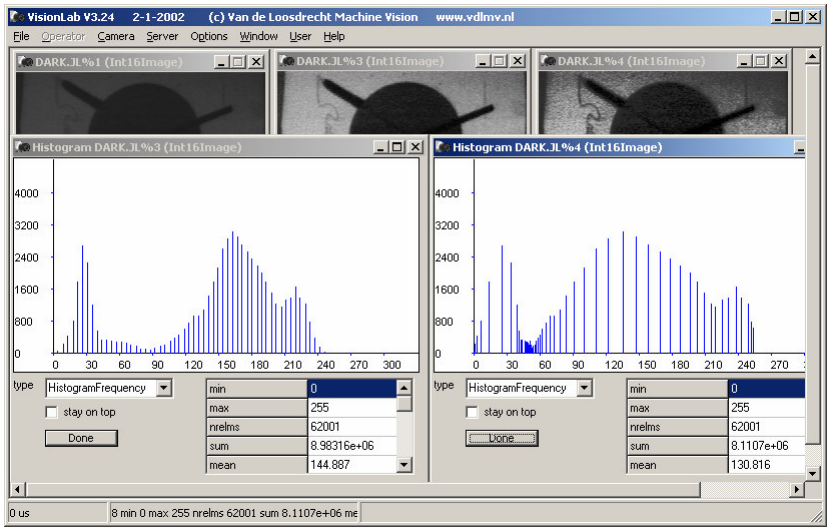
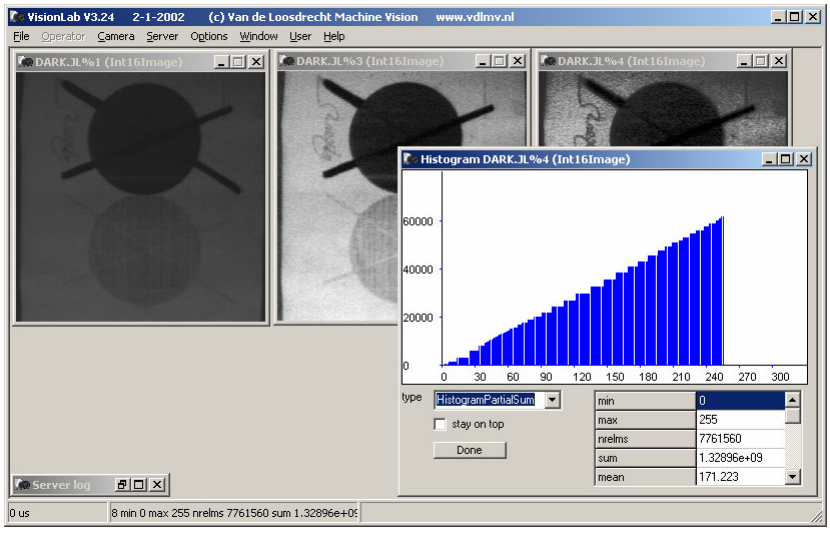
Compare histograms



Histogram partial sum is almost linear



Demonstration Histogram Equalisation

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

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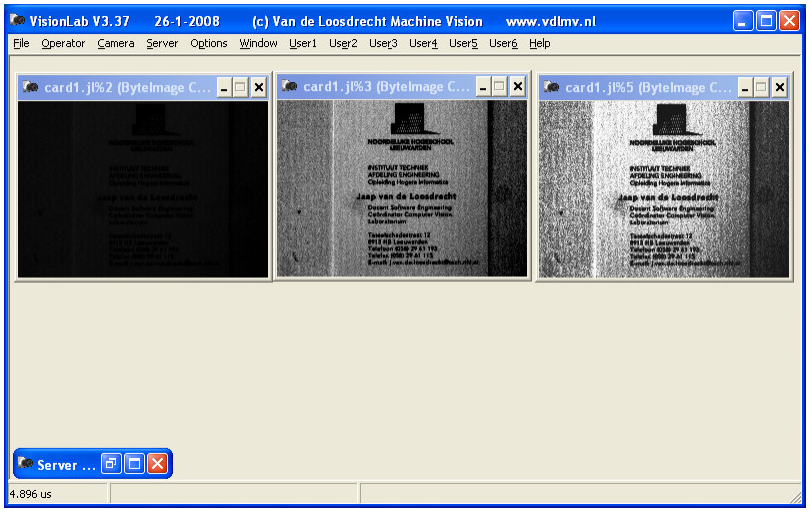
Histogram equalisation on contrast stretched image



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Pixel Clipping

ClippixelValue (image, low, high)

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

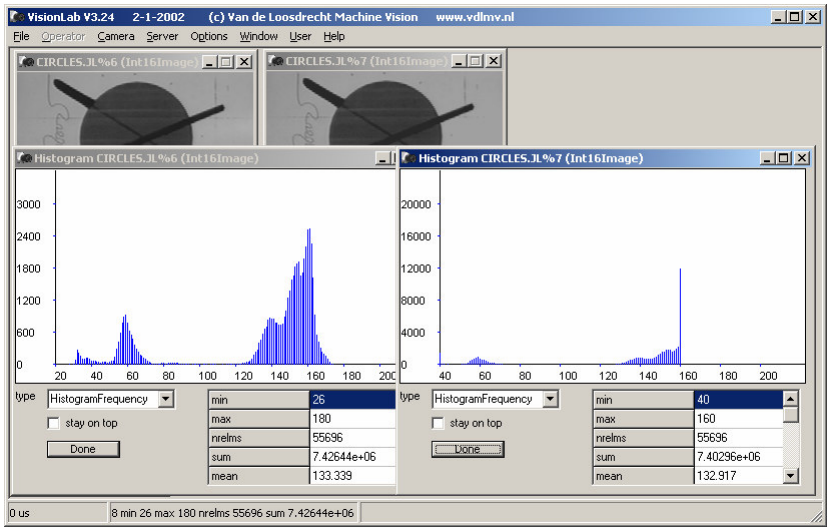
Pixels with a value lower then low will get the value low.

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

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**

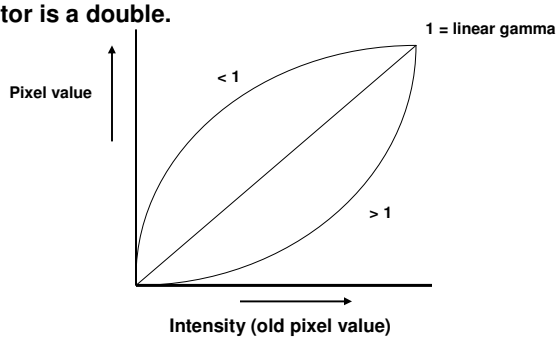
Compare histograms after Clip pixel value 40 160



Gamma Correction

Gamma (image, factor)
GammaLUT (image, factor)

These operators modify the contrast in the image. The parameter factor is a double.



Gamma Correction

$$pixel_{x,y} = pixel_{x,y}^{\ factor}$$

If factor < 1.0 then the contrast range at the dark end of the range is expanded and at the light end of the range is compressed.

If factor > 1.0 then the contrast range at the dark end of the range is compressed and at the light end of the range is expanded.

In VisionLab the resulting values are stretched to its original range.

Usage:

- **to correct the gamma of the camera**

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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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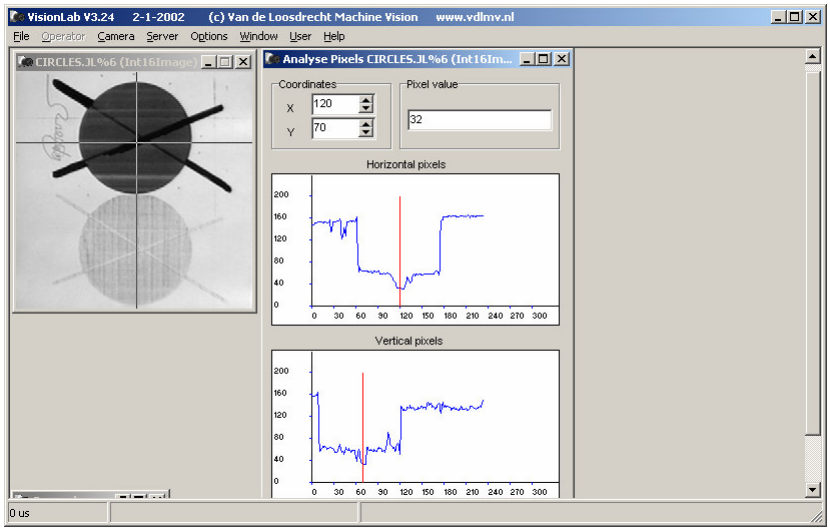
Analyse image



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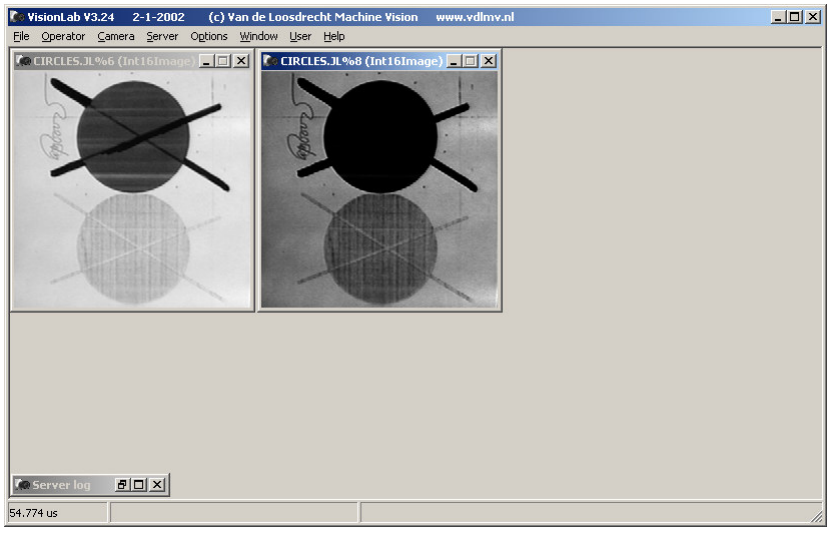
Gamma 4.0



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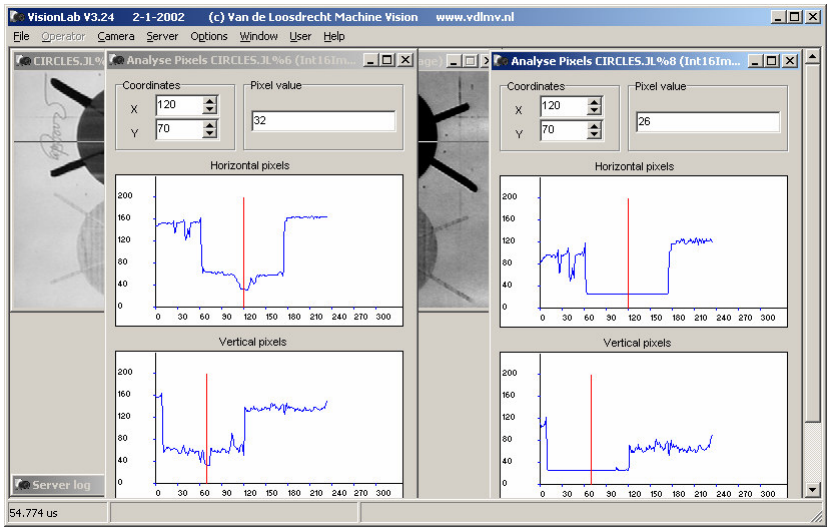
High pixel values higher contrast, low pixel values lower contrast



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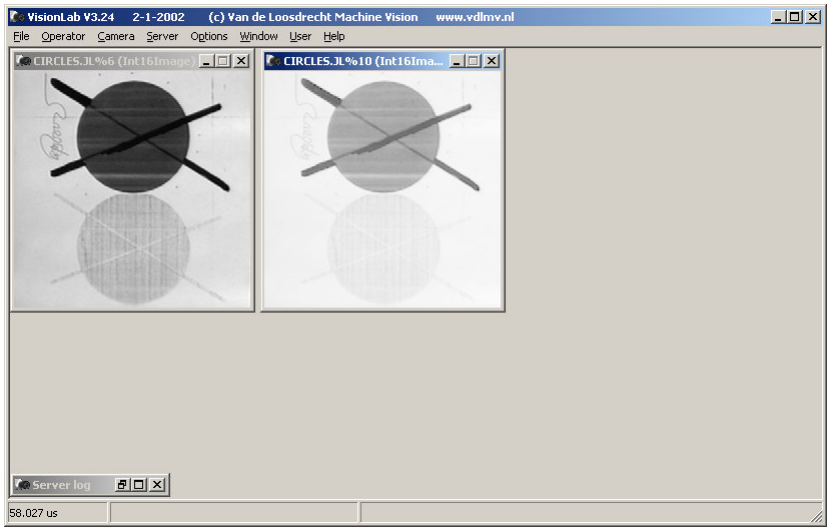
Gamma 0.25



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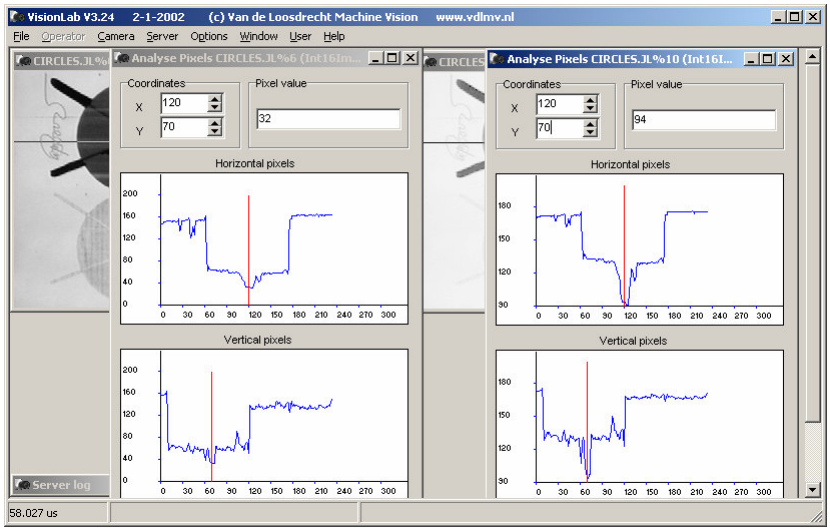
High pixel values lower contrast, low pixel values higher contrast



Exercise

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