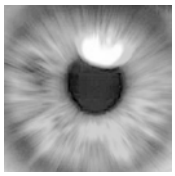

ICAM – QA and QC of displays

ICAM Display application

The ICAM display application software, controlling ICAM, is specialized software for display measurements. The application provides data acquisition, data extraction and 'approval' according to internal production criteria's or according to international standards.

Most displays has refresh rates with frequencies from app. 25 Hz to 100 Hz or even faster and some displays further controls brightness with frequency modulation. See figure 1.

Data acquisition

With an external trigger signal into the build-in ICAM trigger generator and the ICAM time stitch function, high quality measurements (images) of the display are acquired. This operation requires precise information of the display mode of operation, regarding scanning orientation and timing.

Display parameters

Most display characteristics can be extracted from the measurements. Examples are given in the list below.

Colour Gamut - Primary Colours
Gamma - Gray scale
White Point
Contrast - CTF
Angle of View
Defect pixel/LED

Some of these require the display to show appropriate test images.

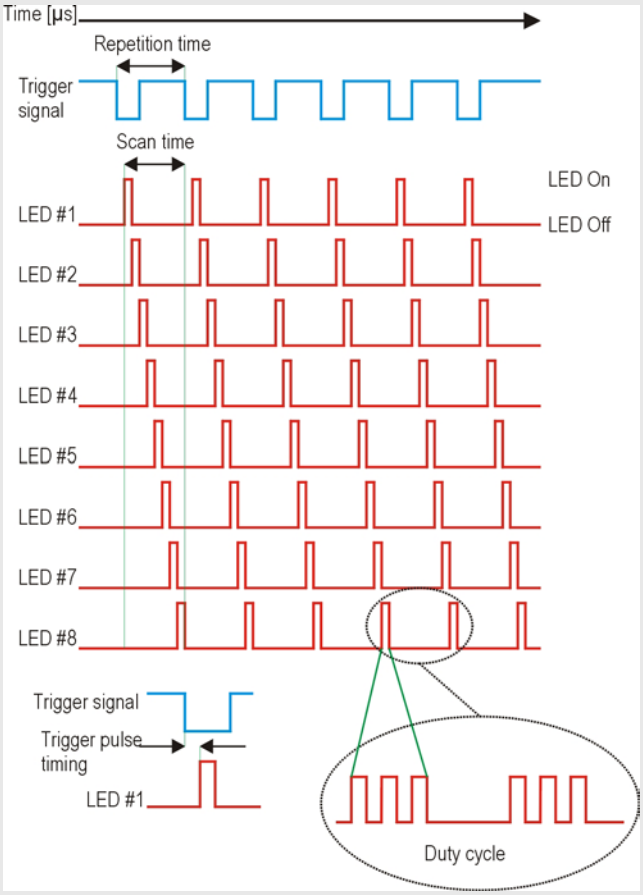

Figure 1 Timing in modulated or scanning display systems

Data extractions

Sampling is done with in a user defined Area Of Interest. Three different methods are used.

- all pixels in the AOI are used as individual samples
- within the AOI a number of rows and columns are defined. For each row-column element, a number of pixels (ex. 3 × 3) are average and used as samples
- features (blobs) are located within the AOI and each feature are used as a sample

In figure 3 the 'feature' mode is used to locate the LED's forming part of the letter 'O'.

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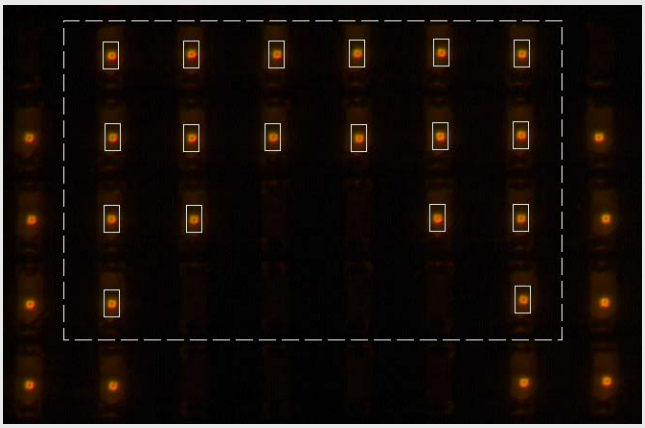

Figure 3 Feature sampling

Quality and criteria test

All photometric and colorimetric properties can be extracted and used as approval criteria. See figure 4.

In figure 3 the set-up of test criteria for luminance is shown. For each wanted parameter, minimum, maximum, average, standard deviation and various uniformity ratios, an acceptance interval is set by an allowed minimum and an allowed maximum value. Single criteria can be cancelled by a -1, and a whole group of criteria's can be cancelled by toggling a check-mark.

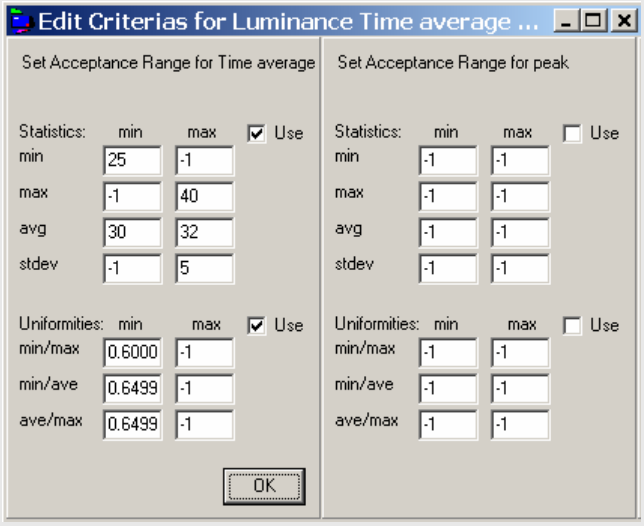

Figure 3 Setting criteria's

Approval

The success of fulfilling the criterions for a property is indicated by a red or green mark. If all criterions for all properties are fulfilled an overall mark is coloured. See figure 4.

Result presentation

A comprehensive text report is formed. See figure 5.

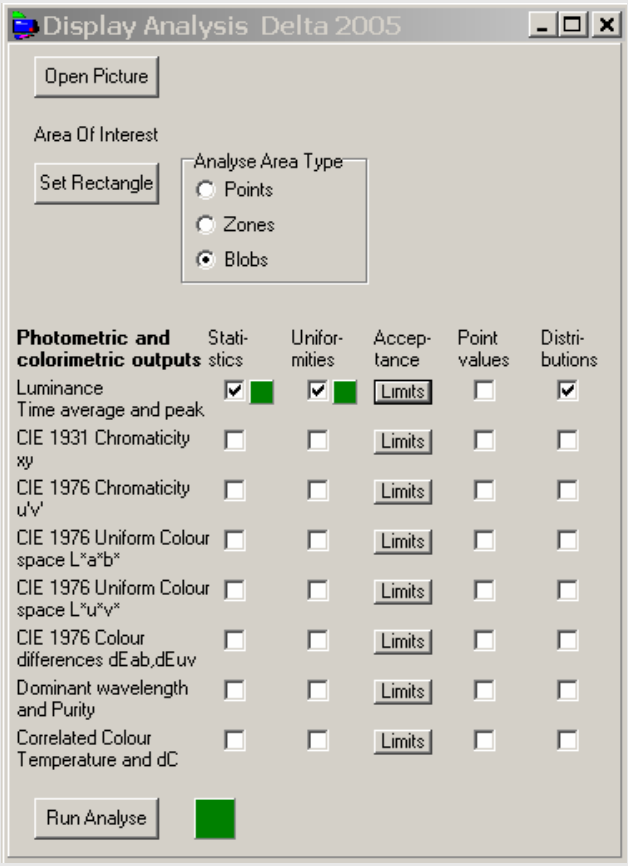

Figure 4 Properties and test-criteria selection

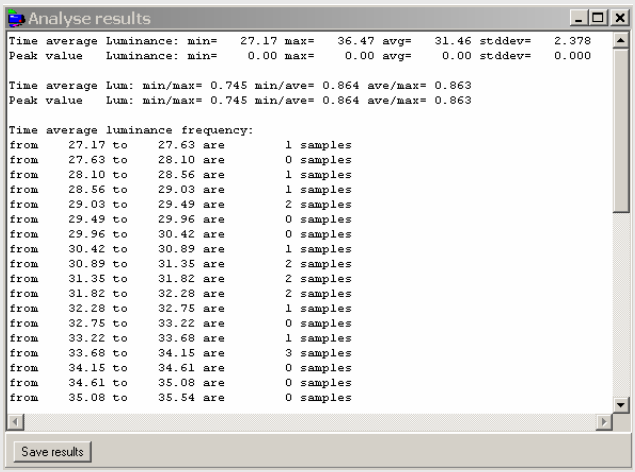

Figure 5 Report with sample values, detailed results, etc.

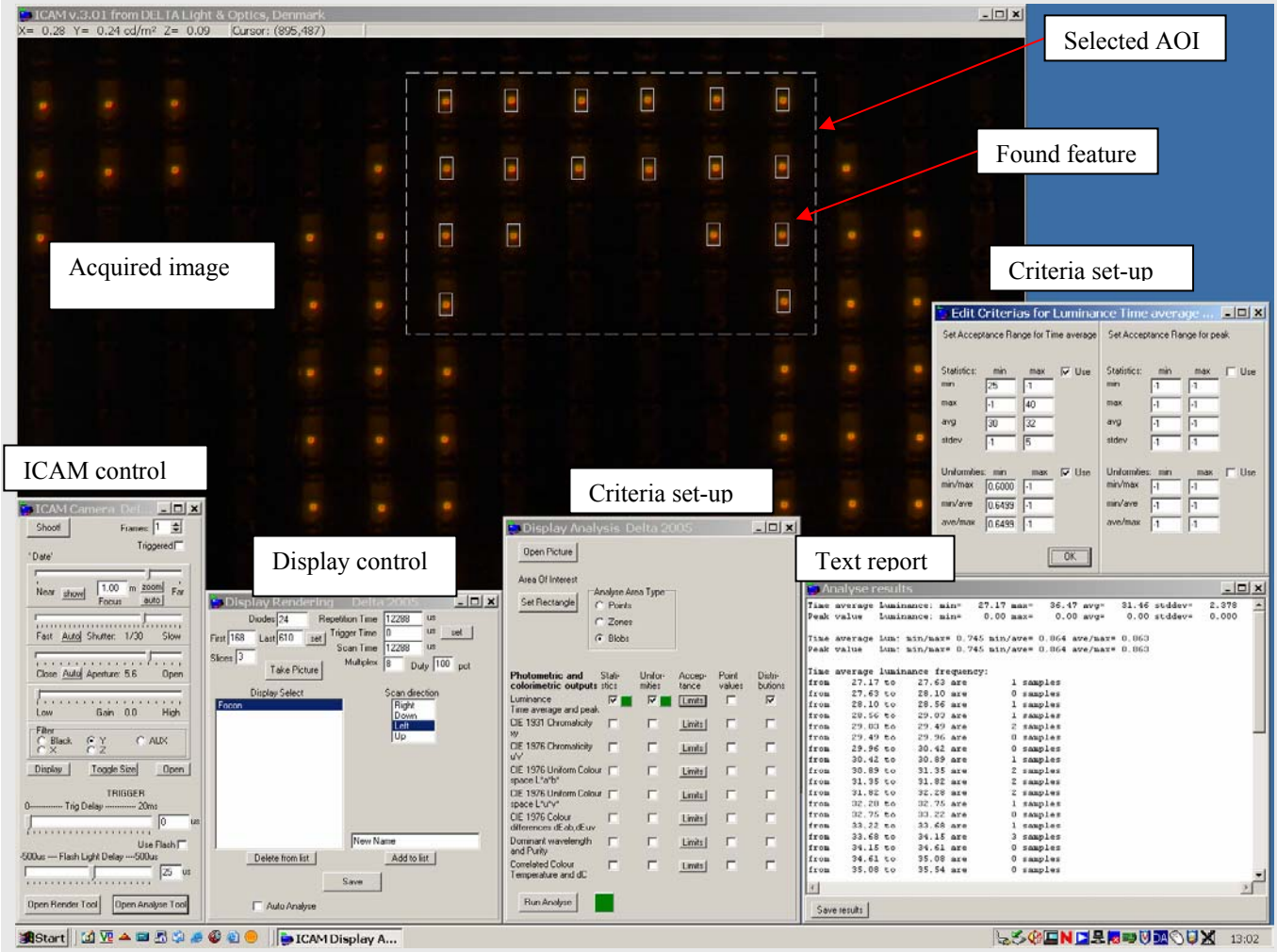

Figure 6 A screen dump from the ICAM Display application software

For each photometric and colorimetric property the distribution of sample values can be shown. See figure 7. Here is shown the variability of the dominant wavelength of the measured app. 3000 LED's.

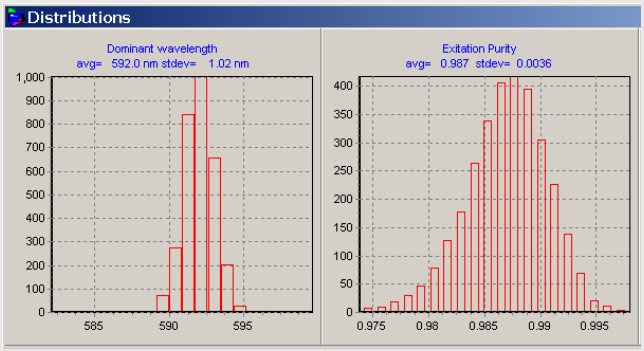

Figure 7 Distribution of sample values; here dominant wavelength and exitation purity.

Closing remarks

The ICAM display software will be available in a standard edition, as described here.

The result of the display test, approval, can be communicated on various hardware ports like USB, RS232, RS485, etc.

On request custom made versions are available.