AEON 2-day In-depth and hands-on EMVA 1288 Course

Exposé

The 1288 standard of the European Machine Vision Association (EMVA) for objective camera charaterization is adopted worldwide and makes it easier to compare cameras and image sensors of different vendors. In addition, the standard also evolved to an indispensable means to shorten development cycles and improve the quality of cameras and sensors. The standard characterizes the devices strictly by physical parameters. It focuses on the camera without a lens and introduces objective criteria for the rating of sensitivity, noise, spectral sensitivity, dark current, nonuniformities and defective pixels and includes a one-page standardized summary data sheet for easy comparison. The standard comprises both area and line cameras with monochrome and color sensors.

Aim of Training Course

The aims of the training course are

- to demonstrate the benefits of the standard
- to acquire in-depth knowledge about its foundations
- to gain first hands-on experience on the required measuring equipment, optimum set up of the measurements, and analysis the results.
- to understand deviations of measurements from ideal behavior: what are the reasons?
- to get practical experience by performing EMVA 1288 measurements with test equipment
- to answer specific individual questions

Instructor

Prof Dr. Bernd Jähne, HCI, University of Heidelberg
(http://hci.iwr.uni-heidelberg.de/)
Chair of the EMVA 1288 standardizing committee (www.emva.org)

Language and Course Material

The course will be given in English or German language, depending on participants; participants can choose between English or German handouts of all slides

Requirements

Basic knowledge of image sensors, digital cameras, and the EMVA 1288 standard is required. This knowledge is, for example, contained in free webinars offered by EMVA, see https://www.viewservice.de/emva-webinar/

Content Day 1, 10:00 – 17:00

I. Introduction

- Purpose, history of EMVA 1288 standard
- Comparison with other standards, especially the ISO standards and the upcoming P2020 for automotive sensors

II. In-depth Foundation

- Photon conversion in image sensors; noise sources
- „Black box“ linear camera model
- Characteristic curve (sensitivity) and photon transfer method
- Causes and types of nonuniformities
- Key quantity (total) signal-to-noise ratio (SNR)
- Dark current and its temperature dependency; temperature dependency of other sensor parameters

III. Optimal EMVA 1288 Measurements and Measuring Conditions

- Mandatory and optional measurements
- Measurement conditions for dark current measurements
- Measurement conditions for sensitivity, noise, and linearity
- Measurement conditions for nonuniformities
- Measurement conditions for spectral measurements

IV. Analysis of all Measuring Curves, Deviation from Ideal Behavior, Accuracy of Parameters

- Characteristic curve (sensitivity measurement)
- Photon transfer curve: a sensitive tool to analyze deficiencies
- SNR curve
- Problem of too low dark noise (influence of quantization noise)
- Derived parameters and their precision, accuracy and reliability: quantum efficiency, absolute sensitivity threshold, saturation capacity, maximum SNR, dynamic range (DR)
- Non-linearity
- Horizontal and vertical profiles to characterize nonuniformities and defect pixels in one representation
- Defect pixels: flexible characterization of defective pixels using the logarithmic histogram-method
- Spectrogram method (Fourier transform to detect periodic nonuniformities)
- Dark current and its dependence on temperature
- Spectral sensitivity and color qualitative: measuring and evaluating the spectral sensitivity, characterization of color quality

IV Template Data Sheet

- Cover sheet
- One-page summary
- Main part with all EMVA 1288 measurements

Content Day 2, 9:00 – 15:30

V. Tests for Correctness of EMVA 1288 Measurements and Model

- Cumulative histogram
- Stability analysis
- Pixel correlation: is there any preprocessing (noise suppression etc.)?
- Dependency of PRNU on saturation
- Dependency of PRNU on wavelength of irradiation

VI. Practical Exercises

- Performing EMVA 1288 measurements with available test equipment, software, and cameras

VII. Further Development of the EMVA 1288 Standard

- Cameras with non-linear characteristic curve
- Joint characterization of camera and optics
- Multispectral and hyperspectral cameras
- Polarization sensors
- 3-D systems such as time-of-flight cameras, stereo cameras, …

VIII. Optional written examination to be certified as an EMVA 1288 expert (extra fee by EMVA), 15:30 – 17:00

Examination of 200 € for EMVA members and 250 € for non-members will be invoiced by EMVA.
Written test in English language.

EMVA offers certification on two levels:

User level ensures that the holder understands the important parameters of a vision application and has a basic knowledge about imaging systems so that he is able to use the EMVA 1288 datasheet for camera comparison and selection. The required level of knowledge is covered by the set of four webinars which have been broadcast in October 2018. Records of the webinars are available online with free access: https://www.viewservice.de/emva-webinar/
Target groups are marketing and sales people and engineers, who want to have a basic knowledge about optimum application of cameras for various vision tasks.

Expert level ensures that the holder has acquired all knowledge to perform EMVA 1288 measurements and that he can interpret the measuring results correctly. Target groups are engineers involved in camera development and/or testing. The required level of knowledge is taught in this course.