Mercury Light Engine

Fact sheet

In-Vision

11/15/2019

Contents

1 Revision history

1.1 Parameter definitions

Version	Date	Author	Description and reason of change
2.15	10/28/2019	MB	Updated definitions of Intensity uniformity
2.14	10/25/2019	MB	Updated definition of Irradiance uniformity
2.1	05/07/2019	MB	Initial version

Table 1: Parameter definitions revisions

1.2 Specifications

Version	Date	Author	Description and reason of change
2.17	11/15/2019	MB	Initial version

Table 2: Mercury revisions

2 General

Based on the DLP6500 chipset, Mercury light engine projects patterns with a resolution of 1440×1080 pixels, matched for 3D metrology applications with an aspect ratio of $4:3$. The optical system is optimized and stopped-down for 3D metrology, scanning and mapping applications requiring high depth-of-field, low distortion as well as high CTF values. The module is available with a variety of screw-on lens types, addressing application-specific requirements such as throw ratio, feature size and working distance. Apart from off-the-shelf lenses, customized modifications are available short-term through our in-house design and production lines.

3 Definition of parameters

3.1 CTF

First, we must define the so-called Michelson contrast. This value represents the amplitude difference between the peaks and valleys of a periodic function (e.g. sine, rectangular). The Michelson contrast is defined as:

$$Contrast = \frac{I_{peak} - I_{valley}}{I_{peak} + I_{valley}} \tag{1}$$

The CTF (Contrast Transfer Function) represents the measured Michelson contrast at a certain line pair frequency in mm (Lp/mm). The line pair frequency is a measure of resolution. Typically, CTF values are stated for a Lpf which represents one pixel row/line in ON-state and one pixel row/line in OFF-state (e.g. for a lens with 75 pixel pitch in the image space, the Lpf is $1000/75/2 = 6.67Lp/mm$). Figure 1 represents a section of the light engine image The yellow line represents a path along which the intensity values are

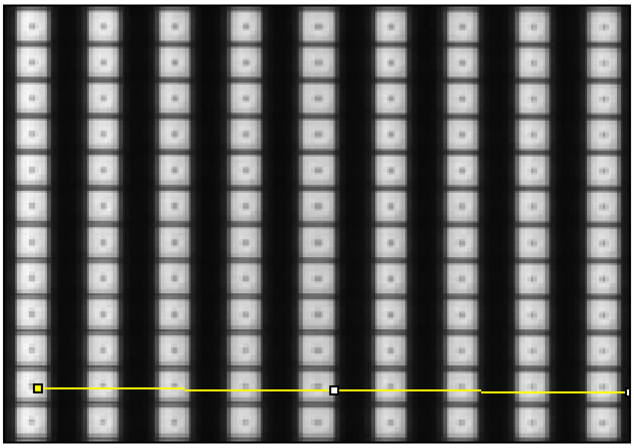

Figure 1: CTF definition, image 1

extracted, which can be used to determine CTF (see figure 2).

3.2 Radial distortion

Distortion is a value representing the deviation of the image height y (pixel position) which is expected from the magnification compared to the measured, real image height (all positions are relative to the position of the central pixel, so a position deviation of the complete image does not count). Its value is defined as, typically stated in % (multiplied by 100):

$$Dist = \frac{y_{real} - y_{ideal}}{y_{ideal}} \tag{2}$$

A lower distortion value represents higher-quality lens designs, but typically needs more lens elements to be achieved.

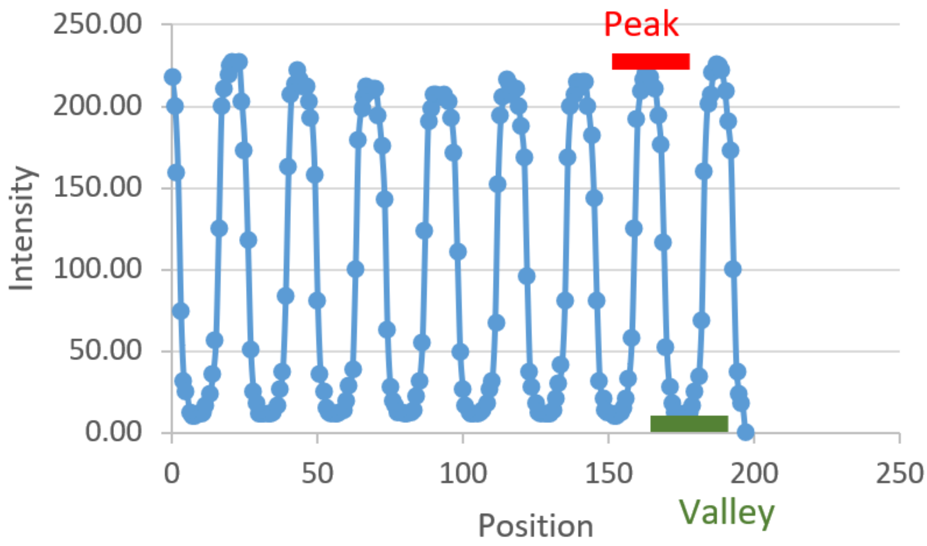

Figure 2: CTF definition, image 2

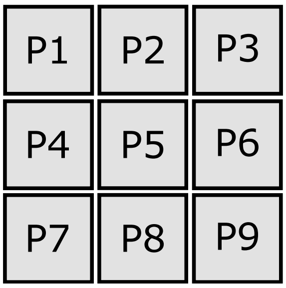

Figure 3: Scheme for Intensity uniformity calculation according to [1]

3.3 Intensity uniformity in image

This value presents how the intensity differs across the image.

3.3.1 Intensity uniformity according to standard IEC 61947

This definition of Intensity uniformity refers to [1] and can be calculated (in %) with respect to fig. 3 as follows:

$$U_{min} = 100 \times \frac{Min\,[P1,\ldots,P9]}{Average\,[P1,\ldots,P9]}$$

3.3.2 Intensity uniformity according to In-Vision standard

Itensity uniformity according to In-Vision standard is measured by using 25 distributed measurement points, each representing 40×40 pixels in ON-state. The intensity is measured locally. The uniformity is defined by the ratio between the dimmest and brightest measurement point, a uniformity of 100% would mean that all measurement points are equally bright. Typically, higher values represent higher-quality systems.

4 Specifications

Parameter	Specification
Display type	TI DLP6500
DLP controller	TI DLPC900
Resolution	1440×1080
Chip pixel pitch	$7.56\mu m$
Min. Intensity uniformity (IEC definition – see section 3.3.1)	$> 70\%$
Min. Intensity uniformity (In-Vision definition – see section 3.3.2)	up to 92%
Full On/Off Contrast	up to $1300:1$
Optical output power in the image plane	$460nm$: up to $200mW$
Operating temperature range	$15..50°C$
Max. relative humidity	non-condensing
IP code	IP40
Pattern rate binary	$9523Hz$
Pattern rate grayscale	$247Hz$
Control interfaces	USB DLP and LED Trigger inputs Status Signal
Data interfaces	HDMI USB

Table 3: Mercury specifications

Tables 4 to 6 show data for the available off-the-shelf lenses.

Parameter	Specification
Available wave lengths	$460nm$
Distance mechanical reference to image plane	$803.5mm$
Image size	$540 \times 405mm$
Depth of focus	$210mm$

Table 4: Lens option 1 specifications

Parameter	Specification
Available wave lengths	$460nm$
Distance mechanical reference to image plane	$803.5mm$
Image size	$241 \times 180mm$
Depth of focus	$90mm$

Table 5: Lens option 2 specifications

Parameter	Specification
Available wave lengths	$460nm$
Distance mechanical reference to image plane	$803.5mm$
Image size	$715 \times 536mm$
Depth of focus	$300mm$

Table 6: Lens option 3 specifications

A Abbreviations

Abbrev.	Meaning
n.c.	not connected
LED	Light Emitting Diode
USB	Universal Serial Bus
HID	Human Interface Device
API	Application Program Interface
MSB	Most Significant Byte/Bit
LSB	Least Significant Byte/Bit
DMD	Digital Micromirror Device
DLP	Digital Light Processor
DLPC	DLP Controller
LUT	Look-Up table
FW	Firmware
LE	Light Engine
HW	Hardware
SW	Software
CTF	Contrast Transfer Function
IP Code	International Protection Marking
LP	Line Pairs
MTF	Mean Time to Failure

Table 7: Abbreviations

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C References

[1] IEC 61947-1:2002: Electronic projection – measurement and documentation of key performance criteria – part 1: Fixed resolution projectors. Technical report, International Electrotechnical Commission, Geneva, CH, August 2002.