VISA-Method Lighting
(Variable Irradiation Solid Angle)

Overturning conventional wisdom about lighting

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About lighting

– Lighting technology for machine vision
– Machine Vision Lighting
– from Technique to Technology
– the 1st prize for lighting technology
– Machine Vision Lighting is a visual function
– Lighting Standard, JIIA LI-001-2013
– VISA-Method Lighting
What is lighting

— In human vision

We can see objects with light.
Because we have heart, the subject to see object.
What is lighting

— In machine vision

The lights must see objects. Because machine has no heart. So, machine must obtain the conclusions only with analyzing features.
An experiment about the relations between the brightness changes of object and the irradiation light

A disk type light source, luminance $L_0$, radius $r$, is set at the position of distance $R$ from the object.

An observation optical system is set to the mirror reflection direction.

The brightness changes of point $P$ are captured as images by camera.

The illuminance of point $P$ is expressed with

$$E_P = \frac{L_0 \pi r^2}{r^2 + R^2} \cos \theta \quad \text{------------------------ (125.1)}$$
An experiment about the relations between the brightness changes of object and the irradiation light.
An experiment about the relations between the brightness changes of object and the irradiation light.
Object light is consist of 2 factors

- Object light is comprises two elements, direct light and scattered light.
- To identify the brightness of an object, we need to consider the brightness of these two elements.
- Scattered light is proportional to the illuminance of the surface of the object.
- However direct light is proportional to the luminance of the light source.
- Bright field is defined as watching the profile of the direct light.
- Dark field is defined as watching the profile of the scattered light.
- If we don’t use above-mentioned basics matters, It is very hard to perform an optimization design of the lighting for machine vision quantitatively.
VISA-Method Lighting
(Variable Irradiation Solid Angle)

overturns conventional wisdom
to provide a totally new method of lighting for visual inspection

controls the optical axis and shape
of the irradiation solid angle at all points of an object
so that they are uniform
The structure of the irradiation solid angle

(a) Conventional Lighting

- The angular range and inclination of the light varies from point to point

(b) VISA-Method Lighting

- Precise and uniform control over the shape and angle for all points of an object, regardless of the distance from the light
The structure of the irradiation solid angle 2

(a) Optimize the size of the irradiation solid angle at the points of an object
(b) Set the orientation of the irradiation angle
● The structure of the irradiation solid angle 3

(d) The shape of ring  
(e) The shape of 2 bar-type lights  
(f) The orientation of irradiation can be adjusted
The structure of the irradiation solid angle 3

(d)

The shape of ring

Irradiation on the surface of object
Image samples by VISA-Method Lighting 1

Irradiated by conventional coaxial surface light source
Image samples by VISA-Method Lighting 1

Half plane angle : 11.0°
Image samples by VISA-Method Lighting 1

Half plane angle: 9.0°
Image samples by VISA-Method Lighting 1

Half plane angle: 5.0°
● Image samples by VISA-Method Lighting 1

Half plane angle : 2.5°
Image samples by VISA-Method Lighting 1

Half plane angle : 0.5°
Image samples by VISA-Method Lighting 1

Half plane angle: B:0～4.0°, G:4.0～7.0°, R:7.0～10.0°
Image samples by VISA-Method Lighting 1

Half plane angle: B: 2.0°~3.0°, G: 3.0°~4.0°, R: 4.0°~10.0°
● The structure of the irradiation solid angle 4

(b) the irradiation solid angles can all be shaped uniformly, regardless of the height or inclination of the object surface.
Image samples by VISA-Method Lighting 2

Commercial food packaging
● Image samples by VISA-Method Lighting 2

Commercial food packaging
Image samples by VISA-Method Lighting 2

Commercial food packaging
Image samples by VISA-Method Lighting 2

Commercial food packaging
Image samples by VISA-Method Lighting 3

Glossy metallic surface
Image samples by VISA-Method Lighting 3

Glossy metallic surface
Image samples by VISA-Method Lighting 3

Glossy metallic surface
Image samples by VISA-Method Lighting 3

Glossy metallic surface
Image samples by VISA-Method Lighting 4

The top of a beverage can
Image samples by VISA-Method Lighting 4

The top of a beverage can
Image samples by VISA-Method Lighting 4

The top of a beverage can
Optimizing VISA-Method Lighting

With VISA-Method Lighting:

• You can precisely adjust the shape of the irradiation solid angle and the optical axis
• You can capture very slight changes in object light in work features

To optimizing irradiation conditions:

• It is necessary to accurately understand the conditions of the surface and the optical characteristics of the features
• You can capture very slight changes in object light in work features
• It is necessary to understand the various optical properties of many different materials, both theoretically and practically.
Optimizing VISA-Method Lighting

To help in learning these kinds of optimization methods:

• Available document

"Machine Vision Lighting, Basic-Level"
"Machine Vision Lighting, Intermediate-Level"
"Machine Vision Lighting, Advanced-Level"

"International Standard on lighting: JIIA LI-001-2013"
Author Profile

Shigeki Masumura  
CEO, President  
Machine Vision Lighting Inc.

He studied at the Kyoto University where he obtained his B.Sc. in 1981. He was a researcher at Hitachi Central Research Laboratory where he developed microcomputers and various system LSI for 15 years.

After that, he became a priest and studied Buddhism for 5 years.

After secularization, he joined CCS Inc. and exerted himself to establish the Lighting technology, which has authorized as the 1st global standard of lighting through JIIA in 2011.

He left the company in June, 2014, and he established Machine Vision Lighting inc., and became independent in July in the same year.

He has been providing lectures on lighting technologies for imaging processing and machine vision system at various conferences and seminars in Japan. He also serves as a lecturer at Advanced Polytechnic Center, the Japanese governmental organizations for industrial development.

He holds published multiple articles and books, “Machine Vision Lighting” Basic Course(2007), Intermediate Course(2010), Advanced Course(2013) of the same series, etc. in Japan.
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