Reflected light Edge Detectors (RED)

Overview document version v190708e

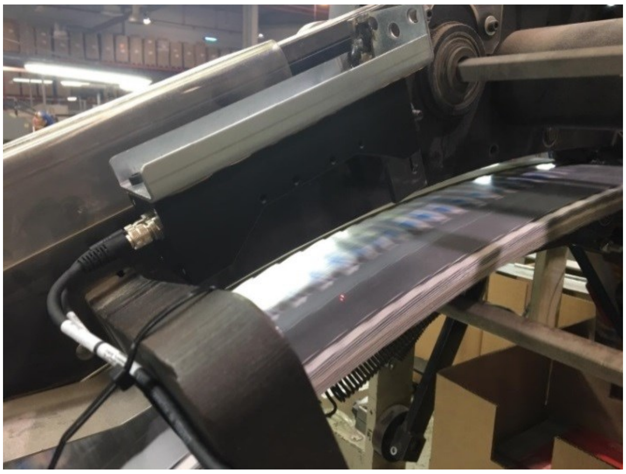
With the RED series from Sensor Instruments, reflected-light edge detectors that are able to reliably detect edges starting from a height of 0.03mm are now available. The detectors of this series are characterized by their large detection distance and detection range, and by their high scan frequency of max. typical 100kHz. With comprehensive software algorithms the RED series also can be used for frequency measurements, for example of turbochargers or fans. RED detectors furthermore can be used to monitor the number of wires when cables are twisted in stranding machines.

Originally developed as copy counters for the printing industry, RED series detectors now have a multitude of other possible applications, e.g. welding seam detection, production of folded paper for air filters, production of corrugated aluminium pipes, or counting of caps that are arranged in stacks. A special detector version within the RED series also allows the detection of rising and falling edges.

- Line laser, Laser class 2 (<1 mW, wavelength 670 nm)
  Typ -P: Visible red laser spot, typ. Ø 0.1 mm in the focus
  Typ -L: Visible red laser line, typ. 0.1 mm x 3 mm in the focus
  –XL–: RED sensors with extended working range
  –CLS–: Central Light Source, Red sensors allowing for the detection of rising and falling edges.
- Automatic adjustment to the product
- Extern trigger mode
- Proof edge detection even with changing surface quality(glossy/matt, dark/bright)
- Max. scan frequency 85 kHz
- Insensitive to ambient light due to interference filter and pulsed laser light
- Sensor type & performance data:

Sensor type:	Ref.-distance:	Min. height of edge	Copies / hour
RED-55-P/-L	typ. 50 mm ... 61 mm	typ. 0.02mm	7.000.000 @ 5m/s
RED-110-P/-L	typ. 90mm ...130mm	typ. 0.05mm	7.000.000 @ 5m/s
RED-55-XL -P/-L	typ. 35 mm ... 75 mm	typ. 0.02mm	7.000.000 @ 5m/s
RED-110-XL -P/-L	typ. 30 mm ...190 mm	typ. 0.05mm	7.000.000 @ 5m/s
RED-60-CLS-L	Typ. 45mm ...75mm	Typ 0.03mm	Detection of rising and falling edges

- RS232 interface (USB or Ethernet converter available)
- Windows® graphical user interface
- 2 digital inputs (IN0, IN1)
- 3 digital outputs (OUT0, OUT1, OUT2)
- 1 analog output (0V ... +10V or 4 mA ... 20 mA)
- Switching state indication via 3 LEDs
  (OUT0, OUT1, OUT2



RED-110-L deployed in a laser copy counter application

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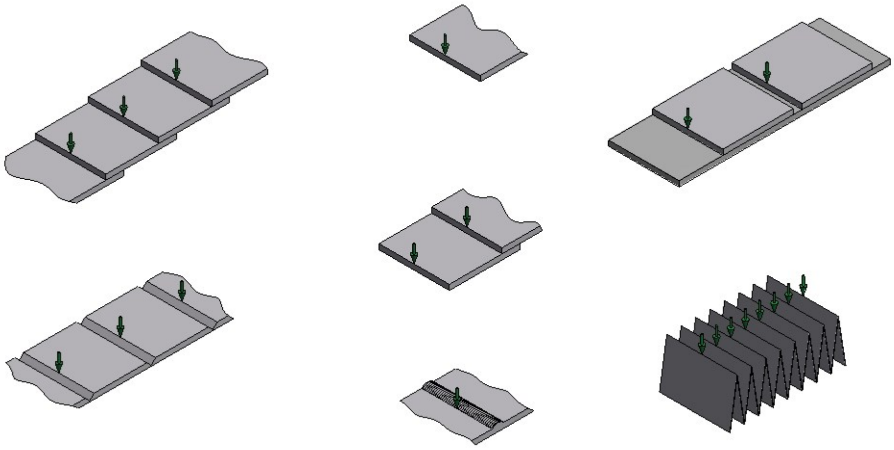
Measurement Principle - Edge Detection

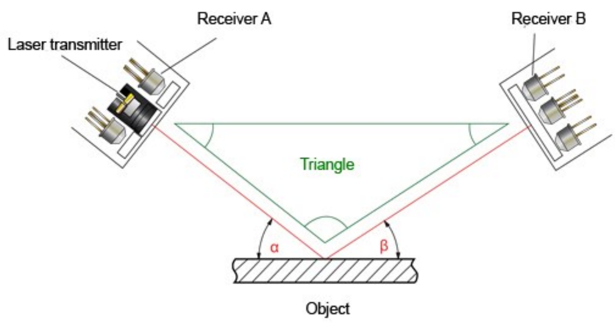
An edge generally is a geometrical discontinuity, for example the start of an object or a sudden height increase of an object.



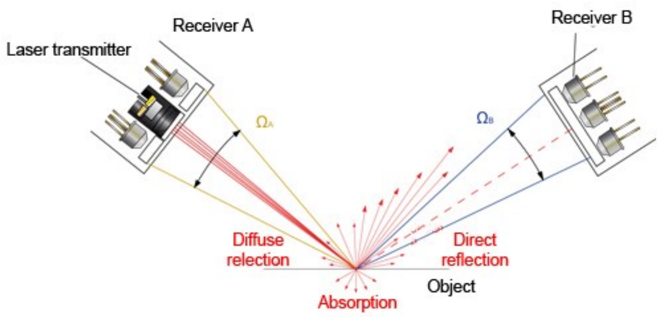
Edge detection according to the triangulation principle

Transmitter, receiver and object are arranged in the form of a triangle. An additional receiver is located at the transmitter side. SI edge detectors us a focused laser diode to ensure a small laser spot at the point of incidence (object). Depending on the properties of the object surface this laser spot is directly or diffusely scattered and also absorbed by the object.

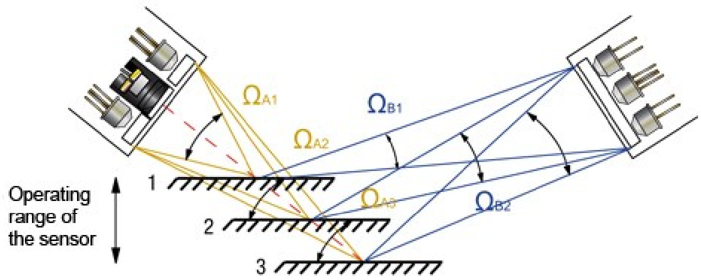
Some of the forward scattered radiation reaches receiver B (solid angle SLB), whereas some of the backward scattered radiation is detected by receiver A (solid angle SLA). Depending on the angle a relatively large operating range can be realized here! Considering the normed value of receiver A (signal A) and receiver B (signal B) the relation is as follows:



Transmitter-/ receiver / object form a triangle



Types of optical reflection



Working range of the RED sensor

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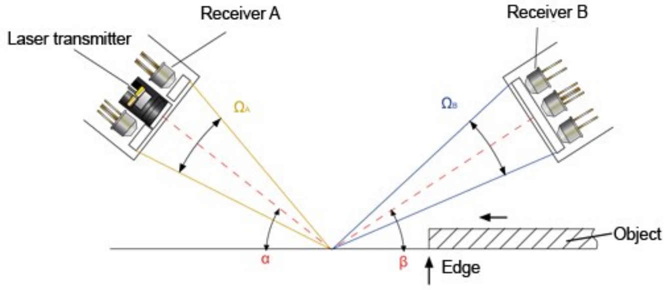
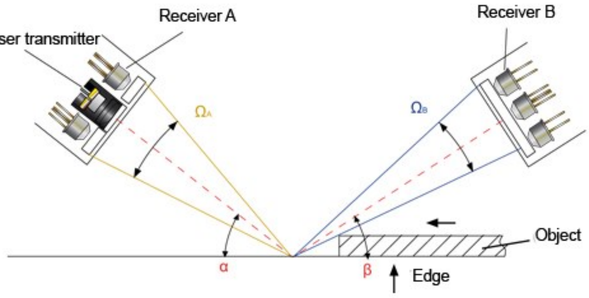
In order to get independent of changes in brightness or color changes of the object surface, a signal ratio could be defined, which sets Signal A and Signal B to a normed ratio, e.g. $\text{Norm} = \frac{\text{Signal B}}{\text{Signal A} + \text{Signal B}}$.

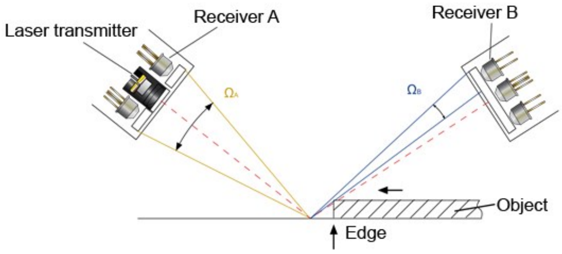
So what happens with the NORM value when an edge moves toward the laser spot?



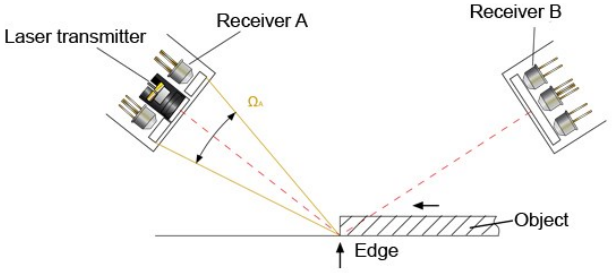
I. At this time the edge still is so far away from the laser spot that laser light influence zone SLB and SLA are not influenced.



II. The object now already enters the view field of receiver B, the laser light influence zone ΩB becomes smaller, while ΩA remains unchanged. The NORM value therefore also becomes smaller, because SIGNAL B decreases while SIGNAL A remains unchanged.



III. The edge of the object now already covers a considerable part of view field ΩB on the laser spot, the NORM value therefore further decreases! ΩA still remains unchanged.



IV. The edge of the object completely interrupts the visual contact of receiver B to the laser spot. SIGNAL B thus approaches zero, and the NORM value also reaches a minimum!
NORM -> Ø!

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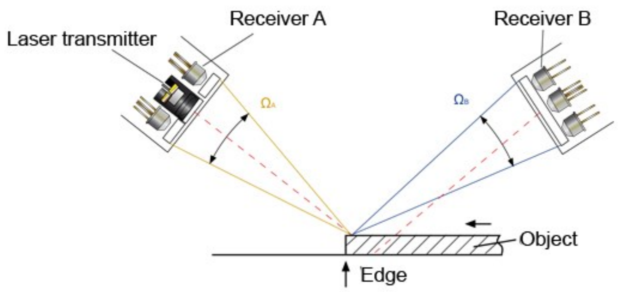
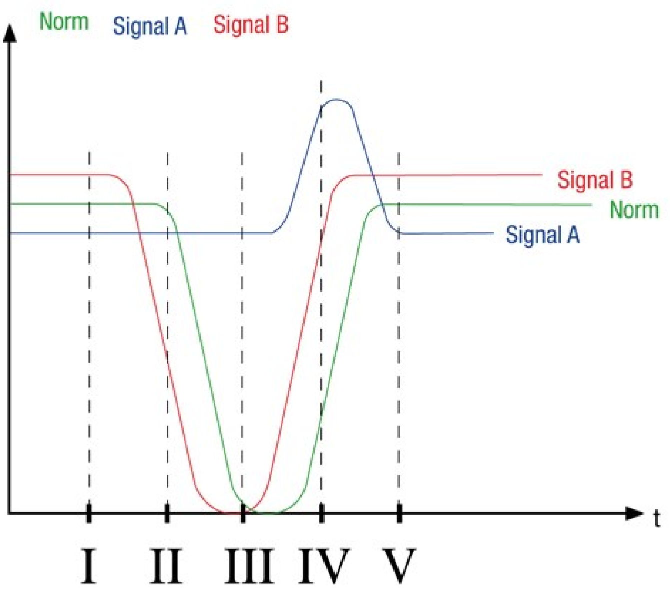
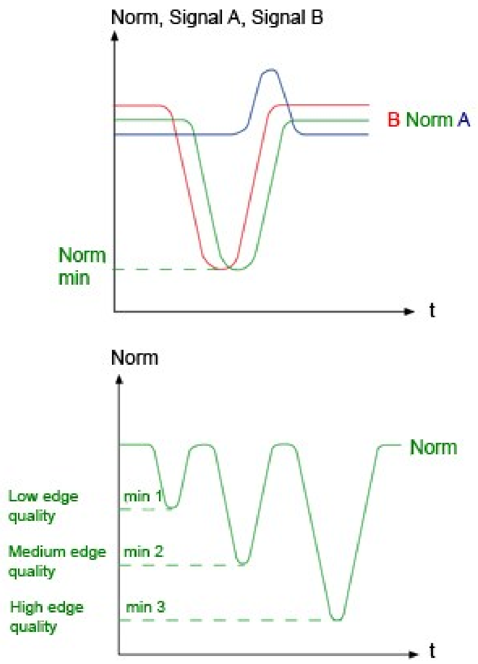
Signal A of receiver A increases slightly, because due to the object edge initially forward scattered light is scattered back and thus partially reaches receiver A.



V. The edge of the object now has passed the laser spot, and view contact between laser spot and receiver B is established again. The NORM value reaches almost the same value as under I

Signal transitions between step I. and V.





In practice the edges of objects in most cases are not so clearly defined, which is why the NORM value does not reach Ø. The minimum of the NORM value thus is a measure for the "edge quality", i.e. a smaller NORM value means a more clearly defined edge. The edge quality is influenced by the density of the object and by the steepness of the edge.

Since edge detectors mostly are used for the counting of objects, only one signal must be exactly provided for every edge, because otherwise the counting result would be wrong.
In addition to reliable optical edge detection, three additional safety measures are required to avoid the multiple detection of an edge: These are HYSTERESIS, DEAD TIME und PULSE LENGTHENING.

For a detailed explanation of HYSTERESIS, DEAD TIME und PULSE LENGTHENING please refer to the following Link on our website:

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