ifm electronic

3D Image Sensing Using Smart Pixel Technology

Shape, Size and Volume
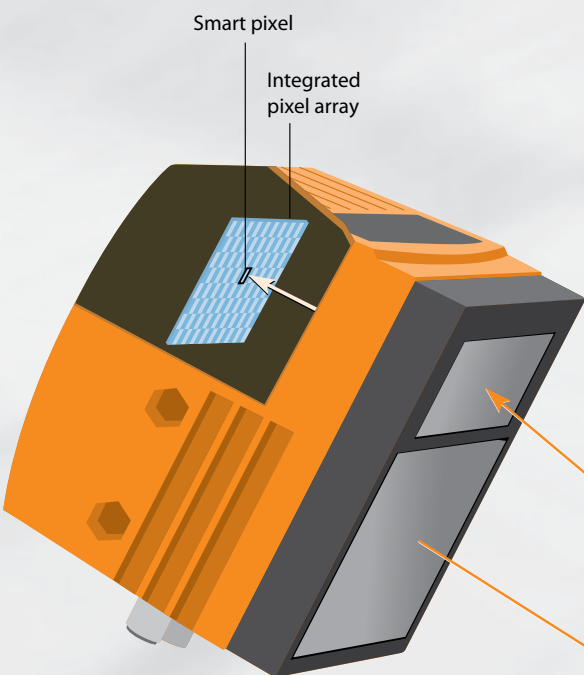
efector pmd3d

STEP
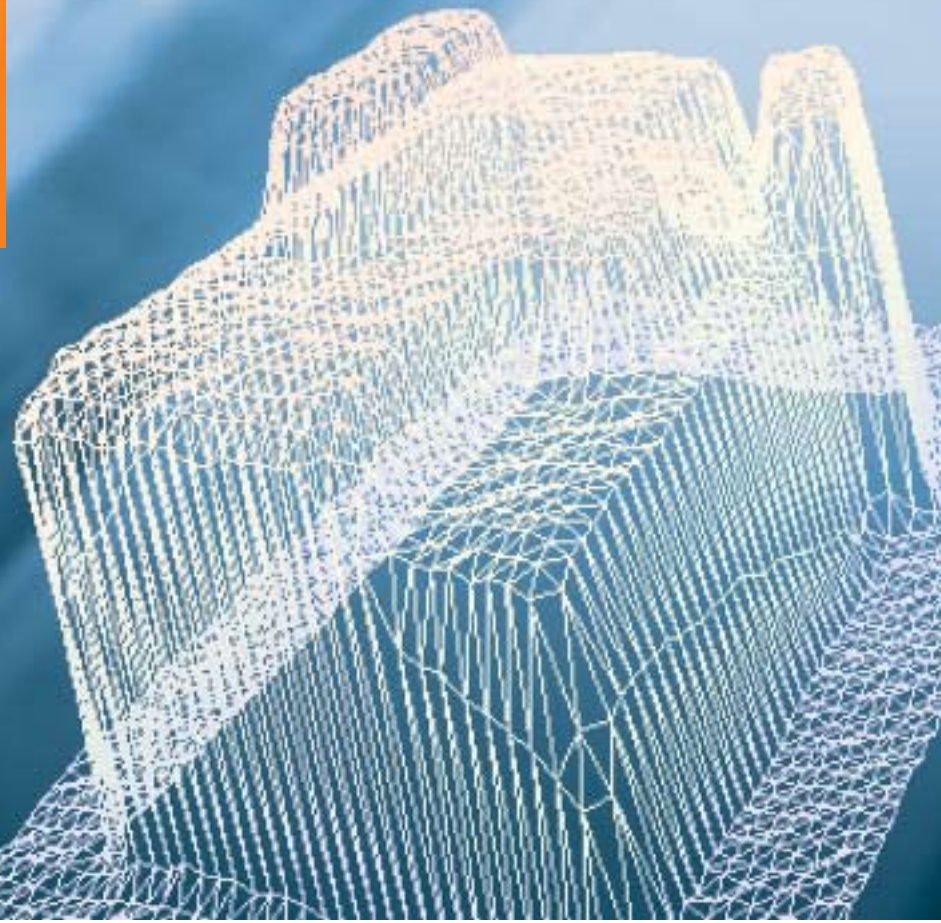
3D Image Sensor using Time-of-Flight Distance Measurement
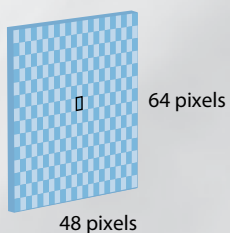
Smart pixel

Integrated
pixel array

PMD Technology

The 3D image sensor is designed to evaluate size, shape and volume in industrial automation applications. The compact, easy-to-use sensor uses time-of-flight distance measurement and photonic mixing device technology to identify an object in its field of view. The integrated 64 x 48 smart pixel array projects 3072 points of reference onto an object, capturing the entire object in three dimensions.

Active Lighting
Active lighting combined with ifm's patented Suppression of Background illumination (SBi) technology allow the 3D sensor to be applied in all lighting condi - tions, both indoors and outdoors.
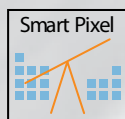
The PMD pixel array
An integrated 64 x 48 pixel array captures the light. Each pixel within the array is able to compute the phase difference directly on-board the sensor chip. This built-in functionality allows the sensor to pre-process the signal, removing the need for expensive high-speed electronics.

64 pixels

48 pixels

Time of flight principal
This principle measures a dis- tance based on the time it takes light to travel to an object and back to the receiver.

Object

Smart pixel
Each pixel has two gates that are controlled by an oscillator. Here, the electrons are convert- ed into photons.The light information is sent from the PMD chip as the representative distance for that pixel, carrying the desired 3D information.
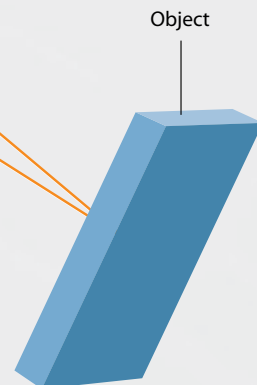
Smart Pixel

Consistent measurement
Variations in color cause chal- lenges with traditional photo- electric sensors. White objects reflect more than dark gray objects. ifm's 3D sensor has minimized this impact creating a more consistent measurement throughout the color spectrum.

Object detection in three dimensions

Determining the Field of View is important for level and volume applications.
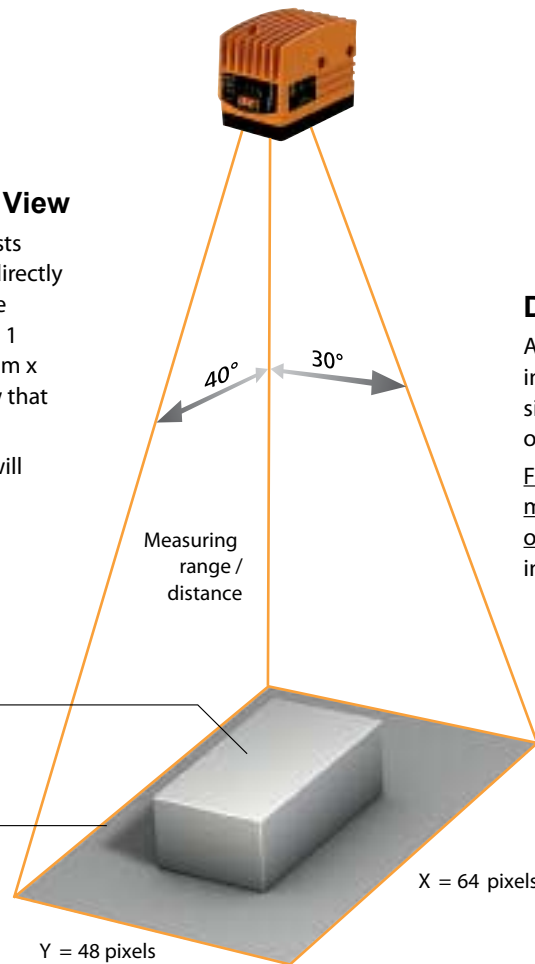
Determining the minimum object size is important for material handling applications such as transporting, sizing and sorting product.

Determine the overall Field of View

The 3D image sensor's Field of View consists of 64 x 48 pixels. The size of each pixel is directly related to the distance of the sensor to the object. For example, in the chart below, at 1 meter range, the average pixel size is 11mm x 11mm square. This creates a Field of View that is 840 mm x 580 mm in dimension.

Increasing the sensor-to-object distance will create a larger Field of View; conversely, decreasing the sensor-to-object distance will create a smaller Field of View.
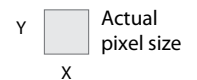
Determine the minimum object size

As the distance between the sensor and object increases so does the size of each pixel. The pixel size will determine the minimum size of the object that can be evaluated.

For best results, ifm recommends that the minimum object size is at least two times the size of an individual pixel. These values can be found in the chart below.

40°   30°

Measuring range / distance

For example, at 0.5 meter the pixel size is 6 x 6 mm.

Y   Actual pixel size
     X

At 1 meter the pixel size is 11 x 11 mm.

Y   Actual pixel size
     X

Minimum object surface should be at least two times the size of an individual pixel

Field of View

X = 64 pixels

Y = 48 pixels
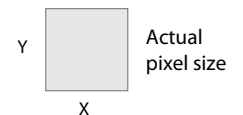
| Measuring range / distance [M]	Length [mm]	Width [mm]	Average pixel	Minimum object surface [mm]	White 90% [mm]	Grey 18% [mm]
0.5	420	290	6 x 6	11 x 11	± 3	± 5
1	840	580	11 x 11	22 x 22	± 3	± 5
1.5	1260	870	17 x 17	33 x 33	± 3	± 5
2	1670	1150	22 x 22	44 x 44	± 4	± 6
2.5	2090	1440	28 x 28	55 x 55	± 4	± 6
3	2510	1730	33 x 33	65 x 65	± 4	± 8
3.5	2930	2020	38 x 38	76 x 76	± 4	± 8
4	3350	2310	44 x 44	87 x 87	± 4	± 10
4.5	3770	2600	49 x 49	98 x 98	± 5	± 12
5	4190	2890	55 x 55	109 x 109	± 5	± 15
5.5	4600	3170	60 x 60	120 x 120	± 6	± 17
6	5020	3460	66 x 66	131 x 131	± 6	± 20

A quantum leap in optoelectronics.

Three-dimensional vision.

efector pmd 3d is the first industrial 3D sensor that can detect objects in three dimensions at a glance. The time of flight measurement principle enables an unimagined variety of application solutions. In conventional systems, either the object or the sensors must be in motion in order to obtain several measurement points of an object.

The innovation: the measurement and the evaluation of the time of flight are integrated on one sensor chip. The sensor chip has 64 x 48 pixels. In addition to the reflectivity, each pixel of this chip matrix evaluates its distance to the object.

This results in 3072 distance values at the same time. The image of the object on the chip matrix and the respective distance values correspond to a 3D image. These measurement points of the 3D image enable distance-independent assessment of the characteristics of the object or the scene. They form the basis for the three evaluation modes volume, distance and level, serving as solutions for different applications.
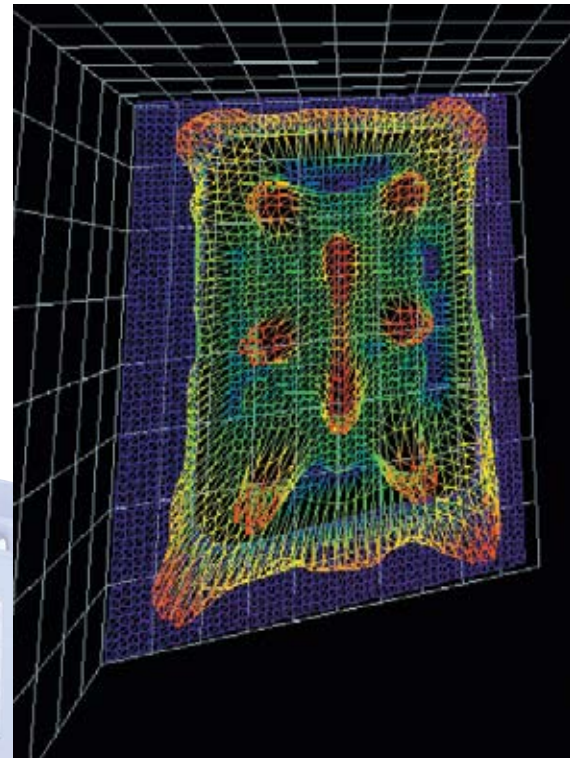
Calculation of volumes.

Volume: irrespective of the distance between sensor and object, efector pmd 3d determines the volume of any object.

Areas of application: control of the loading and filling condition of outer packaging or trays.

Example bread baking pan: dynamic processes in conveyor lines can be detected as well. The different pans are monitored for underfill or overfill.

Example crate: the sensor moreover enables subdivision of the field of view into separate windows. Areas of no interest can be ignored and relevant areas can be inspected in detail.

Up to 64 windows can be monitored for the same adjustable threshold. The missing bottle in this case triggers a switching signal.
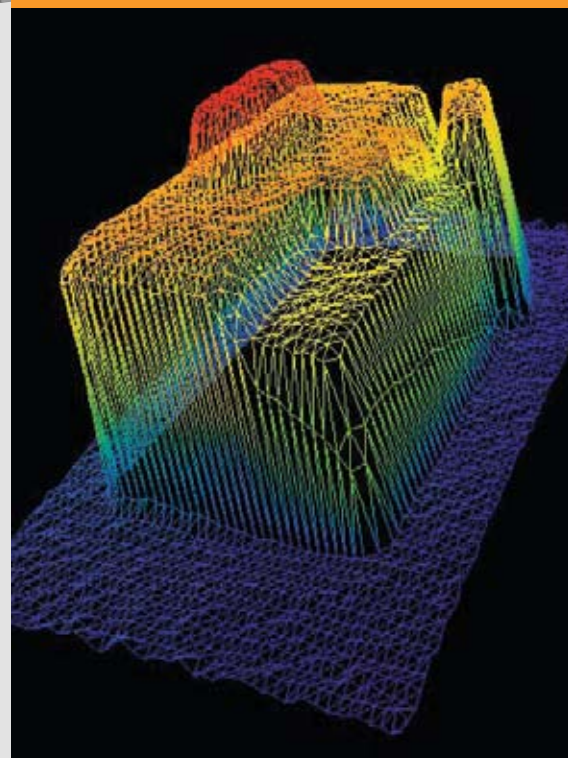
efector
pmd 3d
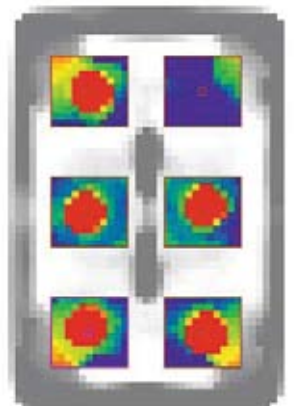
Example Euro pallet: if the 3D sensor is installed about 1.5 m above the maximum stack height, over-lapping parts can be detected in addition to overfill and underfill.
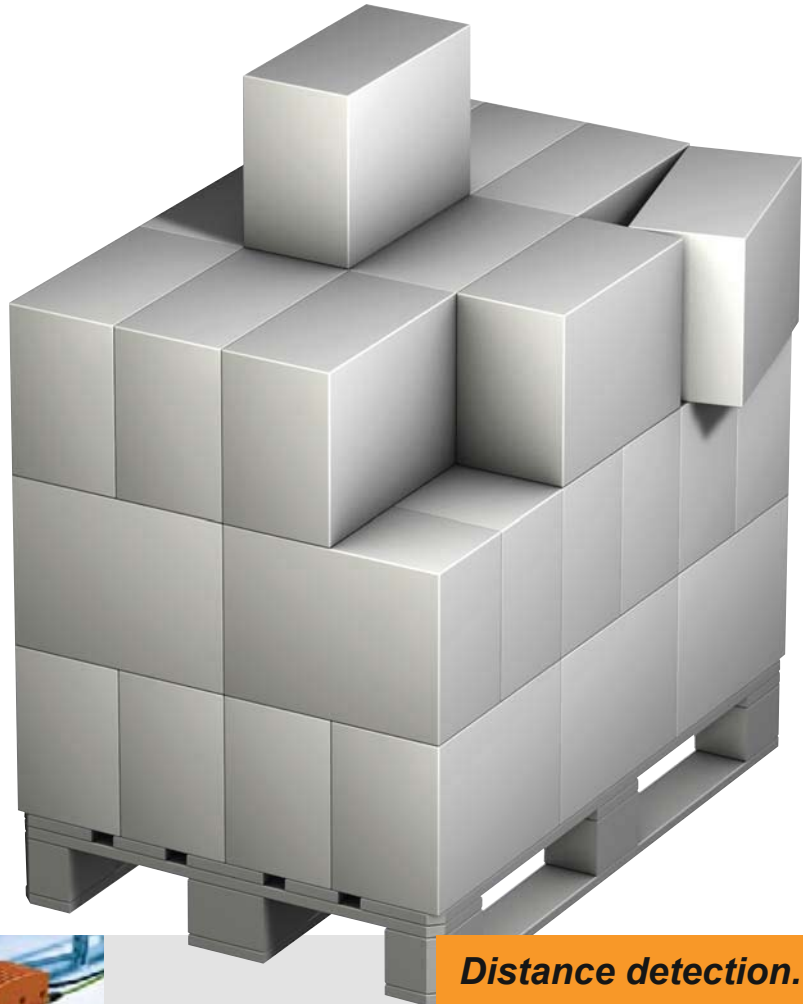
Example conveying technology: navigation support or collision avoidance on AGVs; use in parcel sorting systems.

Distance detection.

Distance: with the 3D sensor, the measurement of distances from irregular surfaces is no longer a challenge. 3072 precise distance values replace a multitude of standard photoelectric sensors.
efector pmd 3d also is a clever alternative to ultrasonic sensors, photoelectric distance sensors or laser scanners.

Application examples: filling status of shelves, pallets or stacks. Navigation support or collision avoidance on AGVs.
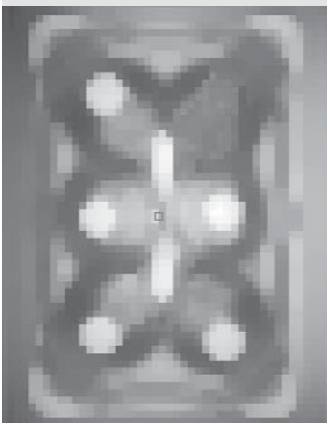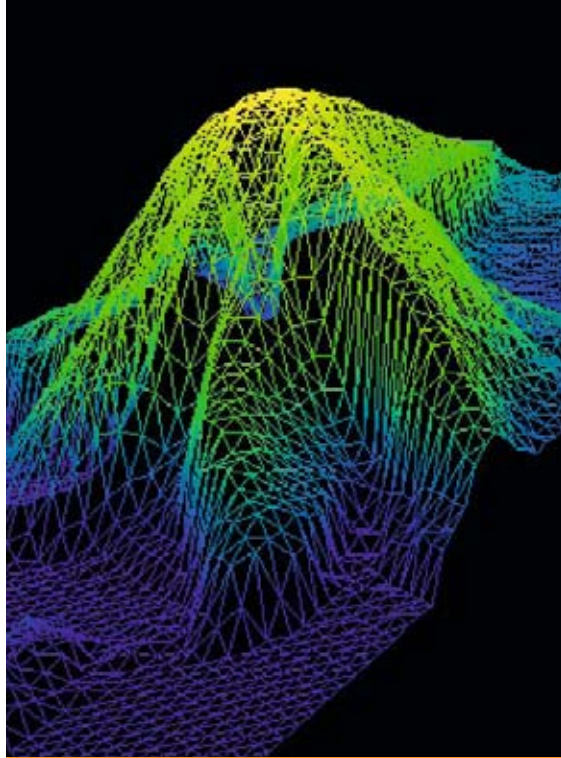
Level: the sensor determines the level above the previously defined background in the search zone. The shape of the bulk material does not matter.

Areas of application: level measurement of bulk material such as grains or granulates in silos. Control of the correct filling of packaging in the food industry.

Level assessment.

Level measurement irrespective of shape, colour or material. Whether coffee powder, grain or small plastic parts.

Technical data efector *pmd 3d*

Application area	Visual assessment of distance, level or volume
Electrical design	**PhotonICs® PMD, resolution: 64 x 48 pixels**
Order no.	O3D200
Sampling rate / switching frequency [Hz]	max. 25, adjustable
Unambiguous ranges [m]	6.5 (single frequency mode) / 48 (dual frequency mode)
Illumination	infrared (850 nm)
Operating voltage [V]	24 DC (± 10 %)
Current consumption [mA]	< 1000 (max. 2500)
Short-circuit protection, pulsed	•
Overload protection	•
Operating temperature [°C]	-10...50
Protection	IP 67, III
Dimensions [mm]	122 x 75 x 95
Materials	Housing: aluminium; lens window: polycarbonate; LED window: polycarbonate
Connections	external trigger; max. 2 switching inputs / outputs; analogue output (configurable)
Parameter setting options	via PC / notebook or 10-segment display and two pushbuttons
Parameter setting interface	Ethernet 10Base-T / 100Base-TX

Accessories (selection)

Description	Order no.
Switched-mode power supply 24 V DC / 2.5 A	DN2011
Operating software for O3D	E3D200
Mounting set for rod mounting Ø 14 mm	E3D103
Mounting rod, 100 mm, Ø 14 mm, M12 thread, stainless steel	E20939

Sockets

Description	Order no.
2 m PUR, M12 straight, 8 poles	E11950
5 m PUR, M12 straight, 8 poles	E11807
10 m PUR, M12 straight, 8 poles	E11311
Parameter setting cable, 2 m, M12 D-coded / RJ45, cross-link	E11898

Overview ifm main catalogues:

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and object recognition
Inductive sensors
Capacitive sensors
Magnetic sensors,
cylinder sensors
Safety technology
Valve sensors
Photoelectric sensors
Object recognition
Encoders
Evaluation systems,
power supplies
Connection technology

● Fluid sensors
and diagnostic systems
Level sensors
Flow sensors
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Evaluation systems,
power supplies
Connection technology

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