



Contact angle measurement  
with high-resolution USB 3.0 industrial camera

## On the trail of the drop shape

Industrial cameras with USB 3.0 interface are on the rise. The interface creates a bridge to the latest CMOS high-performance sensors, eliminating previous bottlenecks. This opens up new possibilities for numerous vision applications, particularly those requiring high resolution, rapid frame rates, and maximum light sensitivity. These are key features for the measuring instrument manufacturer KRÜSS.

This is why they use USB 3.0 cameras from IDS in their video-based drop shape analyzer systems. Up to 200 frames per second at a resolution of 1200 x 800 pixels enable wetting processes to be captured without interruption and then precisely analyzed.

Drop shape analysis is an image analysis method to determine the contact angle from the shadow image of a sessile drop of liquid, and the surface tension or interfacial surface tension from the shadow image of a pendant drop. This method allows wetting or the adhesion behavior of liquids on surfaces to be measured and analyzed, and is used both in industrial quality assurance and in research and development in the chemical and pharmaceutical industries.

For example, the surface tension of liquids is of interest in cleaning processes, or in printing, painting, or coating; these processes can be optimized by exerting a targeted influence on the surface tension. Meanwhile, contact angle measurement is a measure of the wettability of a solid that is prepared for contact with a liquid. This wettability can also be deliberately influenced; depending on the requirement it can be improved (e.g. for preparing a paint) or reduced (e.g. if liquids should roll off better).

KRÜSS GmbH is one of the leading suppliers of measuring technology for wetting and coating analysis. With their DSA25, DSA30, and DSA100 measuring instruments, the Hamburg-based company develops and constructs universal drop shape analyzers for video-based contact angle measurement and drop shape analysis.

The fundamental functioning of these systems can be explained in relatively simple terms: A drop is dispensed onto a solid surface (sessile drop) or is at the tip of a needle (pendant drop). A camera is used to capture an image of the drop, which is transferred to image analysis software. A gray-scale analysis of the image is used to perform an initial contour detection. The second step is to fit a geometrical model describing the drop shape to the contour. This enables the contact angle to be determined, as it is given by the angle between the calculated drop shape function and the contact surface, the projection of which in the drop image is referred to as the base line.

"Contact angle measurement usually also involves capturing the dynamics of the wetting, which means that a combination of high resolution and high frame rate is essential. The required transmission performance also calls for an interface with sufficiently high bandwidth", says Carsten Scheithauer, R&D Manager at KRÜSS, summarizing the requirements of the camera used.



Drop shape analyzer - DSA100

KRÜSS integrates USB 3.0 industrial cameras from IDS's USB 3 uEye CP series into its drop shape analyzers,

including the UI-3060CP Rev. 2 with IMX174 sensor from Sony. This all-round industrial camera has a very compact design, at just 29 x 29 x 29 mm, allowing it to be integrated into measuring instruments where space is at a premium. Screw-in Micro USB 3.0 and Hirose connections make the camera suitable for professional applications, both in industry and in non-industrial environments.

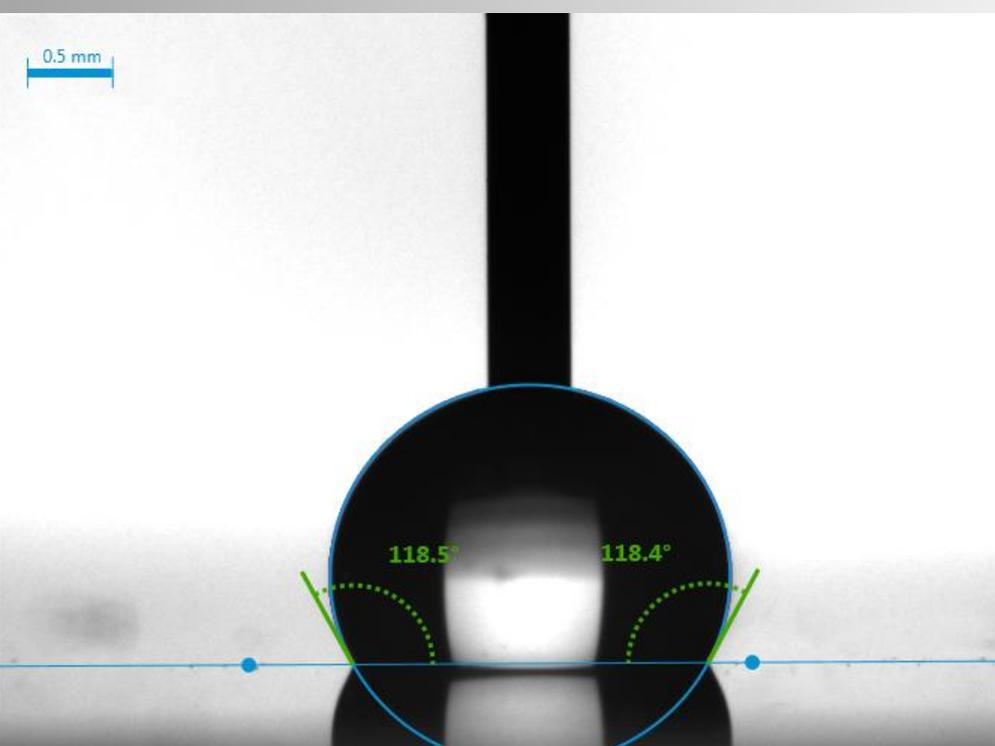
It has an integrated memory and is consistently designed for the latest generation of high-performance CMOS sensors. These include the 2.3 megapixel IMX174 sensor from Sony, which delivers pin sharp pictures even at high frame rates. A sensor element with analog memory effectively prevents focal plane distortions by simultaneous reading of all pixel signals. It also supports a dual frame output mode with various exposure times.

The combination of the two images increases the dynamic range to 73 dB (12 bits), with the addition of high sensitivity and extremely low readout noise. "For a specialized process like contact angle measurement, low noise and maximum light efficiency are exceptionally important", says Carsten Scheithauer. Thanks to the high light sensitivity of the IMX174 CMOS sensor, the camera used can detect even a few photons.

In the KRÜSS drop shape analyzers, the cameras generally capture the wetting processes at up to 200 frames per second at a resolution of 1200 x 800 pixels. Depending on the measuring task, the videos can be anywhere between a millisecond and several hours long. "To investigate very fast processes, such as wetting of absorbent materials, a frame rate of up to 2000 frames per second can be achieved by reducing the image size to 90 x 60 pixels, and the data obtained still leads to reliable analyses," says Carsten

Scheithauer, highlighting the possibilities provided by the USB 3 uEye CP camera from IDS. "All frames from the videos are used, as with our method the contact angle is continuously determined."

Live drop image analysis during dispensing





USB 3 uEye CP: compact USB 3.0 industrial camera with screw-in connectors

The USB 3.0 interface transfers the huge volume of image information at high speed and without losses to the KRÜSS ADVANCE software, where the drop shape analysis is carried out fully automatically. This guarantees objective measured data unaffected by user interventions. When presenting the results, the software assigns the corresponding drop image to each measured value and displays it. The image can be re-analyzed at any time using different parameters or methods. There is no need for time-consuming saving, loading, and management of image files. One very special feature is the continuous background recording of the camera image. This also takes place when no measurement is in progress. The live image can therefore be stopped at any time to analyze the previous period or to save it as a video file. This means that valuable information cannot be lost – if no measurement has been started at the time of wetting, for example.

The camera is integrated into the KRÜSS image analysis software using the uEye API, which is part of

the IDS Software Development Kit (SDK) and supports all the features of modern CMOS sensors, such as the IMX174 from Sony. The camera package from IDS includes the SDK for Windows and Linux (32 and 64-bit) and is the same for all models – regardless of whether they have a USB 3.0, USB 2.0 or GigE connection.

The benefits to OEM customers like KRÜSS are two-fold. Firstly, the camera can be very quickly and easily integrated into the system. Secondly, it works with all models and interfaces. This means that changes, e.g. the model, can be made at any time with no problems. The application does not have to be reprogrammed, only the camera-specific parameters have to be adjusted. This IDS driver philosophy is future-proof, just like the USB 3.0 interface. OEM customers such as KRÜSS can rely on the fact they will remain a standard on the PC in the long term, as universal availability, plug & play convenience, and high data rates are advantages that will ensure the interface's continuing success in the future and provide a basis for further development.

## USB 3.0 uEye CP:

Incredibly fast, incredibly reliable, incredible sensors

Name:	<a href="#">UI-3060CP Rev. 2</a>
Interface:	USB 3.0
Sensor type:	CMOS; monochrome
Manufacturer:	Sony
Framerate:	161 fps
Resolution (h x v):	1936 x 1216
Shutter:	Global Shutter
Optical class:	1/ 1.2"
Dimensions:	29 x 29 x 29 mm
Weight:	52 gr
Connectors:	8-pin Hirose connector



## Customer:

[www.kruss.de](http://www.kruss.de)

Krüss is a specialist in interfacial chemistry and the world's leading supplier of measuring instruments for surface and interfacial tension. The combination of unique products and highly qualified advice has made them the global market leader in the field of surface tension and interfacial tension measurement. With high-precision mechanical systems and innovative technical solutions, Krüss satisfies in a highly complex market, helping people in research, development and industrial quality control in a wide variety of company sectors and with the most diverse requirements.

