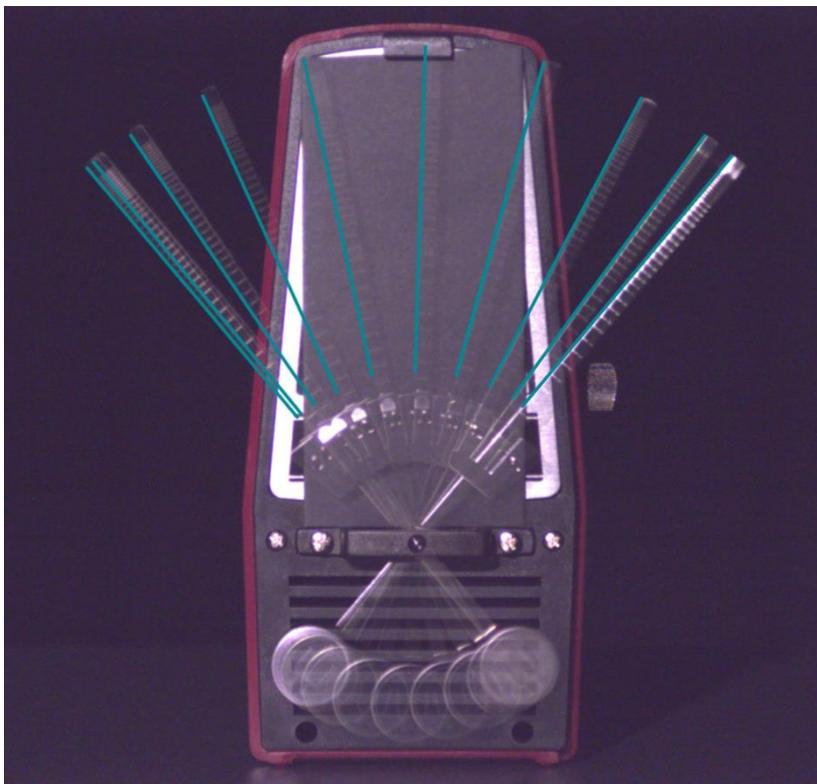


## Multi integration mode: Multiple exposures within one image

The multi integration mode of the 2 MP CMOS sensor from e2v used in the USB 3 uEye families opens up exciting new opportunities in machine vision.

### Background

In multi integration mode, the sensor is exposed multiple times within an image. As a result, extremely short integration durations within the set exposure time are possible, which can be used to capture even fast moving objects.



*Example of a moving object that was captured using multi integration mode*

Until now, there were two ways of capturing an image like this for analyzing speed, for example: using either a high-speed flash or a high-speed camera. A high-speed flash is complex to install and is heavily dependent on the lighting conditions. A high-speed camera is extremely expensive and takes several images, which need to be included in the analysis.

The advantage of multi integration mode, compared to these two methods, is that it is easy to use, does not require a high-speed camera, and can even be used in critical lighting conditions. Furthermore, only a single image is needed for the speed analysis.

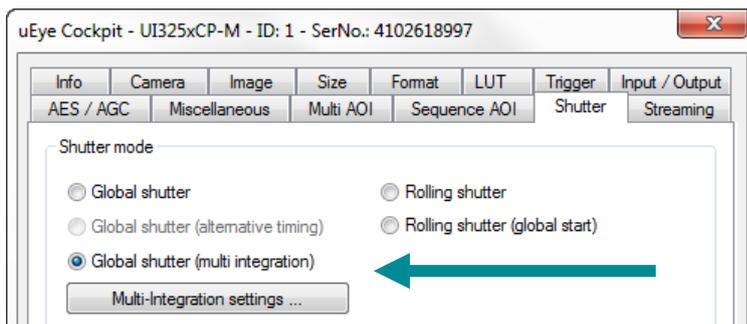
The speed analysis takes into account the length of the integration durations and the distance covered by the moving object. In addition, image processing software such as HALCON can be used to calculate the speed and whether the object speeds up or slows down.



*Speed analysis using multi integration mode*

## Using multi integration mode

To use multi integration mode, you first have to enable the "Global shutter (multi integration)" shutter mode under Properties in the uEye Cockpit.



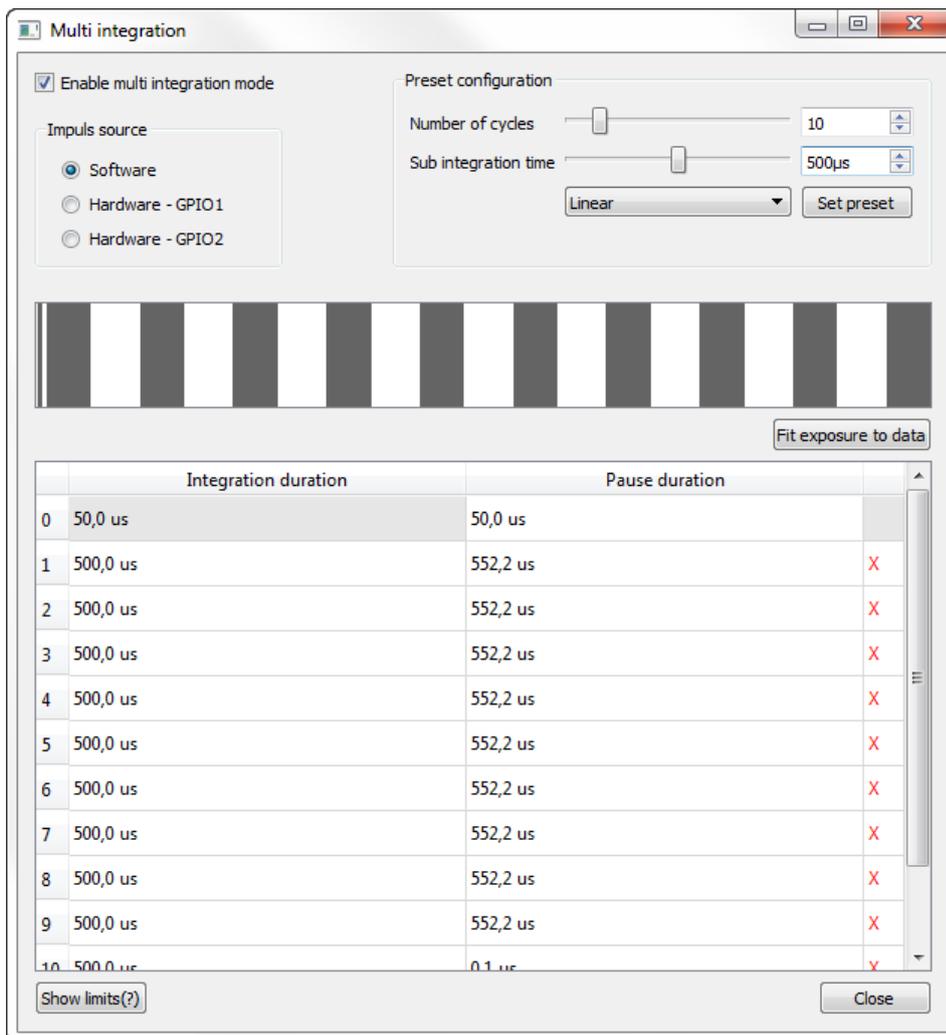
*Enabling multi integration mode in the uEye Cockpit*

Click the "Multi integration settings" button to configure the default settings for multi integration mode in the next dialog.

The "Impulse source" area controls the integration duration using either the hardware or software. If you select the hardware option using one of the two general purpose I/Os, the exposure time is controlled by the duration of the trigger signal level. This enables you to alter the image brightness directly using an external electrical signal without needing to use any other software commands.

If you control the integration durations using the software, you specify the number of integration durations ("Number of cycles") directly in the dialog as well as the length of these. The length of the integration duration depends on the (total) frame exposure and the number of cycles. The shortest possible integration duration is 100 ns. Pause durations are calculated automatically between the individual integration durations in order to achieve the set total frame exposure.

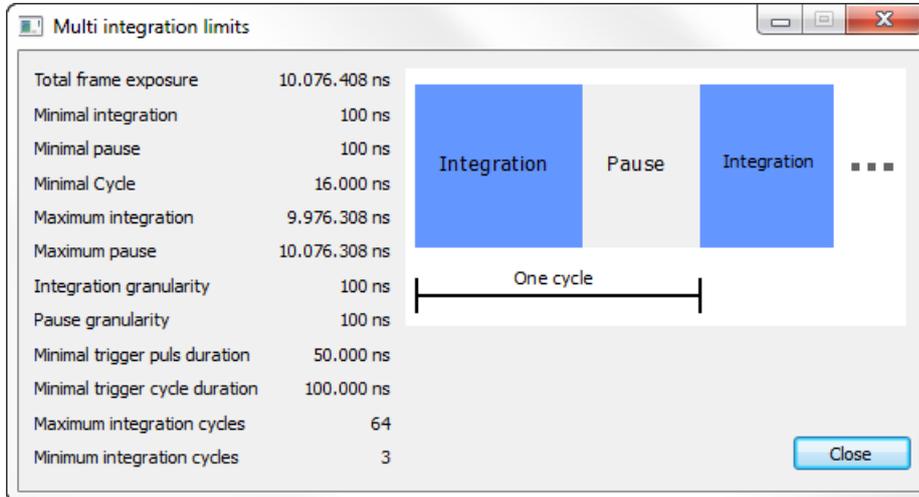
You can edit specific integration durations and pause durations individually in the table below.



*Dialog for configuring integration durations for multi integration mode*

In "Preset configuration", you can also select "Coded exposure" as well as linear as the default setting. For more information on the timing of the "coded exposure", see the study "Resolving Objects at Higher Resolution from a Single Motion-blurred Image" by Amit Agrawal and Ramesh Raskar, Mitsubishi Electrical Research Labs (MERL), which is available online at: <http://www.merl.com/publications/docs/TR2007-036.pdf>

Click the "Show limits" button to open another window, which displays the values for the minimum and maximum integration durations, pause durations, etc. independently of the total frame exposure selected.



*Integration duration and pause duration limits*

## Application areas

Multi integration mode allows multiple exposures to be made on just one image. This mode is therefore ideal for reducing motion blur and visualizing speed.

Multi integration mode can also be used to superimpose multiple exposures of a positional state in one shot for extremely short exposures and dark images associated with these. This allows summing to be carried out on dark images in cyclical processes.

Multi integration mode is especially suitable for use in ITS for automatic number plate recognition as well as in the sports and medical fields or particle analysis/tracing.

## Summary

With the 2 MP CMOS sensor from e2v, the UI-325xCP offers a sensor that covers a broad range of uses. Its multi integration mode also allows applications to be implemented that are not possible with a single exposure.

Simple setup and low system costs make it an affordable alternative to expensive high-speed systems.

For more information on configuring and programming multi integration mode for the UI-325xCP, refer to the uEye manual at <http://en.ids-imaging.com/manuals-ueye.html>.

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