MCS2 Camera Scanning Application

INTRODUCTION
This application note demonstrates how an MCS2 can be used to scan a 2D grid and record an image at each grid point e.g. by a CCD camera. Since the time required to move to a new grid point or take an image may vary, the MCS2 and the camera need to be synchronized. This is achieved with the help of digital I/O signals that are exchanged between the MCS2 controller and the camera.

This application note comes with example code, which can be easily extended to more channels and different types of measurement equipment.

It is recommended that you have read the MCS2 Programmer’s Guide, in particular the sections “Command Groups”, “Input Trigger” and “Output Trigger”.

1. SETUP
For this example application it is assumed that the camera can be triggered using an external signal. The camera in turn needs to generate an output signal once it has finished recording an image (due to potentially varying exposure times). These camera input/output signals are connected to an MCS2 controller that incorporates an I/O module (type 3). The setup is shown in Fig. 1.

![Figure 1. Overview of example setup](image)

After reaching a target position for an image, the MCS2 triggers the camera to start a new recording. Once the recording is finished, the output from the camera triggers the movement to the next target position, repeating this process until all points of the 2D grid have been scanned.

For each grid point the movement commands for all positioners are put into a command group so that the positioners all start to move synchronously.

2. CONFIGURATION
Before starting the actual scanning process we need to configure the device properly for this setup to work. First, the IO module needs to be configured. In line 57 of the example code the global I/O Module voltage is set to 3.3 Volt before it is enabled in line 60. Depending on your hardware you may also select 5 Volt for the I/O signals. Note though that it is recommended to select the voltage level first and then enable the module in order to prevent glitches.

Next, we configure an output trigger to trigger the camera. In this case we use the output trigger of channel 0 to tell the camera when it may begin a recording. In line 65 we configure an active high polarity of the output trigger. Depending on your setup you could also chose a different polarity. The constant mode of the output trigger that is configured in line 67 is used to control the output level by software.

Finally, we configure the input trigger that the camera sends to the controller to indicate a finished recording. Here we assume that the camera outputs a busy signal, being high when recording and low when idle. Therefore, we use a falling edge to trigger a command group (lines 72 and 74).

3. IMPLEMENTATION
After the triggers have been configured the setup is ready to scan the 2D grid. Overall, there are 4 steps which need to be executed inside a loop for every grid point:

1. Create a command group with movement commands that move the positioners to the next grid point (lines 120 to 129).

2. Wait until the command group has been triggered by the camera (starting at line 136). The first loop iteration is an exception here (see below).

3. Wait until all movements are finished (starting at line 166).

4. Trigger the camera by creating a pulse on the output channel (starting at line 187).

The camera always records images between the loop iterations (after step 4). While the camera is recording the next grid coordinates are preloaded by creating a new command group (step 1). The finished recording of the previous loop iteration then triggers the new command group and the process repeats.
For the first loop iteration the command group must be triggered directly, because there is no previous iteration. In this case the movement starts as soon as the command group is closed (in line 129). In all other iterations the command group is triggered by the external camera signal. After the last loop iteration the camera is still busy recording an image. Therefore, no new movement commands should be sent before the camera has finished.

Note that the order of steps was chosen for simplicity and only works if the creation of the command group is faster than the recording time of the camera. For very short exposure times these steps can be reordered, so that the creation of the command group happens before the camera is triggered. To detect and recover from a too fast or incorrectly configured camera the second step should include a timeout detection.
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