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An Investigation into the Effects of Shutter Shock within Various Modern Camera Models

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Introduction

Shutter shock is the result of a cameras mechanical shutter sending vibrations through the camera body when taking a photo, which can cause a distortion in the final image. This issue is only caused by mechanical shutters since they contain moving parts. Therefore both electronic and electronic first curtain shutters (EFCS) will also be tested, although these methods of shutter also have their own issues. The following cameras will be tested:

-Nikon D5300
-Olympus EM1
-Panasonic G6


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Aims & Objectives

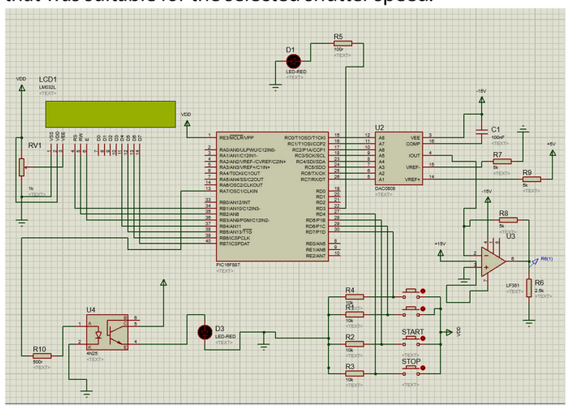
The aim of the this project is to investigate the effects of shutter shock on the output image of cameras. This will be achieved by sweeping a laser across a vertical surface and capturing an image of the laser, while it is in motion. Any vibrations caused by the shutter should produce perturbations in the laser sweep.

- Develop a circuit that is able to measure which cameras are affected by shutter shock
- Test the cameras using various shutter speeds and types of shutter.
- Import the images to Photoshop for analysis

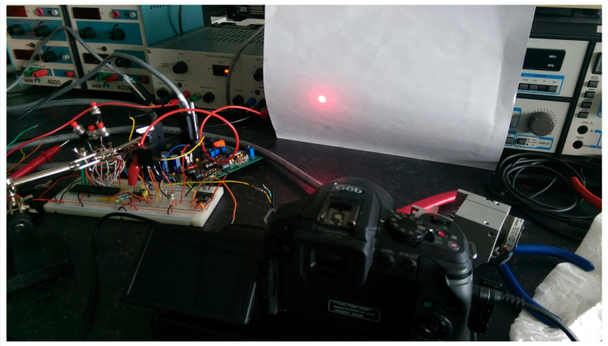
Design

The laser sweep was created by using a loan unit of the Cambridge Technology galvo system consisting of 6800 motor and CB6580 driver board. To control the galvo system a voltage between +10V and -10V must be applied, because sweeping a laser doesn't require a large movement, 0-5V from the microcontroller would be suffcient.

The rest of the design consists of a DAC0800 to convert the binary output from the microcontroller into an analogue voltage and an LCD so the user could select a sweeping speed that was suitable for the selected shutter speed.



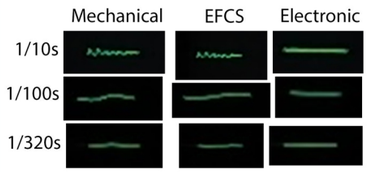
The final part of the circuit consisted of a relay to trigger the Panasonic's shutter remotely. The relay proved to be problematic with its long and and inconsistent delays. This would cause problems of the laser finishing its sweep before the camera has taken the shot, despite the camera being triggered first.



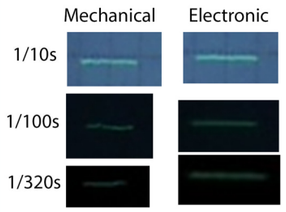
The relay was then later replaced with an opto-isolater, this solved the issues of the delays between the shutter being triggered and the laser sweep. It also allowed for the power of the circuit to be isolated from the camera.

This circuit functioned successfully, however the diameter of the lasers beam proved to be too wide, making analysis of the perturbations difficult. Instead, to test the cameras an analogue oscilloscope was used, the results of which proved much easier to work with.

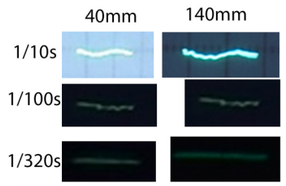
Results



To the left are the results for the Olympus EM1. These images show that the EFCS has little effect on shutter shock and that its effects decrease as the shutter speed increases.

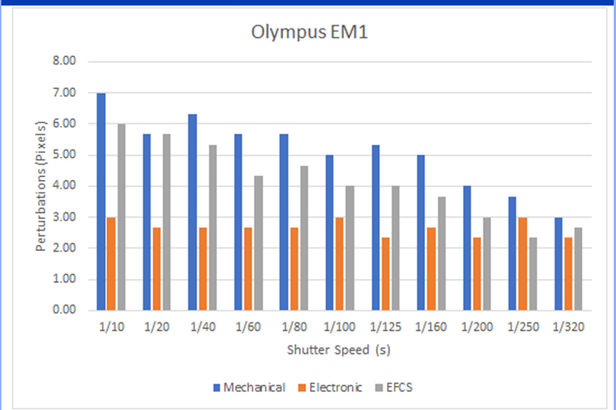


These results are for the Panasonic G6. They show the elecronic shutter removing the effects of shutter shock and the camera is most affected at 1/100s.



The Nikon D5300 did not have an electronic shutter so was instead tested at 2 focal lengths. At both focal lengths the shutter shock is worse at lower shutter speeds.

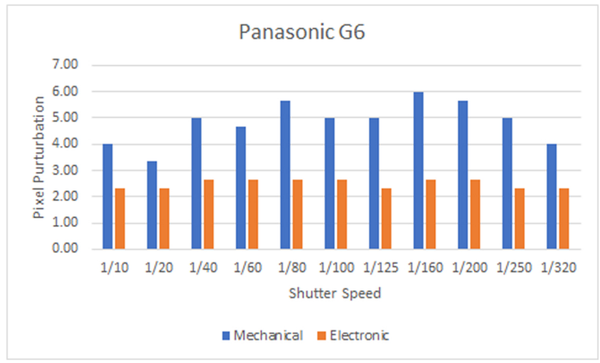
Analysis of Results



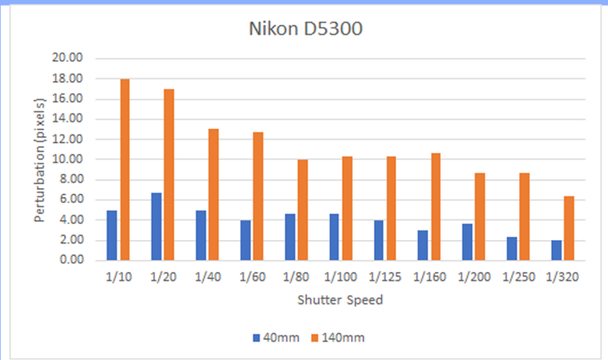
There is a slow decline in perturbation as the shutter speed increased for both the mechanical and EFCS. At 1/320s there was only a marginal difference in perturbation. It is likely that shutter shock would be removed enitrely if the shutter speed continued to increase.

The electronic shutter results are consistent at around 2-3 pixels at each shutter speed. The EFCS did not solve the issue of shutter shock but it marginally reduced its effects at all shutter speeds. EFCS began to produce results similar to that of the electronic shutter at lower shutter speeds than the mechanical shutter.

EFCS performed far worse than expected, based on the research carried out prior to the test. It was assumed that it would produce results similar to that of an electronic shutter but with less of the slow readout issues of an electronic shutter. This was not the case for the Olympus EM1.



The worst cases of shutter shock for the Panasonic G6 occur between 1/40s – 1/250s compared to the Olympus EM1 which slowly declined as the shutter speed increased. However the effects of shutter shock peak at 1/160s and then starts to lessen. The assumption would be made that this decline would continue past 1/320s. The electronic shutter is consistently between 2-3 pixels wide similar to the Olympus EM1.



The Nikon D5300, compared to both the Olympus and the Panasonic, suffers less from shutter shock. With a maximum perturbation of 6.67, it was on average lower than the other two cameras at all shutter speeds, with a focal length of 40mm. Shutter shock effects have gone by 1/320s.

At 140mm the results are far worse, even when considering that the sweep would be larger without perturbations. If the assumption is made that there is little to no shutter shock at 1/320s the width of the beam is 6 pixels. Whereas at 1/10s the width of the beam is 18 pixels, which is an extra 12 pixels of perturbation.

Conclusion

In conclusion shutter shock is clearly an issue as it was present in all three of the cameras tested. There was however no specific trend that it would follow, each camera suffered the worst results at different shutter speeds. What can be confirmed is that by 1/320s the shutter shock had decreased substantially on all cameras and is assumed to only decrease further.

By testing the Nikon D5300 at two separate focal lengths it was also proved that focal length does have an effect on the severity of shutter shock.

As the Olympus EM1 was the only camera with an electronic first curtain shutter it opened up the option for that be tested too. It performed worse than expected, the expectation was for it to perform very close to, if not as well as the full electronic shutter. In reality, it performed marginally better than the mechanical shutter. However, an EFCS can have different implementations and not all implementations may perform as poorly.

Acknowledgments

[1] "Panasonic_Lumix_DMC_G6_front-612x500.jpg (612×500)." [Online]. Available: http://keyassets.ti[1] "Panasonic_Lumix_DMC_G6_front-612x500.jpg (612×500)." [Online]. Available: http://keyassets.timeincuk.net/inspirewp/live/wp-content/uploads/sites/12/2013/06/Panasonic_Lumix_DMC_G6_front-612x500.jpg. [Accessed: 30-Apr-2017].

[2] "intro.jpeg (2000×1500)." [Online]. Available: https://www.dpreview.com/files/p/articles/3675840530/images/intro.jpeg. [Accessed: 30-Apr-2017].

[3] "1519_D5300_left.png (700×595)." [Online]. Available: http://cdn-4.nikon-cdn.com/e/Q5NM96RZZo-YRYNeYvAi9beH-K4x3L-8lV__2R-oGYSKeMMUpn__DSbsOX4QQI1MBxLX9BO6gD8NqzjK0CXEJ_g==/Views/1519_D5300_left.png. [Accessed: 30-Apr-2017].