

Rolling Shutter

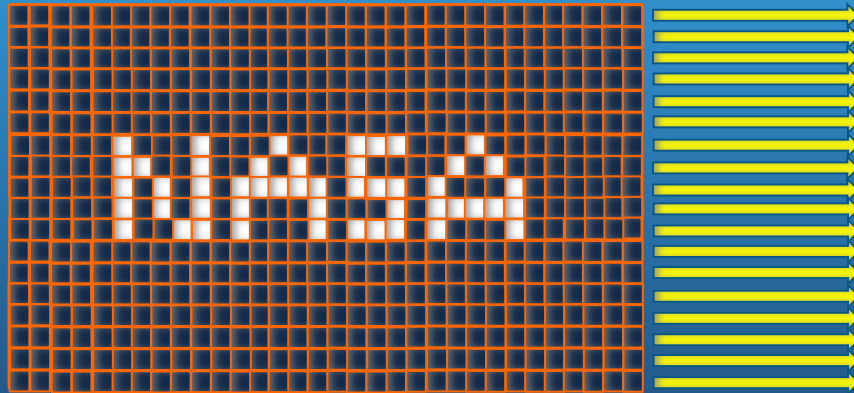
Or, how to make new cameras look like old ones!

Camera Sensors

- Two Types
 - CCD Charged Coupled Device
 - CMOS Complementary Metal Oxide Semi-Conductor
- They Acquire Images Differently
 - CCD collects an entire frame at once
 - Reads out image one line at a time
 - Global Shutter
 - CMOS collects and reads out one line at a time
 - Bottom of the image taken later than the top
 - Rolling Shutter

Camera Sensors

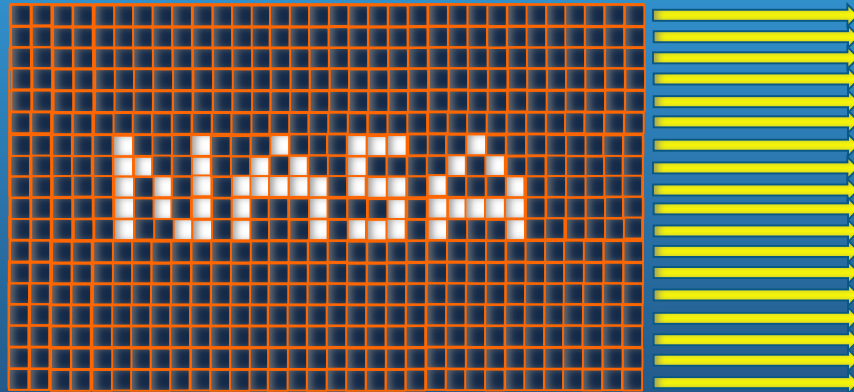
CCD Sensor



Global Shutter !!

Camera Sensors

CMOS Sensor



Rolling Shutter !!

Okay, so what?

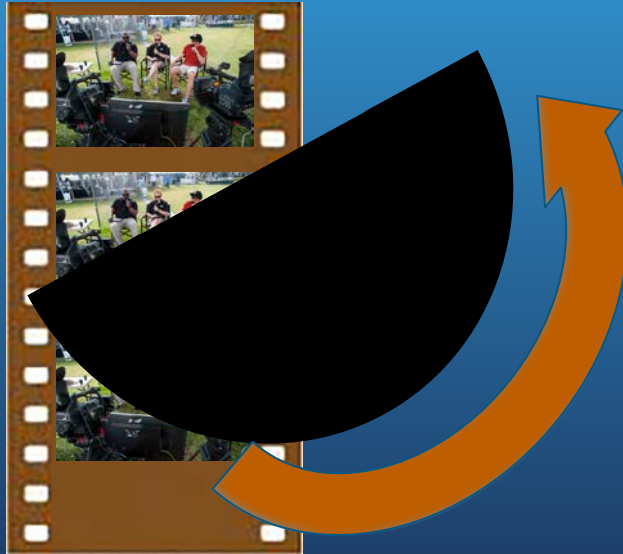
- With fast motion, an object in the image may show up on multiple rows of pixels where it doesn't belong
 - Rolling Shutter Effect
 - Jello Effect with fast motion and camera shake
- Here's a short video tutorial on what can happen and why it happens

Rolling shutter effect



So, what makes a CMOS like an old camera?

- Film Cameras have a rotating shutter that effectively scans the image from top to bottom



So, what makes a CMOS like an old camera?

- Tube TV Cameras scanned the image from top to bottom, one scan line at a time



And Why Do I care?

- Every maker of broadcast cameras has a top-end camera with CMOS sensors
 - They are seen every day, all day long on all types of programming
- How often have you noticed a problem?
- The effect of rolling shutter is virtually invisible with typical video camera shutter speeds, regardless of how fast the subject is moving
 - Typically, video cameras shoot 1/60 shutter and use ND to keep the aperture in a good range

But, when the camera is shuttered,
you can see the effect.

- So, we tested some cameras!
- Used a Chopper to get a controlled object in motion
- Shot comparable 1/3" CCD and CMOS cameras at different object speeds and shutter speeds

The Chopper



Comparison



CCD - 1/60 shutter 500 RPM



CMOS - 1/60 shutter 500 RPM

Comparison

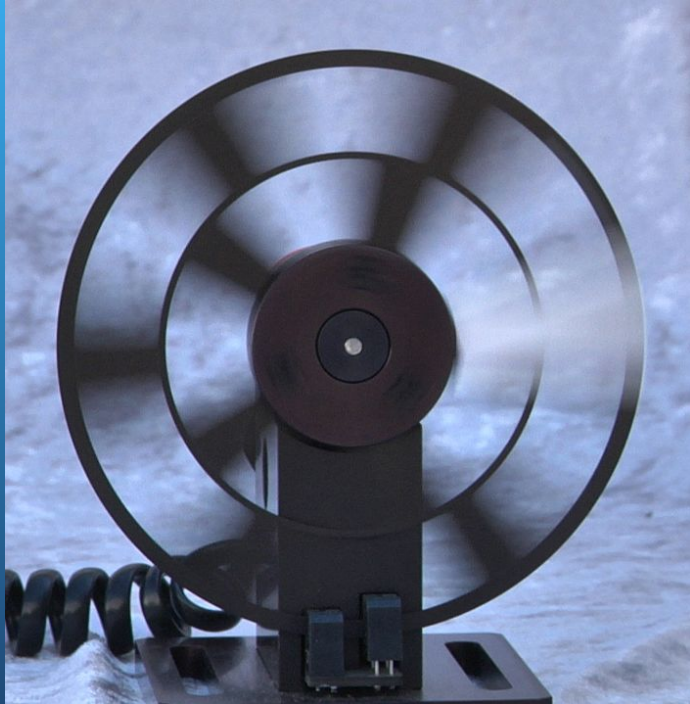


CCD - 1/120 shutter 500 RPM



CMOS - 1/120 shutter 500 RPM

Comparison

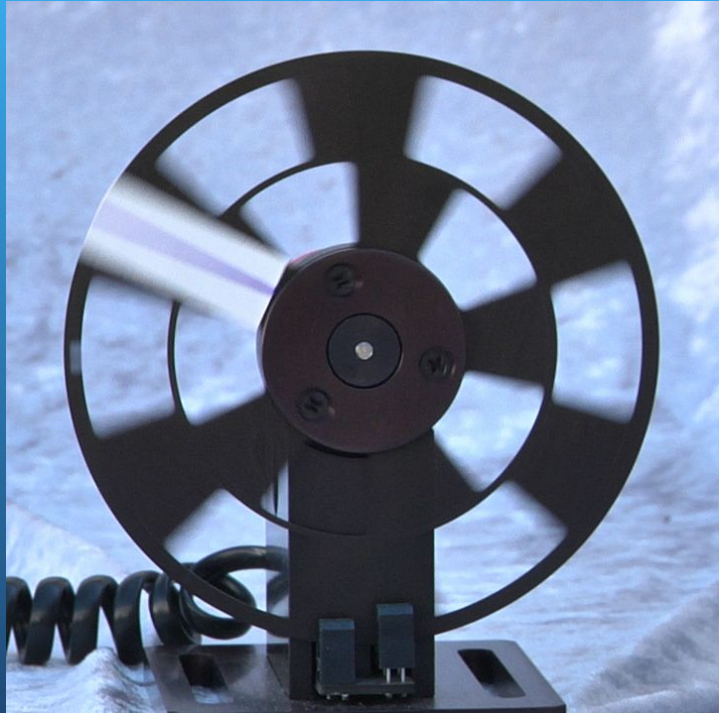


CCD - 1/250 shutter 500 RPM



CMOS - 1/250 shutter 500 RPM

Comparison



CCD 1/500 shutter 500 RPM



CMOS 1/500 shutter 500 RPM

Comparison



CCD - 1/1000 shutter 500 RPM



CCD - 1/1000 shutter 500 RPM

Comparison

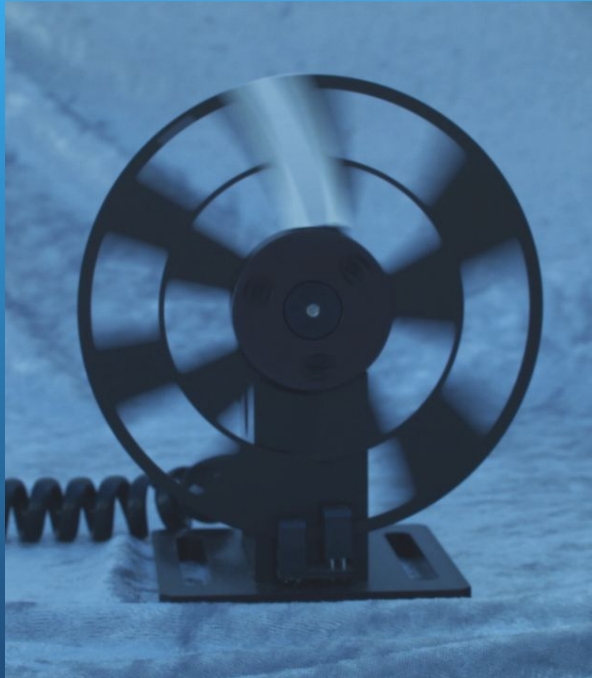


CCD - 1/2000 shutter 500 RPM



CMOS - 1/2000 shutter 500 RPM

More Cameras



Pocket Cinema Camera
CMOS - 1/240 shutter 500 RPM

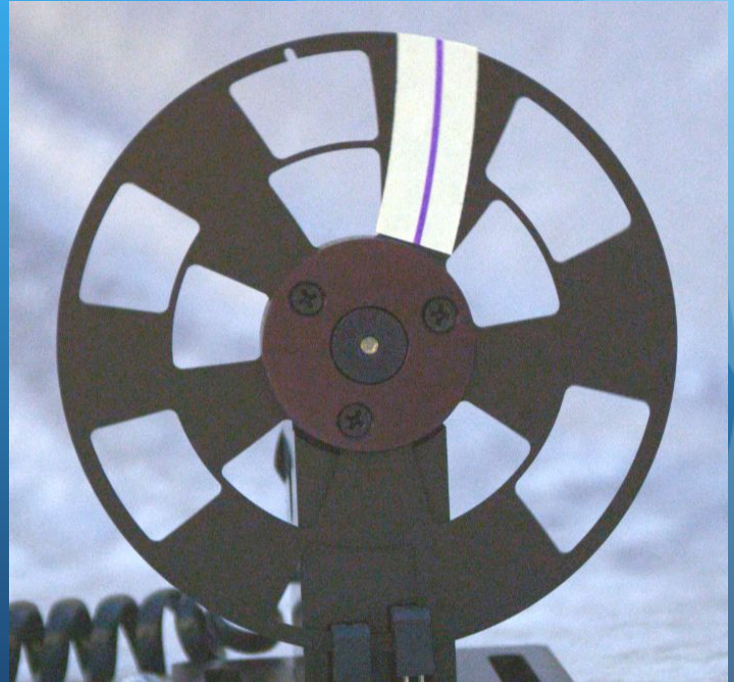


iPhone 4S
CMOS - ??? Shutter 500 RPM

More Cameras



Red Epic
CMOS, 1/4000 shutter 100 RPM

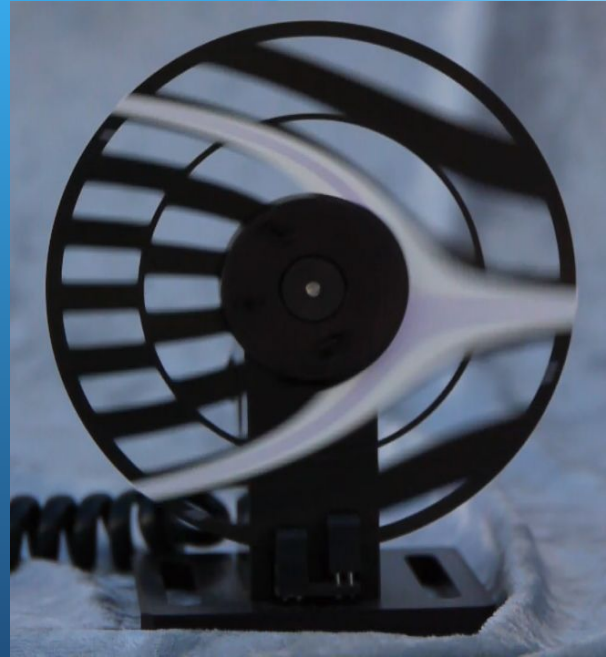


Red Epic
CMOS, 1/4000 shutter 500 RPM

More Cameras



GoPro
CMOS, ?? shutter 3000 RPM



Lumix GH1
CMOS, ?? shutter 3000 RPM

Now!!!
Let's Look
At Video

What's the Future?

- New CMOS Cameras with Global Shutters
- CMOS has been gaining favor because they are less expensive to make & consume less power
 - Inherently more noise than a CCD, but camera CPU power has increased such that processing to remove noise makes CMOS more desirable from a cost standpoint
- Global Shutter CMOS loses some of the cost & power advantages over CCD, but is a preferable solution

Questions ?