Optical Methods for Solid and Fluid Mechanics
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Lecture - 11
Lab Demo II: Lenses and Camera

(Video Starts Here: 00:04) Hello everyone. Welcome to this lab demonstration session for the course optical methods for solid and fluid mechanics. In this session, I will show you different camera lenses that we have in our lab and then I will show different imaging parameters that you can control to get a good imaging. So, coming to the lenses. This is a wide angle lenses with variable focal length between 24 mm to 120 mm.

And this gives large field of view, but the resolution is low. Now, we have this Navitar zoom lens. It gives you very high resolution, but the field of view is small then we have a sigma macro lens, it is a prime lens with fixed focal length of 105 mm and the field of view and the resolution is in between these two lenses. So, depending upon the requirement you can choose different lenses that are available in the market.

Now, I will move to the different imaging parameters that you can set in the camera to get desired imaging. There are three critical parameters that decides a good imaging. First is exposure time it signifies the amount of time for which the camera shutter is open then second is f number. This signifies how much aperture you want to open then third is ISO; ISO signifies the sensitivity of the camera.

Now this settings are common to all the cameras even high speed camera, but I will show how to change this settings on a Nikon camera and its model is D850 and to control this parameters you need to put your camera in manual mode and there you have a button for changing the mode and then when m appears on screen it means it is in manual mode. Now, to change the f number there is a knob you can rotate this knob to control the f numbers.

So, here is a knob you can rotate this knob to change the exposure time and you have ISO button, you can simultaneously press the ISO button and rotate this knob to control the ISO of your imaging. Now, with the help of a demo let us see how you can control this parameters

to get a desired imaging. Here is our Nikon D850 camera. There is one object near to the camera and there is another object comparatively away from the camera.

And the value of three different parameters you can see on the bottom of the camera screen the exposure time is 1 by 200 second, f number is 5.3 and the ISO is 12,800. Here it is m which signifies the camera is in manual mode. Now, let us click an image for this setting and let us see how it looks. So, you have exposure time of 1 by 200, f number of 5.3 and ISO of 12,800.

For this value of parameters the image looks like this where you have the front object in focus whereas the object in the background is not in focus. Now, if you want to keep your depth of focus high means you want to focus both the objects then you can increase the f number and then both the object will be in focus because depth of focus will increase. Here, I will increase the f number to very high value and then click another image.

Now, let us see how this looks. You see a dark image because when we increase the f number basically we have reduced the aperture. It means the amount of light that is entering into the camera has been reduced that is why we see a poorly exposed image. To address this issue you can increase the exposure time right now the exposure time is 1 by 200 given the same f number in ISO setting if I increase the exposure time.

It means I allow the more amount of light to enter into the camera and then you can get a good image let us see that. So, I am increasing the exposure time to 1 by 4 second and click one image. Let us see how it looks. Now you see a properly exposed image with the front object as well as the background object both are in focus and the parameters are 1 by 4 seconds of exposure time f number is 36 and ISO is 12,800.

Now, what happens if you increase the exposure time even higher let us see. So, I am making the exposure time of 2 seconds and then click one image and this is how it looks. When I increase the exposure time since the shutter is open for long time the whole image is over exposed and saturated and lot of information has been lost from this image. To overcome this problem you can decrease the sensitivity of the sensor that is ISO.

So, keeping the other two setting same if I decrease the ISO then I can again get the properly exposed image. So, I am decreasing the ISO to 1,000 and then click an image and let us see how it looks. Now, you see I have kept the exposure time fixed to 2 seconds, f number to 36 and ISO is decreased from 12,800 to a value of 1,000. Now, you see you have a properly exposed image with both the object is in focus.

So as per the requirement you can play with this parameters like exposure time, ISO and the f number and then you can get desired imaging. All the lenses I have shown earlier were all spherical lenses, however, there can be cylindrical senses which are used in, for example, particle image velocimetry where you want to create a sheet of light from a cylindrical beam of light.

Here is one such lens it is a plano concave cylindrical lens and it is mounted on a 3D printed holder, there is a plano concave cylindrical lens it has a concave curvature on one plane whereas it has no curvature on the other plane. So, it converts a cylindrical beam of light into a diverging sheet of light that I will show here with the help of laser light source, it is a green laser and it is a 5 milliwatt laser.

Although, the power is not high, but before turning on it is important to put on safety goggles that are rated for this particular laser. Now, I will turn on this laser and you see it produces a cylindrical beam of light that appears as a circular projection on the screen. Now, when I put this cylindrical lens in front of the laser you can see the cylindrical beam of light has transformed into a sheet of light that appears as a line on the screen.

And as I told earlier these lenses are used in Particle image velocimetry where you want to create a sheet of light to illuminate the particles in a particular plane. **(Video Ends Here: 09:46)** With this, we have come to an end for this session. Thank you.