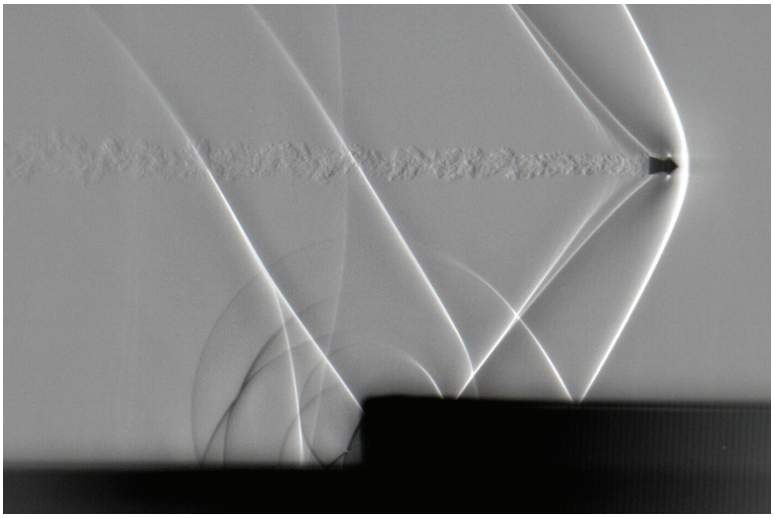
Analog Schlierenscope

Making the Invisible Visible



Supersonic projectile and shock waves

Capture digital images and video of air currents, gas vapors, and shock waves.

Heat rising from tea kettle

Spectabit Optics LLC

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Analog Schlierenscope

Description

Spectabit Optics LLC offers two portable instruments that capture digital images and video of air density gradients that are normally invisible to the human eye. Density gradients are produced by hot air rising from ovens, cold air flowing out of refrigerators, gasoline vapors leaking out of containers, and shock waves surrounding bullets. These phenomena are made visible using the centuries-old schlieren technique, which detects the bending of light rays caused by small changes in the refractive index of air and other gases. In the past, schlieren systems required large, complicated optical setups that were hard to move and required an expert to keep them aligned. The Spectabit Schlierenscope simplifies the setup by putting all the critical optical components on a single platform. Images are captured by digital camera sensors. Users can adjust the field of view and working distance with easy to reach controls. No expertise in optics is required!

How it works

The Schlierenscope employs specially designed optical filters to project a pattern of lines onto a high-gain retroreflective screen behind the object. The screen reflects the light back into the Schlierenscope where it passes through a cutoff filter before it reaches the camera sensor. The sensor is focused on the object, not the screen or cutoff filter, and the depth of field is shallow enough that the screen pattern is completely defocused. In the absence of density gradients, light rays travel straight from the screen to the cutoff filter, which blocks approximately half of the light rays. Advanced image processing algorithms are applied to remove background noise and enhance contrast, resulting in a background of uniform intensity.

Hot and cold air currents, gas vapors, and shock waves create zones of varying density that bend light rays, thereby distorting the line pattern projected on the background screen. The distortion alters the amount of light that passes through the cutoff filter to the image sensor. In the resulting image, air currents and shock waves appear as sharply focused light and dark objects etched in a gray background. The system is so sensitive that it is possible to see warm air rising from the palm of an outstretched hand.

Models

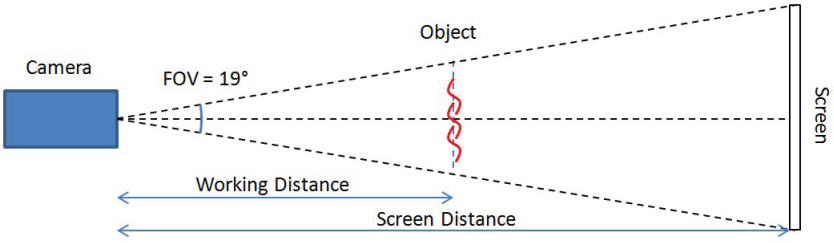
Spectabit Optics LLC offers two models of the Schlierenscope. Controls can be automated in both models to facilitate operations in inaccessible locations.

> **The Large-Field Schlierenscope** offers a large field of view, and uses a digital SLR camera to capture videos as well as still photographs. This model lets engineers visualize hot and cold air flows in ventilation systems, as well as gas fumes from industrial equipment.

> **The High-Speed Schlierenscope** offers a 1-microsecond strobe that freezes the motion of high-speed phenomena such as shock waves, air jets, explosions, and sound waves. Still images are recorded by a scientific CCD camera, which can be triggered externally by microphones or other sensors to capture events at the decisive moment.

Large-Field Schlierenscope

The Large-Field Schlierenscope offers a fixed angular field of view that is 19° tall and 11° wide. The vertical field of view ranges from 36″ to 60″, depending on the working distance. The system requires a background screen that is twice as large as the field of view, which should be placed approximately twice the working distance from the camera.



Specifications for Large-Field Schlierenscope

Parameter	Maximum	Minimum	Comment
Angular Field of View	19° H x 11° W	19° H x 11° W	fixed (Height x Width)
Field of View (FOV)	60″ H x 34″ W	36″ H x 20″ W	depends on working distance
Working Distance	15′	9′	= 3 x vertical FOV
Screen distance	30′	18′	= 2 x working distance
Screen size	10′ H x 5′-8″ W	6′ H x 3′-4″ W	= 2 x FOV
Image Sensor	Digital SLR camera with 24 fps HD video (1280 x 720 pixels)		
Illumination	Continuous White LED		
Line Pattern	Vertical Lines		
Instrument Size	36″ long x 18″ wide x 10″ high		

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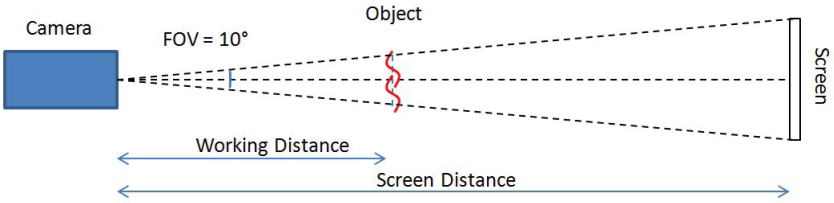
High-Speed Schlierenscope

The High-Speed Schlierenscope offers a fixed angular field of view that is 10° by 6.6°. The sensor has an aspect ratio of 3:2, and can be oriented in landscape or portrait mode according to request. The field of view ranges from 6″ to 16″, depending on the working distance. The system requires a background screen that is 2.5 times as large as the field of view, which should be placed approximately 2.5 times the working distance from the camera.



Specifications for High-Speed Schlierenscope

Parameter	Maximum	Minimum	Comment
Angular Field of View	10° x 6.6°	10° x 6.6°	fixed (3:2 aspect ratio)
Field of View (FOV)	16″ x 10.7″	6″ x 4″	depends on working distance
Working Distance	8′	3′	= 6 x FOV long dimension
Screen distance	20′	7′ -6″	= 2.5 x working distance
Screen size	40″ x 27″	15″ x 10″	= 2.5 x FOV
Image Sensor	Scientific monochrome CCD (4032 x 2688 pixels)		
Video Rate	4.9 fps at full resolution		
Illumination	Xenon strobe with 1-microsecond flash		
Line Pattern	Lines can be rotated to any orientation		
Camera Size	24″ long x 18″ wide x 10″ tall		

Contact Us

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