Schlieren photography works by essentially creating a very sensitive beam of light. This beam of light will then show any changes in pressure or heat in the air due to the changing the original refractive index. The refractive index or how fast light travels through something varies from substance to substance. Much like how sound is faster underwater, light might be faster in nitrogen gas when compared to oxygen gas.

When showing the changes in pressure it showing areas of more or less dense air causing a change from the original refractive index. This is like looking at something in pool from outside the pool – it looks distorted until you look at it from inside the pool.

Refractive index is also effected by temperature as a changing temperature changes density as well. The hotter a substance gets the more the molecules that make up that substance will spread apart, leading into a decrease in the density of the substance. Likewise if the substance cools down, the molecules will group up more and increase the density. These changes can actually be seen without a Schlieren set up – if it’s a hot enough day you can see heat waves, or scintillation, in the air!

What can we use it for?

Schlieren photography has many important industrial applications, including examining heat transfer and examining pressure changes. Due to these Schlieren photography has bee used in aeronautical and aerospace engineering – the engineers are able to see what areas on the aircraft experience large amounts of pressure as the aircraft accelerates and can reinforce it accordingly. They can also see how aircraft produce sonic booms and adjust the aircraft structure in order to reduce that sonic boom and make the plane stealthier.

Schlieren photography can also be used for things such as leak detection where the set up is used to determine where a gas leak is located and how large the leak is.

As it can detect shockwaves of various aircraft, Schlieren photography can also detect shockwaves generated by ballistics in order to study the air flow around them and then develop more powerful ballistics.

Links and references

Schlieren Photography of moving air
https://www.youtube.com/watch?v=1SFuH0Bvd3Q

NASA Schlieren Explanation
https://www.grc.nasa.gov/WWW/K-12/airplane/tunvschlrn.html

Introduction to shadowgraph and Schlieren imaging
http://scholarworks.rit.edu/cgi/viewcontent.cgi?article=1480&context=article

How Schlieren Imaging Works
https://talkingphysics.wordpress.com/2012/02/09/how-schlieren-imaging-works

An Overview on Schlieren Optics and its Applications

Principles and Techniques of Schlieren Imaging Systems

Pamphlet written by Forrest Eagle For more information, contact Prof. Michael Grubb at 970-247-7238.
Known to few, there is a hidden world all around us that people take for granted every day. However, Schlieren Photography allows us to see this hidden world by showing us all of the gasses in the air! By finding the focal point of reflected light and blocking half of it we essentially make a sensitive light beam. Because different gasses have different refractive indexes – that is they bend light in varying amounts – it becomes easy to visualize different gasses in the air. As refractive index changes with temperature and pressure (changes make gas more or less dense), the technique is also highly valuable when trying to determine pressure and temperature differences in the air. This technique has a huge amount of uses – from ballistics design to aerospace engineering, even in building design to detect gas leaks!

Schlieren photography has also been used as a method of study in the fields of heat transfer, fluid mechanics, and material science.

**Schlieren Photography Demo**

**Instructions**

Step 1 – collect the necessary equipment; a concave mirror, a white light source, a knife or razor blade, and dark surface to show the image on.

Step 2 – First try and make the light in a highly focused beam – you will get better results this way!

Step 3 – Place your mirror a short distance away from the origin of the light source and slightly angle it.

Step 4 - Find the reflected focal point and place your knife/razor blade there. This should block off half of the light.

Step 5 – Place your dark surface behind the knife.

Step 6 – Play with the air in front of the mirror and have fun!