SEEING A SHOCK WAVE

If you could see the shock wave from a jet moving faster than sound, this is what it would look like.

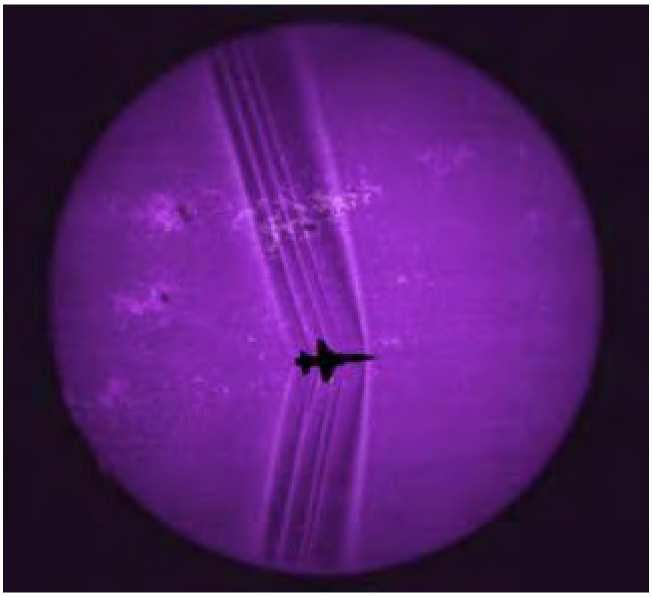
The image shows a supersonic jet passing in front of the sun, with the jet's shockwave visible. A team of NASA researchers generated the images and other like it, using a modern version of a 150-year-old German photography technique called Schlieren imaging. Shock waves appear darker because changes in the air density affect how much light is refracted.

Shock waves are narrow regions of air where pressure, temperature, and density characteristics are drastically different than surrounding areas. **Shock waves occur when objects move faster than the speed of sound in air, which is 1,236 kilometres per hour.**

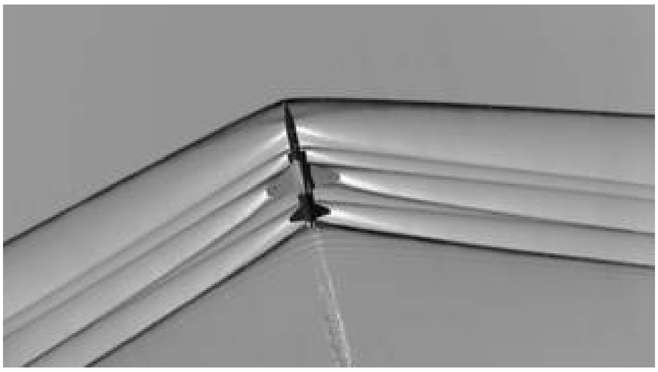
Specialized image-processing techniques were required to produce the images. Researchers first collected a series of photographs on a speckled background pattern. They then used computer algorithms and image processing software to deduce the locations of the shock waves based on distortions of the background pattern—an approach called the background-oriented schlieren technique.

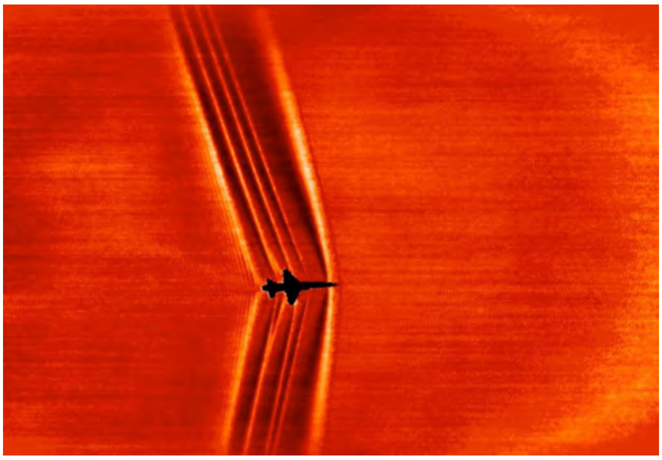
While either the land surface or the sun can serve as the background, using a celestial body is simpler and cheaper because the camera can be located on the ground rather than on a second airplane.

In the wake of recent success with air-to-air schlieren photography using the speckled desert floor as a background, researchers at NASA's Armstrong Flight Research Center, Edwards, California, are now looking to the heavens for backgrounds upon which to capture images of supersonic shock waves using ground-based cameras. A bright light source and/or speckled background – such as the sun or moon – is necessary for visualizing aerodynamic flow phenomena generated by aircraft or other objects passing between the observer's camera and the backdrop. **This patent-pending method, made possible by improved image processing technology, is called Background Oriented Schlieren using Celestial Objects, or BOSCO**.



Shock waves streaming from a jet flying at supersonic speeds. The jet is passing in front of the sun, using a calcium-K optical filter. Dark sunspots are also visible.





Shock waves produced by a supersonic jet flying over the Mojave Desert. The image was captured by a high-speed camera on the underside of a smaller aircraft flying several thousand feet above the jet.

Flow visualization is one of the fundamental tools of aeronautics research, and schlieren photography has been used for many years to visualize air density gradients caused by aerodynamic flow. Traditionally, this method has required complex and precisely aligned optics as well as a bright light source. Refracted light rays revealed the intensity of air density gradients around the test object, usually a model in a wind tunnel. Capturing schlieren images of a full-scale aircraft in flight was even more challenging due to the need for precise alignment of the plane with the camera and the sun.

Researchers at Armstrong and NASA's Ames Research Center at Moffett Field, California, have developed new schlieren techniques based on modern image processing methods. Shock waves, represented by distortions of the background pattern are accentuated using special mathematical equations. AK from EarthSky and NASA Notes

August Joseph Ignaz Toepler (7 September 1836 – 6 March 1912) was a German physicist in Dresden known for his experiments in electrostatics. and Schlieren photography