Now, see through dense fog easily

New simple and low-cost technique gives real-time, clutter-free images

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During numerous everyday situations like navigation, medical imaging and rescue operations, the inability to see clearly owing to fog, smoke or due to scattering of media, is a common and challenging problem. Now, scientists from Raman Research Institute (RRI), Bengaluru, and Universite de Rennes, France, have designed a simple, fast, portable and inexpensive solution, which enables one to see through turbid media instantly. The researchers have demonstrated real-time imaging through "strongly scattering media," for instance, dense fog or extremely muddy waters, and at a speed which is a thousand times more than that obtained by conventional techniques.

According to the research team, the technique is well applicable to areas like imaging through flesh, rescue operations in fires, and deep ocean viewing, that demand the mitigation of effects of multiple scattering and where speed is of essence. Compact, low cost portable devices can be made, and used in many different areas.

"Some situations of medical imaging, for instance, looking at a beating heart, impose an upper limit on the time afforded for data capture, while viewing moving objects like a victim in a smoke-filled room, or saving a drowning person, also restricts the time afforded for processing. The extreme simplicity of the technique, and its implementation with present day low-cost technology promises its utility in a variety of devices in maritime, aerospace, rail and road transport, in medical imaging and defence. It is of equal interest to the common man and adventure sportsperson like hikers, divers, mountaineers, who frequently encounter situations requiring realtime imaging through obscuring media," said Prof Hema Ramachandran from RRI in the research paper. The findings have been published in "Scientific Reports" of the Nature Publishing Group.

Hema Ramachandran

Top: The scene as seen by the camera. The light has travelled through fog, and no feature is visible; Below: On processing, two animal models hidden by fog come into view.

"Come winter, air and rail traffic, especially in the northern part of the country, is thrown out of schedule due to poor visibility under foggy conditions. This inexpensive technique could help in such situations," she told Bangalore Mirror.

According to a release from "Research Matters", to capture an image, the light rays should travel in straight lines, or should be deviated in a predictable way as in a lens. However, if light is scattered in unpredictable ways, only a diffused illumination, no recognisable image is obtained, it says.

"Scientists have been trying for decades to overcome this impediment, as the ability to image through turbid media has a wide range of applications. Some techniques have been developed that either require lasers that give out bursts of light of very short duration, or cameras that have very short exposure times, both of which are very expensive. Cheaper alternatives require much longer data collection and processing times. For most applications, however, one would like to form images with little or no delay," said "Research Matters".

THE TECHNIQUE

The research team have now addressed this problem by successfully demonstrating, for the first time, instant, real-time imaging through strongly scattering media, simulating a quarter of a kilometre of fog, without using any sophisticated equipment like ultra short-pulsed lasers or ultrafast cameras.

Using an inexpensive LED light source, ordinary scientific camera and by performing computations using a typical desktop computer, they obtain images within a few thousandths of a second. The images refresh at rates faster than the eye can perceive, so that motion is perceived as continuous. The crux of the technique lies in using a simplified data analysis algorithm, and using the immense parallel-processing capabilities of the graphics card present in all computers nowadays, said the findings.

The team conducted three experiments to demonstrate that the technique is capable of providing real-time, clutter-free images. For instance, one scenario mimics the pilot's view while approaching a runway for landing through fog and a clutter of other sources of light like streetlights, lights in buildings and vehicular lights, besides the runway lights. The technique showed that with regard to continuity of motion and immediacy of view, the processed images appear to the pilot akin to normal vision. In another experiment, using toy models of a tree and a cow, they show how objects hidden from view can be instantly revealed by this technique.