Vibrating Optical Fibers To Make Laser Speckle Disappear

Rapid shifting of speckle makes it appear to be smoothed away.

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In optical systems in which laser illumination is delivered via multimode optical fibers, laser speckle can be rendered incoherent by a simple but highly effective technique. The need to eliminate speckle arises because speckle can make it difficult to observe edges and other sharp features, thereby making it difficult to perform precision alignment of optical components.

The basic ideas of the technique is to vibrate the optical fiber(s) to cause shifting of electromagnetic modes within the fiber(s) and consequent shifting of the speckle pattern in the light emerging from the fiber(s). If the frequency of vibration is high enough, a human eye cannot follow the shifting speckle pattern, so that instead of speckle, a human observer sees a smoothed pattern of light corresponding to a mixture of many electromagnetic modes.

If necessary, the optical fiber(s) could be vibrated manually. However, in a typical laboratory situation, it would be more practical to attach a vibrating mechanism to the fiber(s) for routine use as part of the fiber-optic illuminator. In experiments, a commercially available small, gentle, quiet, variable-speed vibratory device was used in this way, with the result that the appearance of speckle was eliminated, as expected. Figures 1 and 2 illustrate the difference.

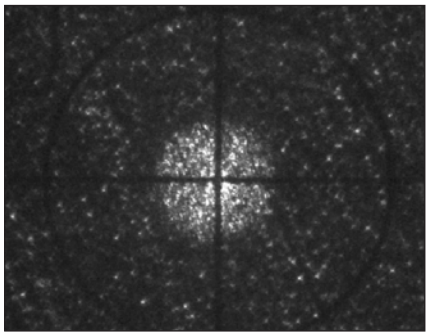

Figure 1. A **Laboratory Image** of the output of a 100-mm diameter multimode fiber is shown illuminated at 532 nm. Notice the speckle makes edges difficult to discern.

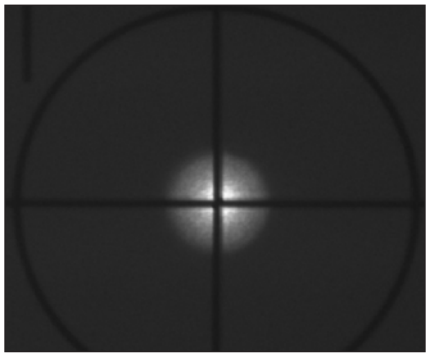

Figure 2. The **Same Image Is Improved** with the fiber being randomly vibrated. Now the edges and intensity distribution are clearly visible.

This work was done by Matthew McGill and V. Stanley Scott of **Goddard Space Flight Center**. *Further information is contained in a TSP (see page 1).*

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