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Laser speckle contrast imaging for measuring blood flow

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Abstract

When a diffuse object is illuminated with laser light, a random interference effect known as a speckle pattern is produced. If there is movement in the object, the speckles fluctuate in intensity. These fluctuations can be used to provide information about the movement. A simple way of accessing this information is to image the speckle pattern - the fluctuations cause a blurring of the speckle, leading to a reduction in the local speckle contrast. Thus velocity distributions are coded as speckle contrast variations. The same information can be obtained by using the Doppler effect, but producing a two-dimensional Doppler map requires scanning: speckle imaging provides the same information without the need to scan. This paper reviews the development of laser speckle imaging, starting with the connection established between speckle fluctuations and movement in the nineteen-seventies. In the eighties, a photographic technique for monitoring retinal blood flow was developed, and ten years later a digital version was used to monitor capillary blood flow in the skin. Today, many groups around the world are either using or researching the technique, and the paper will close by presenting some of their recent results.



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