Long-distance optical fiber collimation system for Doppler vibrometer

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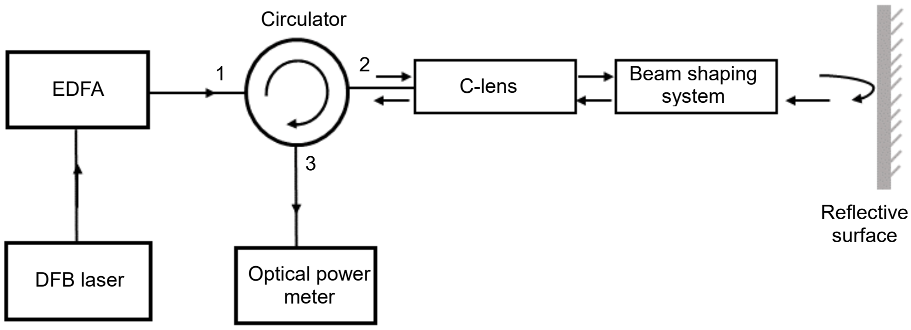

Coupling efficiency test scheme

Overview: When an optical Doppler vibrometer with the C-lens or G-lens collimator is used in the long-distance non-contact measurement, there exists problems like weak signal, messy waveform at zero-point and difficulty of demodulation. The rear end of G-lens fiber collimator is plane. The refractive index of the lens along the gradient changes, and the focal length can be achieved by changing the length of the lens. Generally speaking, 0.23 cycle length is used to achieve the collimation effect. The C-lens collimator for our own research and development, with good long-distance performance and low cost, uses a constant refractive index of the thick lens. The rear end of the spherical surface of the front bevel 8°. In order to solve these problems, a new configuration type of collimation system is obtained by adding a beam shaping system at the end of a small C-lens fiber collimator and optimizing the Gaussian beam with ZEMAX software. The 1550 nm invisible laser beam emitted by the fiber collimator is collimated and optimized through the beam shaping system, and irradiate on the surface of the vibrating object at a distance of 2 m. The beam reflected by the vibrating object is coupled back to the C-lens collimator through the beam shaping system to achieve a return light signal with high coupling efficiency.

The experimental setup is built for the designed collimation system as shown in the figure. At first, the beam emitted by the DFB laser is amplified by the EDFA. The use of the optical circulator effectively enables the return light to be output from the 3-port, which introduces a small amount of insertion loss compared to the conventional 3 dB coupler, thereby significant improvement of the utilization of the light power is emitted by the light source. Then passing through the C-lens collimator and the beam shaping system and incident perpendicularly onto the surface of the objectThe beam is finally reflected by the surface of the object and returned to the system and outputted through the circulator port 3. Lastly, the optical power of the output light can be measured by optical power meter.

The experimental results provide a reference for improving the contrast of the Doppler interference signals obtained by long-distance non-contact measurement of vibrating objects. The results show that the system can meet the working distance of 2 m and the space coupling efficiency of the return optical transmission reaches 6.3%, it greatly reduce the subsequent data processing work of vibration measurement experiment.

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