Flat-top beam shaping with increased depth of focus

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Beam shaping technology for shaping Gaussian beams into flat-top beams has been applied in materials processing and medical fields. There are various methods to shape the flat-top beam, such as using an aspherical optical system and a diffractive optical system. The method of displaying a computer-generated hologram (CGH) on a spatial light modulator (SLM) enables a high degree of freedom in beam shaping with high diffraction efficiency. The issue of the generated flat-top beam is its short depth of focus. In general, after the flat-top beam propagates over a long distance, the intensity distribution is distorted and deviates from a flat-top beam. The short depth of focus is due to the non-flat phase of the flat-top beam. Therefore, in order to increase the depth of focus, the phase distribution of the flat-top beam should be flat.

In this paper, we demonstrated the flat-top beam shaping with increased depth of focus using two SLMs. The CGH displayed on the first SLM shaped the Gaussian beam into the flat-top beam. The CGH was calculated using the weighting iterative Fourier transform algorithm [3]. The CGH displayed on the second SLM flattened phase of the generated flat-top beam. The CGH was equivalent to the phase conjugate of the flat-top beam generated by the first SLM. To validate the effectiveness of our proposed method, we implemented the method in simulation. Figure 1(a) shows the conventional flat-top beam with the short depth of focus. Figure 1(b) shows the improved flat-top beam with the long depth of focus.
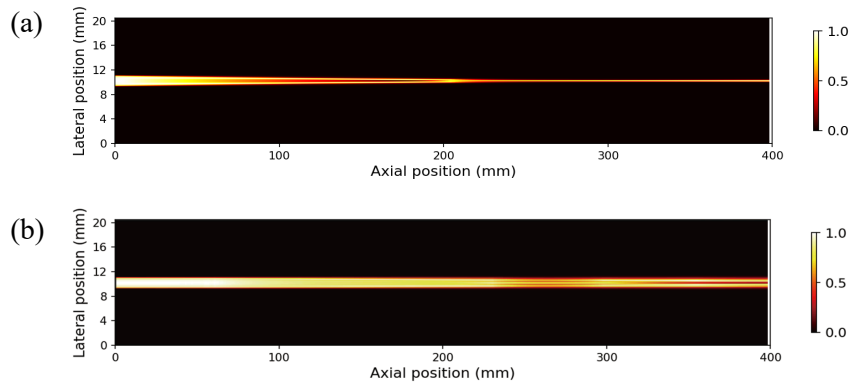

Fig. 1 (a) Conventional flat-top beam with the short depth of focus. (b) Improved flat-top beam with the long depth of focus.

Short biography:

Kasumi Kawasaki was born in Kitakami City, Iwate Prefecture on March15, 2002. After graduating from Iwate Prefectural Kurosawajiri Kita High School, she entered Utsunomiya University. She currently belongs to the Hasegawa laboratory. Her research fields are laser material processing using computer-generated holography.