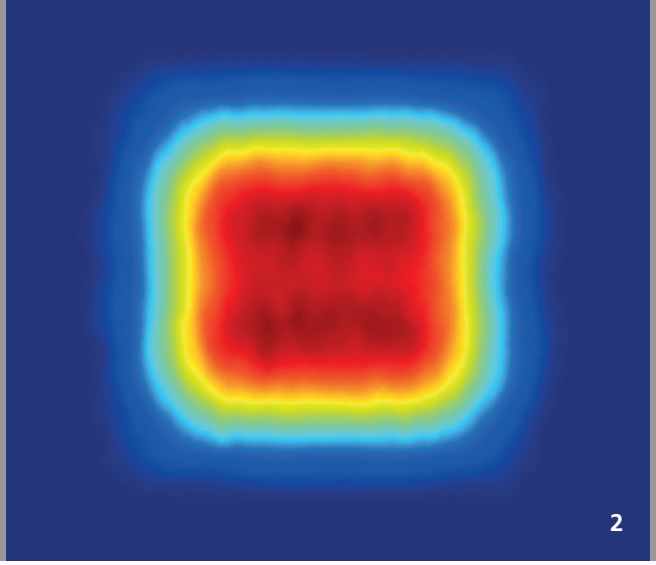

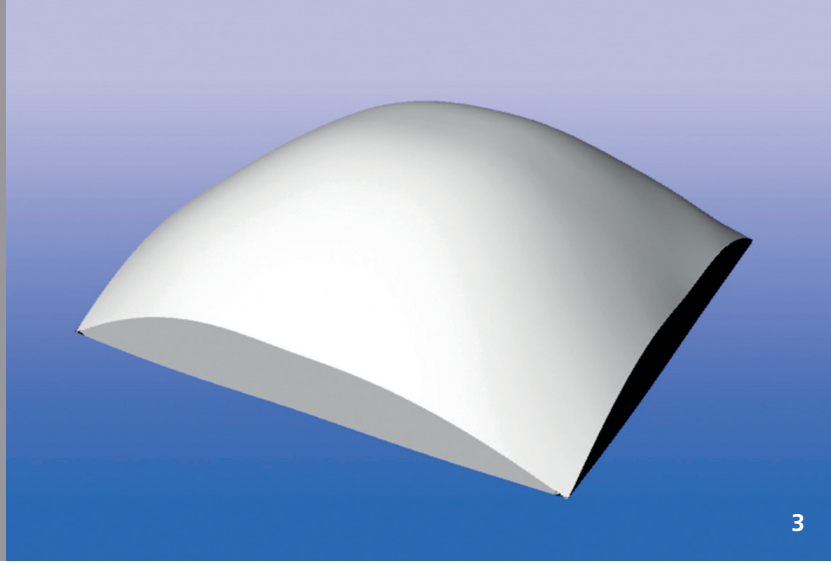

DESIGN OF FREE-FORM OPTICS FOR EXTENDED LIGHT SOURCES

Task

Thanks to free-form optics, adapted illuminance distributions can be generated for various applications. For this purpose, the optical surfaces are described by a multitude of degrees of freedom and their parameters adapted specifically and correspondingly. While methods for designing free-form optics for idealized light sources such as point sources or collimated radiation are state of the art, transmission to real light sources still presents a current challenge.

Method

To design free-form optics for real light sources, Fraunhofer ILT has implemented a design algorithm based on a description of the free-form optics by polynomials defined piece by piece (splines). This algorithm is combined with a quick calculation of the resulting illuminance distribution and a mathematical optimization. The program developed by Fraunhofer can be run on a conventional PC.

Results

For various applications, optical surfaces have been calculated in the form of lenses or mirrors, whereby different light sources such as LEDs or diode lasers can be assumed. In particular, configurations have been generated in which the idealization of a point source or of collimated radiation is no longer sufficient to describe the input radiation. The illuminance distributions thus obtained are significantly closer to the specifications than in the case of a calculation with previous design algorithms.

Applications

The implemented method can be used in various applications of lighting technology, e.g., in automotive lighting or architecture. In addition, one focus of current work is using freeform optics for application-adapted beam shaping in laser material processing.

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2 Top-hat intensity distribution simulated with a freeform optic for a divergent diode laser beam.

3 Freeform optic design for general lighting with LEDs.