



- 1 *Beam shaping of a green LED source by means of a freeform mirror.*
- 2 *Freeform lenses for Lambertian light sources together with sub-elements.*
- 3 *Freeforms in optical systems (top: telecentric spot generator bottom: cross-line generation).*

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## FREEFORM OPTICS FOR INCOHERENT BEAM SHAPING

### Background

Arbitrary light distributions can be obtained by means of freeform optical elements. The beam shaping is caused by reflective or refractive light redistribution and, therefore, can be used with incoherent light sources (e.g. LEDs) as well as with lasers.

### Design

The profile of the optical element is decomposed into a huge set of primitive sub-elements (Cartesian Ovals) according to the beam shaping task. The resulting profile consists of a basis structure (deflection / focusing) and a fine structure (generation of intensity distribution). Special automatic design algorithms ensure a continuous element profile without shadowing.

### Manufacturing

Single point diamond turning together with Fast-Tool-Servo (FTS) can be applied for the simultaneous manufacturing of basis and fine structures. On- or off-axis spherical and aspherical surfaces are used as a basis. The perfect synchronisation of all the machining motions and the proper selection of the cutting regimes ensure an appropriate precision and quality of the resulting elements. Directly turned surfaces may serve as replication tools for moulding and embossing techniques.

### Applications

High-demanding illumination systems for:

- Signage
- Sensors and security applications
- Lighting design