



## DESIGNING FREE-FORM OPTICS FOR PARTIALLY COHERENT LASER RADIATION

### Task

Free-form optics make it possible to shape beams flexibly so that adapted intensity distributions can be generated. For laser beam sources, however, the methods for designing free-form optics have been limited to either completely coherent or completely incoherent sources. Since laser beam sources often behave partially coherent, the methods need to be adapted.

### Method

In order to consider the partial coherence of radiation, the Chair for Technology of Optical Systems (TOS) at RWTH Aachen University has implemented an alternative definition for radiance, a definition that transfers the wave character and the coherence properties of light into a ray tracing model. By implementing this, TOS can modify the designing algorithms for incoherent radiation already existing at the institute to consider sources with arbitrary coherence properties.

### Results

Since the algorithm has been continuously developed, it is now possible to design and build free-form optics for various applications. In particular, the target intensity distribution and the laser beam source can be freely specified. The efficient implementation via ray tracing also minimizes the computation needed. Furthermore, the coherence properties changed during transmission by optical elements can be calculated.

### Applications

The method implemented here can be used to dimension free-form optics for application-adapted beam shaping in laser material processing. Further potential can be found by analyzing the transformation behavior of the coherence properties of arbitrary sources after they pass through optical elements.

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- 2 Irradiance distribution simulated with free-form optics for a partially coherent laser beam source.
- 3 Calculated surface for generating illuminance distribution.