



## RECONSTRUCTION OF PHASE DISTRIBUTION BASED ON INTENSITY PROFILE MEASUREMENTS

### Task

When a laser beam is designed specifically for a particular laser application, the distribution of intensity laterally to the beam axis is a design factor used to satisfy the quality criteria required by the application. To form a given laser beam in such a way that it has a desired intensity distribution during its propagation, one needs to understand the intensity and phase distribution of the beam. In contrast to measuring the intensity distribution, measuring the phase cannot be done so simply. Therefore, the measurement of the phases is replaced by their reconstruction, which is based on measurements of the intensity distribution at several positions in the beam.

### Method

Fraunhofer ILT has implemented and applied a numerical algorithm that reads the intensity measurements from commercially available beam-measuring instruments to determine the beam profile and reconstructs the phase fronts of the measured laser beam. For this purpose, according to Gerchberg and Saxton, one of the measured intensity distributions and a suitably chosen phase front are used as starting

distributions. The free propagation of the radiation is then calculated with this information and the phase front then is reconstructed in an iterative process through the forward and backward propagation between the measurement planes.

### Result

The iterative process shall be continued until the calculated and measured intensity distributions agree with each other. The phase distribution, with which that agreement is obtained, then corresponds to the phase distribution actually present in the beam, thus completing the reconstruction.

### Applications

The method can be applied to tasks in which shaping the intensity profile is used to dimension a laser beam for a specific application. Common examples of such applications are – as in the EU-funded project »HALO« – laser cutting of, for example, glass or metal and laser-based medical applications.

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- 1 Measured distribution of intensity.
- 2 Reconstructed distribution of intensity.
- 3 Reconstructed phase surfaces.