Active Beam Shaping using Sequential Deformable Mirrors

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Technology description

Invention novelty: The current invention is a method and device to shape a beam of light, with a broad range of applications to improve optical resolution and image quality.
Value Proposition: Current telescopes and optical arrays suffer from limited resolution and observational discontinuities. The problem of active beam shaping is addressed with two Deformable Mirrors. It makes calculations very realistic and solutions feasible using existing hardware. The predominant telescope design, both of current and future telescopes, entails minimally a two mirror design. The primary mirror collects large quantities of light and reflects the image to a secondary mirror. The secondary mirror then relays the image to an eye piece or other equipment. The secondary mirror, which is located above the primary mirror, requires struts to support it. These struts generate aperture discontinuities: there are portions of the collected image that are blocked out by the struts. In addition to the discontinuities, light is refracted and/or reflected around the blocking objects which further distort the image. The net sum of these effects is that the resolution of the telescope or imaging device is limited. The invention involves use two deformable mirrors to reshape the light beams and largely remove the effects of the aperture discontinuity.
Technical Details: Johns Hopkins researchers have developed an approach using two sequential Deformable Mirrors to shape the amplitude of a beam of light. It uses a modal solver that describes the optical surfaces by a finite number of eigenfunctions with realistic curvatures and stroke. This technique is applied compensate for the large amplitude excursions in astronomical telescope aperture due to secondary support structures and/or segment gaps. The highly non-linear Monge-Ampere equation, the fundamental equation describing the physics of phase induced amplitude modulation, is solved. The optimum configuration for our two sequential Deformable Mirror system is determined, and it is shown that high-throughput and high contrast solutions can be achieved with on-axis and/or segmented telescopes, using realistic surface deformations that are accessible using existing technologies. The technology is applicable to any situation where beam shaping could be useful, including but not limited to fiber optics, telecommunications, and defense applications.
Categories: Optics
Keywords: beam shaping, telescope, light, particle duality, mirrors, lens, optics

Advantages

- High-throughput and high contrast possible
- Can be used in any situation where light needs to be controlled
- Beam-shaping solutions are achievable through existing technologies

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