Can You Imagine . . .

. . . a deformable mirror that can help astronomers obtain Hubble Space Telescope–quality imaging with a ground-based telescope.

ADAPTIVE OPTICS BRING SHARPER IMAGES TO ASTRONOMY AND MEDICINE

XINETICS' TECHNOLOGY WON A *PHOTONICS SPECTRA* CIRCLE OF EXCELLENCE AWARD AS ONE OF THE 25 MOST INNOVATIVE PRODUCTS IN 1995.

The atmosphere's turbulent mix of hot and cold air distorts starlight, making it difficult for astronomers to see faint stars through telescopes on earth. Finding a way to compensate for turbulence effects has been a top priority for many in the astronomical community.

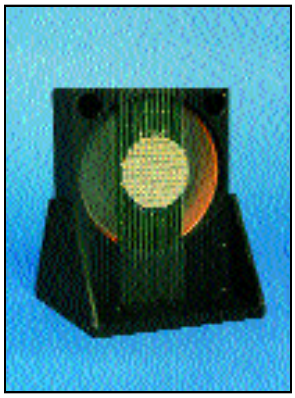
Xinetics, Inc. (Littleton, MA), developed adaptive optics (AO) technology that can help ground-based telescopes probe the mysteries of the universe with 20/20 vision. This technology is based on a deformable mirror system that, with additional AO components, performs real-time compensation for distortions in the optical path. It achieves this compensation through a series of actuators that deform the mirror into different shapes. In 1995, Xinetics' technology won a *Photonics Spectra* Circle of Excellence Award as one of the 25 most innovative products of the year.

AO technology is particularly attractive to astronomers trying to obtain Hubble Space Telescope–quality images with a ground-based telescope. For example, Xinetics' 37-actuator deformable mirror maintained its optical figure (flatness) at 0°C on the mountaintop site of the Keck Observatory in Hawaii. A 349-actuator mirror is also in development for Keck. Under a Hughes Danbury Optical Systems subcontract, Xinetics has built a 941-actuator mirror for the U.S. Air Force's Starfire Optical Range, and is building a similar mirror for the Advanced Electro-Optical System observatory, also located on Mount Haleakula, Hawaii.

In addition to astronomical telescopes, Xinetics uses its AO technology to enhance the image quality of medical and photonics equipment. For example, the company teamed with researchers at the University of Rochester to improve the resolution of a retinal camera. The camera, which analyzes laser light reflected out of the eye, could help the researchers better understand the biological causes of macular degeneration and retinitis pigmentosa, two common eye diseases that can lead to blindness. Researchers integrated a Xinetics' mirror into the AO system, which corrects light distortions coming from the eye.

In another collaboration, Xinetics is developing a distortion-control device for laser film recorders to improve high accuracy scanning, clearing up aberrations from thermal effects. The company expects this teaming effort to produce filmless x-ray technology for medical uses. Working with a leading producer of industrial bar-code scanners, Xinetics is also building an optical corrector that allows scanners to read any size bar code on both small and large packages.

BMDO's ground-based laser program required advanced optics to view space objects clearly and funded much of Xinetics' AO technology to meet this need. Recently, Xinetics has been supported by two new BMDO SBIR Phase I contracts: one for developing a monolithic multilayer actuator module, and the other for developing an adaptive pumping technology for laser mirrors.



■ Xinetics' deformable mirror, pictured above, performs real-time compensation for distortions in the optical path.

ABOUT THE TECHNOLOGY

Key elements of Xinetics' AO technology—piezoelectric or electrostrictive actuators made with lead magnesium niobate (PMN) crystals—expand and contract during application of an electric field, pushing and pulling the mirror into different shapes. Historically used as the preferred piezoelectric material, lead zirconate titanate (PZT) exhibits large hysteresis (cyclical energy lost because the process is not totally reversible), creep, and aging effects. PMN, originally developed at Pennsylvania State University in the late 1970s, overcomes the deficiencies of PZT, making it attractive for adaptive mirrors because of its high stiffness, negligible hysteresis, and excellent stability.