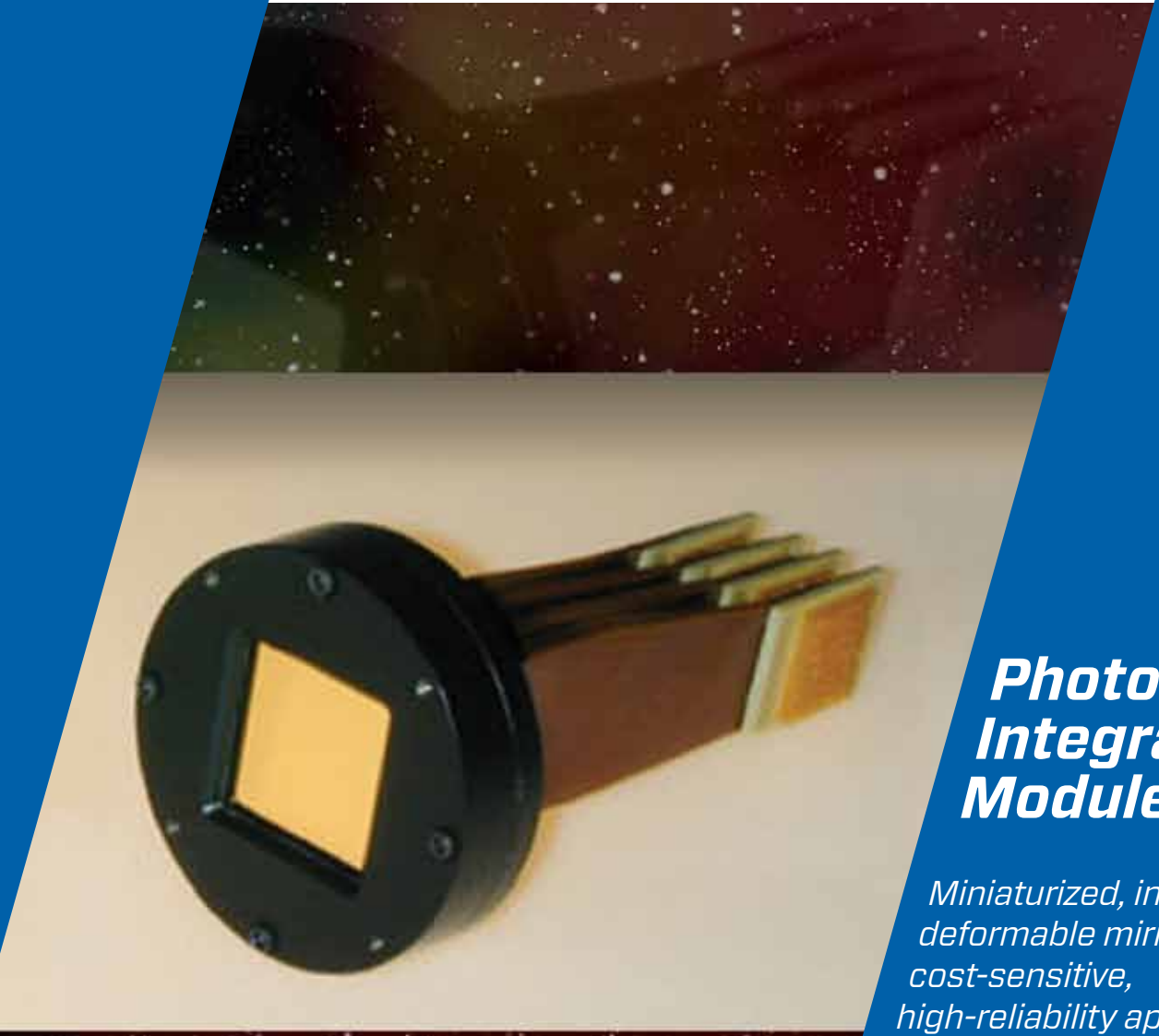

Photonex Integrated Modules

Miniaturized, integrated deformable mirrors for cost-sensitive, high-reliability applications

NORTHROP GRUMMAN

Photonex Integrated Modules

Precision actuators and proven, simple designs are the critical elements in making highly reliable deformable mirrors. The Northrop Grumman AOA Xinetics Photonex Module offers a high density deformable mirror for applications in which volume, weight and/or size are critical.

The AOA Xinetics Photonex Module presents a more scalable, reliable wavefront correction product that improves mirror reliability, increases actuator density, and reduces cost.

Performance Breakthrough

The major problems in making highly reliable deformable mirrors are the structural interface and the electrical connection.

Using three-dimensional ceramic processing, a monolithic block is formed that contains an integrated actuator array. With its built-in electrical interface, the modular array resolves the greatest limitation to channel scaling and actuator density – the electrical interconnects.

By incorporating microcircuit technology, interconnection to individual actuators is done without labor-intensive discrete processing. Eliminating discrete actuator wiring increases the actuator fill factor, improves optical quality and enhances actuator reliability.

A discrete actuator contains 120 individual parallel plates, which must be contacted via a silver filled conductive stripe. This adhesive is prone to migration and oxidation that resists current flow over time. The solution to the structural and the electrical problems is the transverse array module.

Transverse Array Module

With this module, the actuator force train runs through the bulk ceramic. Tests have shown that delamination in the conventional array limits function and degrades optical quality, but structural or electrical integrity was not compromised in the transverse array.

Electrically, a transverse actuator requires only 11 connections, an order of magnitude reduction compared to the conventional array. The transverse array features electrical connections integral to the block.

In the transverse module, actuator electrodes are connected at the top to form a common ground plane. Internal electrodes are routed through the ceramic to facilitate interface at the back of the module, which eliminates discrete wiring, reduces labor cost and increases packing density.

Standard Module Sizes

AOA Xinetics offers modular building blocks with 1 and 2.5 mm actuator spacing. Joining modules to create much larger form factors enables large-scale mirrors with thousands of actuators. Using a continuous facesheet retains optical quality and dimensional stability.

Tests have been conducted on 1,024 channel modules having 1 mm-spaced actuators arranged in a 32 x 32 array. The mirror was powered using 50 volts.

While held in the powered condition for a period of several months, the dimensional change was measured to be less than $\lambda/1000$ rms ($\lambda = 0.63\ \mu m$). The influence function was measured to be less than 10%. The average capacitance for each actuator was 30 nf while the average stroke was 500 nm.

Photonex Model	Channels	Array	Spacing	Stroke	Coupling	Aperture
PH02.5S3-37	49	7 x 7	2.5 mm	2.5 μm	10%	17 mm
PH02.5S3-164	196	14 x 14	2.5 mm	2.5 μm	10%	35 mm
PH02.5S3-349	441	21 x 21	2.5 mm	2.5 μm	10%	52 mm
PH091.8S2-97	121	11 x 11	1.8 mm	1.8 μm	10%	20 mm
PH01.8S2-349	484	22 x 22	1.8 mm	1.8 μm	10%	40 mm
PH01S1-1024	1024	32 x 32	1.0 mm	0.5 μm	10%	32 mm
PH01S1-4096	4096	64 x 64	1.0 mm	0.5 μm	10%	64 mm

Photonex Deformable Mirror Product Options

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