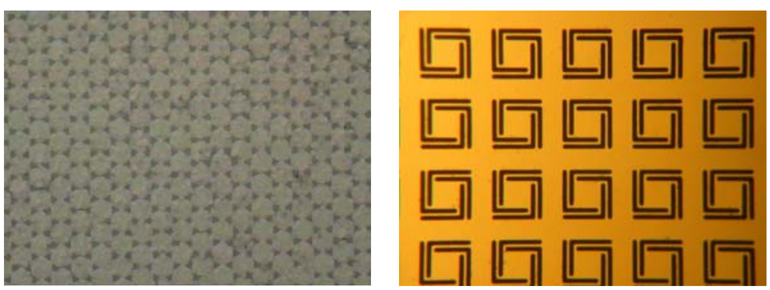
Adaptive Optics (AO) is a technology for correcting captured images from an optical system in which optical wavefront imperfections are compensated to produce good quality images. In many applications such as astronomy, object acquisition, satellite imaging, laser communication and medical imaging, this technique has been introduced to restore the image from distortions introduced by the medium between the object and its image.

Deformable mirror spatial light modulators such as conventional deformable mirrors[1] and smart pixel deformable mirrors[2] are the key enabling components of adaptive optics systems for distorted wavefront correction. Conventional deformable mirrors are bulky and they can only correct the distorted phase information. They are passive to noise and their response time is limited to msec. Smart pixel deformable mirrors require electronic circuitry under each pixel, which limits the achievable device resolution.

To overcome the electronic control's bottle neck, all optically addressed deformable mirror Micro-Electro-Mechanical-System (MEMS) devices with Dynamic Range Compression capability has been proposed, designed, fabricated, and modeled. The architecture and analysis of these devices for the implementation of the first Nonlinear Dynamic Range Compression Deconvolution for adaptive optics systems also has been demonstrated [3, 4, 5].

In contrast to the conventional and smart pixel deformable mirrors, the proposed technology is capable of reducing noise and correcting the distorted images from all forms of distortions in μsec scale and also allow much higher pixel density; hence improvement in the image fidelity after processing.

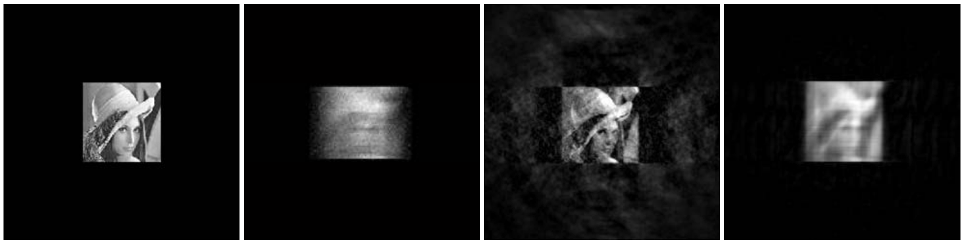
Figure 1 shows 100μm pixel size MEMS deformable mirror devices (a) Honeycomb Tangent Circles with Mylar membrane mirrors and (b) Spring patterned squares with Silicon-Nitride membrane mirrors.



(a) (b)

Figure 1

Figure 2 shows simulation results demonstrating that the Dynamic Range Compression Deconvolution outperforms the optimal Minimum Mean Square Error deconvolution (Wiener filter)[6]. Where (a) is the original image, (b) is the noisy motion distorted image with SNR=1, (c) is the corrected image using the MEMS Dynamic Range Compression Deconvolution device and (d) is the corrected image using the optimal Minimum Mean Square Error (Wiener) filter[7].



(a) (b) (c) (d)

Figure 2

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