PROGRAMMABLE IMAGING WITH MOEMS
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**OBJECTIVE**

Using Programmable Imaging we can selectively sample an object plane, by utilizing a state of the art MOEMS (Micro Optical Electro Mechanical Systems) mirror device. This approach will result in increasing the FOV and the resolution our imaging system and mirror device. This approach will result in increasing MOEMS (Micro Optical Electro Mechanical Systems) sample an object plane, by utilizing a state of the art Using Programmable Imaging we can selectively over the years to increase the information received

**INTRODUCTION**

Hundreds of imaging methods have been developed over the years to increase the information received from an image.

- Mechanical Systems - Image Mosaicing
- Lenses & Mirrors - Curved Mirrors
- Image Mosaicing

Advantages
- Increases' image resolution and FOV.
- Slow acquisition process.

Disadvantages
- Curved Lenses & Mirrors produce very wide FOV images.
- Introduce curvilinear distortions.
- Non-uniform pixel distribution.

**PROPOSED METHOD**

- Tilting a flat mirror along a given ray, maps the ray from a point on the object plane to a corresponding one the image plane.
- A given correspondence between the pixels in an image plane and a collection of point on object plane can be achieved.
- Correspondences can be created for every tilt of the mirror.

- Introduce into the optics of the system a MOEM mirror device.
- The Micro-mirror will scan the entire object plane.
- Its states are highly repeatable.

Advantages
- Increases' resolution compared to the native. Camera used to capture images.
- Increase the FOV of the captured image.

**EXPERIMENTAL PROCEDURE & RESULTS**

- The Camera was focused on object plane through the a micro-mirror.
- System scan the object plane using a linear voltage table.
- For each mirror state:
  - Extract one pixel.
  - Place pixel into image plane based on mirror voltage.
- 25,600 (16x160) states of a single micro-mirror results in a 25.6K Pixels image.
- Distortions related to projection.
- Distortions related to MOEMS system behavior
  - MOEMS have a non-linear relationship between voltage vs. tilt.

- Developing a system calibration algorithm we can produce a non-linear voltage scanning profile for the micro-mirror device.
- The new scanning profile will result in capturing rectified sampled image.
- Each point in the rectified image is sampled data and NOT a point generated from software interpolation.
- Only have to characterize the system once.

**EXPERIMENTAL SETUP**

- The Experiments were performed with a Sony Camera interfaced with MATLAB for pixel correspondence computation.
- The MOEM Device used was Lucents' Wavestar Lambdarouter
  - It is a 16x16 micro-mirror array.
  - Each Mirror has diameter 650um and 18 degrees of tilt on each axis.
  - Each mirror can be controlled individually and can be controlled easily within 50mdeg resolution.
  - Each mirror can take over 100,000 discrete states.
- The object plane was composed of a checkerboard with checkers of size 5mm, 0.5mm and 0.25mm.
- The MOEM Device was placed at an angle of ~20 degrees with respect to the object plane.

**FUTURE WORK**

- Introduce external optics into the imaging system of a single MOEM mirror.
  - Increase FOV & Resolution
- Imaging with MOEMS Arrays
  - Faster image acquisition
  - Larger Field of view images
  - Multi-perspective imaging

**CONCLUSION**

We have introduced a new approach in Digital Imaging by using MOEMS-Programmable Imaging.

- Samples an object plane in a dynamic fashion that controls FOV and Resolution.
- Controls the number of samples to be captured.
- Compensates for system distortions caused by lenses, projection and image sensor in real time.

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