**Motivation**
- Requirement for grazing-incidence x-ray shell optics with angular resolution of < 5 arcsec HPD.
  - Typical mirror shells fabricated to date at MSFC have HPDs in 13-15 arcsec range.
  - Achievable resolution depends on the quality of the mandrels from which the mirror shells are replicated.
  - Mid spatial-frequency range errors on the mandrel surface are currently limiting the quality of the mandrel.
- Therefore, deterministic and localised polishing of the mandrel is desirable.

**Simulation studies on cylindrical polishing process**
- Establishing a relationship between the polishing process parameters and the generation of mid spatial-frequency error
- Optimization of the process (speeds, stroke, etc.) to keep the residual mid spatial-frequency error to a minimum.
- Consideration of the polishing lap design to optimize the process in order to keep residual errors to a minimum.

**Cylindrical polishing**

**Cylindrical mandrel**

- Mandrel is desirable
- Therefore, deterministic and localised polishing of the mandrel is desirable

**Simulation Studies**

**Performance evaluation**

**Effects of Influence function**
- Three different Gaussian shaped influence functions
- Different material removal capacity

**Asymmetric Influence function**
- Edge dependent influence function
- Different influence in forward and backward stroke direction

**Status of the experiment**

**Salient features of the polishing machine**
- Accommodates specimen of length from 12 to 30 inches with diameter ranging from 1.5 to 12 inches.
- In order to keep uniform pressure distribution on the optical surface, a floating lap is used.
- Applied pressure on the lap can be varied by the addition of weights.
- Cog-free linear motor is employed to avoid vibration during polishing stroke.
- Linear scale feedback system with 10µm feedback resolution.
- Straightness of 2.5 µm in axial motion.

**Conclusions**
- Ability to simulate the polishing process is an important contribution to extend automation further and thus increase cost effectiveness.
- It is expected that the study will help us bring the angular resolution of the final electroformed shell optics close to the 5 arcsec HPD goal.

**Literature**