Photo-Printing Foldable Sheets for Origami Engineering

Overview
Our team was tasked with improving the set-up of the Magneto Active Composites and Structures (MACS) lab’s current photo-curing system. The current method of producing magneto-active materials involved shining a projector light from a fixed distance to a cardboard box which houses the stage for curing the polymer sample. While that set-up worked, the lab was seeking a more concrete design that would allow the adjustment of several dimensions and the reproducibility of photo-curing results that would accompany a more robust set-up.

Objectives
Our team’s objectives consisted of:
- Light source motion must be able to move a specific distance from the main structure
- Designing the platform vertical motion to be within at least 1% Translational length
- Designing the platform rotation to be within 1 degree of desired resolution
- Designing the mirror rotation to be within 1 degree of desired resolution
- Obtaining box material that increases visibility of the system’s inner components

Approach
- Customer needs were gathered when the team met with the sponsor to view the current prototype and gather information on desired specifications and design needs
- Concept generation was done both individually and as a group. Each member of the group was tasked with proposing a concept to the group. From there, a concept selection table was made to gage how well each drawn up design exhibits an improvement in comparison to the original set-up in each of the categories from our Needs-Metrics Matrix.
- After reviewing relevant patents and analyzing existing processes, it was determined that copyright or patent infringement is unlikely to be an issue since few of the current processes are aimed towards MAE materials and none are using the same curing methods
- Isometric view CAD designs were created to show the specifications of the design options and from those CAD designs, a prototype was fabricated
- The team followed an outlined testing plan to test the functionality of each component, to ensure that it works as it is intended to. The steps were then repeated in a different direction to check for hysteresis and the results were conclusively similar.
- Based on the testing performed, improvements were made to the prototype
- The final prototype was able to exhibit the desired motions and fulfill the customer specifications

Outcomes
- A more transparent, robust overall set-up
- Manually-driven horizontal motion from the light source
- Stepper motor-driven platform rotation and vertical motion of the curing platform
- Free rotation of the mirror rotation
- Each of the outcomes contributes to either light exposure, accuracy, and/or the overall functionality of the system as specified by the sponsor