Kwabena Arthur

Mechanical Engineering Portfolio

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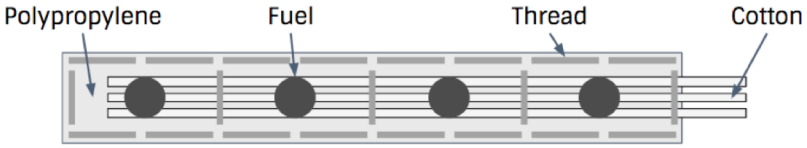
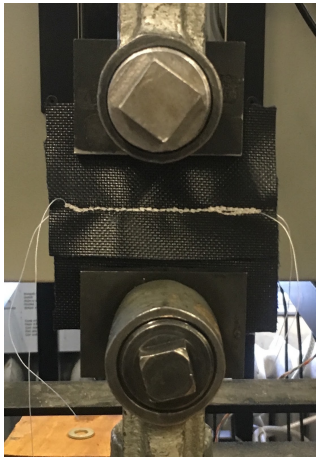
EPP - The Engineering Systems Design class is an opportunity for students to create real systems as required by sponsors. Partially sponsored by MIT Lincoln Labs, my team continued previous work of creating a portable power system. We were able to design and test solutions to the current system and a working prototype will hopefully be created by the end of spring of 2017.





Previous Model

Improved Design

The system is developed around aluminum fuel which is more energy dense than any current energy storage system (at this scale). I worked with the reaction regulation team and we devised a new method of regulation by utilizing the wicking action of materials.

Reflections

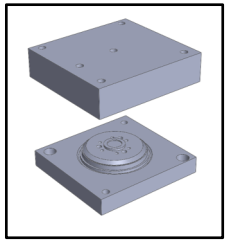
- Rapid prototyping and experimentation were instrumental for this project
- Fully understanding and design requirements is invaluable

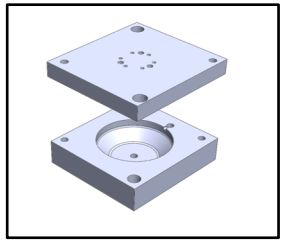
Skills Learned

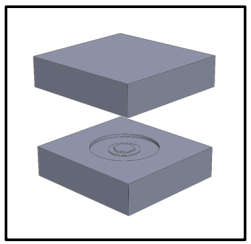
- Communication and presentation skills
- Team communication skills
- Systems design
- Communication with sponsors

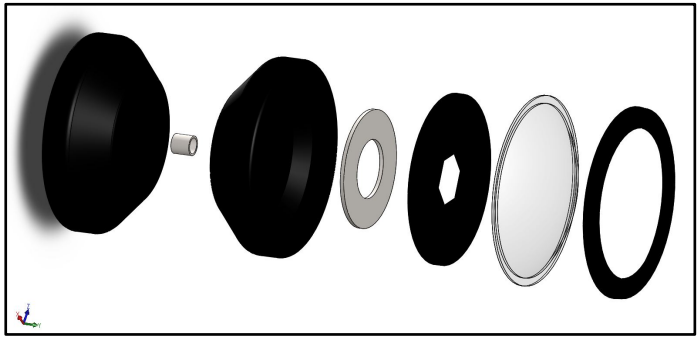
Flash! Yo-yo In Design and Manufacturing II, we studied different methods of manufacturing, and the considerations made for successful and efficient production. My group design and made 50 camera-inspired yoyo's. We utilized multiple manufacturing methods including CNC milling, lathe-work, thermoforming, and injection molding.

I was specifically charged with manufacturing the lens and lens cap. I created the molds for both in Solidworks, and using CAM software, generated the g-code to machine the molds out of aluminum blocks on CNC mills and lathes. The designs had to take into account snap-fit tolerances and estimated material shrinkages.

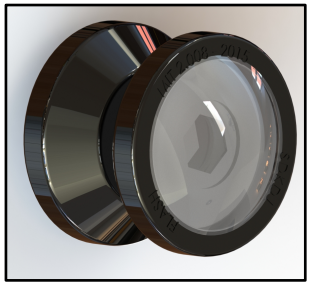


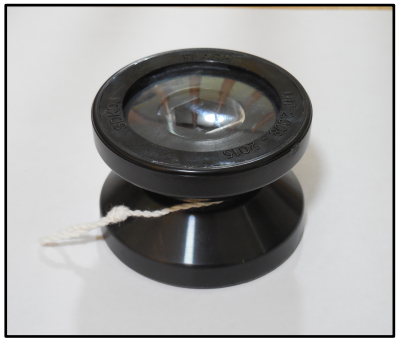






- We optimized the weight and distribution – our yoyo was the fastest spinner in the class history.
- Using CAM software, I design and created the molds and blanks.





Final Part

Reflections

- Design for manufacturing and assembly.

Skills Improved

- Group CAD Integration
- CNC programming
- Design for Manufacturing
- Thermoforming
- Injection Molding

Next Big Thing.

In my first year at MIT, a new student group was initiated in my dorm. They built a small swing in the courtyard. The next semester, we decided to up the ante and build zip-line that stretched across the courtyard. I joined the group then and worked on all the subsequent projects: slide (slipper), a larger swing(dipper) and zip-line (zipper). In the final semester of my junior year, I had the honor of designing and leading the construction of a 16 ft. see-saw (tipper).

I learnt a lot from leading Big Tipper with my co-leaders. Being the most technical of the co-leaders, I spent a lot of time with CAD-ing and regularly led construction. I managed the construction on several of days we were afforded for the project. This was my first exposure to project management in a larger scale project.

We had to interface with a lot of regulation, getting requisite permission from the City of Cambridge and MIT EHS regulations

Reflections

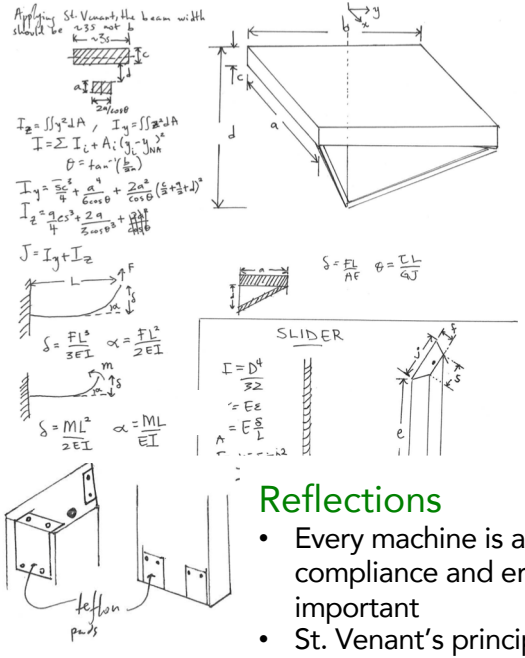
- Project scoping and time management.

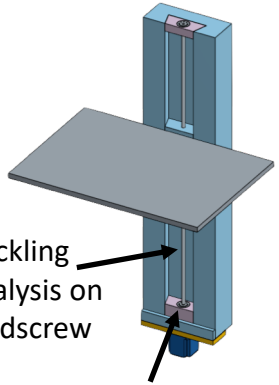
Skills Learned

- Group CAD Integration
- Wood-working skills
- Project Management and Leadership
- Project planning
- Larger-scale construction
- Interacting with city officials

Transforming Desk.

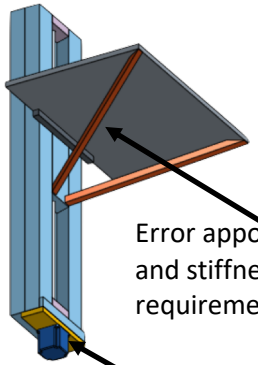
In Precision Product Design class, we were tasked with designing and building a desk that could go from a regular desk position, to a standing desk position. Throughout the class, we learned several important design elements, including kinematic couplings, fail-safes, as well as modelling the compliance and tolerances of these additional components. The final desk achieved the target end-deflection error < 2mm at twice the expected load.





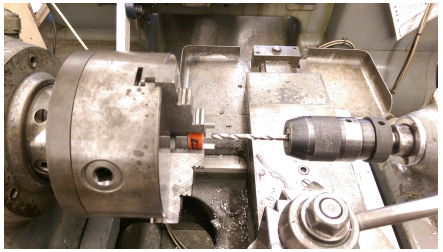
Buckling analysis on leadscrew

Preloaded dovetail carriage for rigidity & transverse preloading



Error apportionment and stiffness requirements

Motor spec'd for load requirement



Reflections

- Every machine is a precision product: compliance and error are always important
- St. Venant's principle is indispensable
- Error apportionment, compliance calculation and error propagation were instrumental in designing load bearing structures, and analyzing responses

Skills Learned

- Designing from first principles
- Error apportionment and rigidity design
- Designing to a precision requirement
- Fail-safe design
- Screw and attachment point analysis