Advanced CAD Week 5: CAD Design Close Study Part 1: Swerve Drive

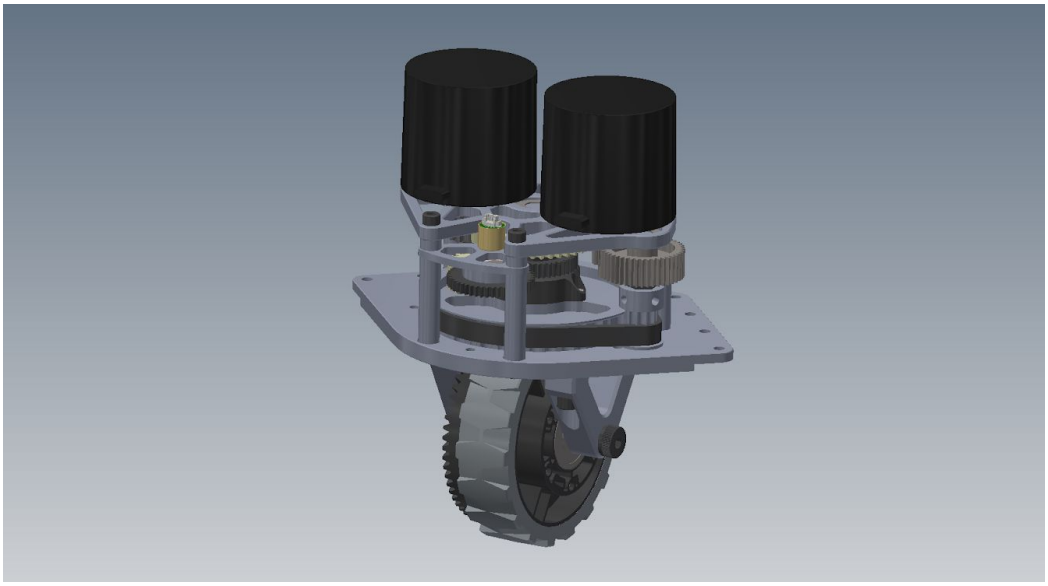
Rohawks 3419 -- Celina, Nathan, Lili -- 2019-2020

Lesson Goals

- Bring attention to subtle details that make the CAD better; for example, fillets and chamfers, threading in holes, or material specifications.
- Also highlight the greater structure of the CAD (the sidebar showing each part) - discuss how this can be done most efficiently.

Lesson Plan

- Lesson Format
  - Most of this lesson will be done on the Smartboard, where a teacher can point out different parts of the model. The other teachers will answer questions or work on other computers.
- CAD Overview & Context
  - 2019 2910's swerve drive (.x_t file - can be imported into Inventor).
  - Like our team, 2910 specializes in swerve drives.
  - 2910's matches from that year can be viewed here (you can see all the blue banners for all the regionals and championships they've won).



- Breaking Down the CAD
    - Imports: Scrolling down, the first thing to notice is the sheet number of imports — nearly all the parts in the CAD are imported, from the motors, encoders, gears, bearings, screws, and washers.
        - When you get to CADing complex subsystems like this, a lot of it isn't going to be about designing parts, but about figuring out where parts we already have fit together (assembly work!).
    - Process: When you're CADing something, you always start with the big picture of what you want to accomplish. For instance, here 2910 may have wanted to make their swerve module more lightweight, or to find an effective way to implement the NEO motors introduced in 2019.
        - Then it's onto designing the big picture overview of how that looks: what existing parts do we have to put together? What special parts do we have to CAD and machine/print? What kinds of parts do we need to hold it all together?
        - Then you move onto the CAD and model/assemble it together. There's a lot of importing/assembling. The parts you have to CAD, though, generally fall into a couple of categories:
            - Parts to be machined. These parts are generally derived from their original shape, only with a few modifications. These parts require you to have some knowledge of our inventory at the workshop/what kinds of materials are generally used. (Ex: MK2 Center Shaft V2. It's likely a shaft machined on the lathe. One other example is 8020 extrusion.)
            - Parts that hold together other parts. A lot of the custom parts you end up CADing just exist to keep together the other parts. Their shape is dependent on what they're holding together. (Ex: MK2 Main Plate (With Chamfers). It doesn't have a mechanical function, but it serves as a frame for the rest of the parts.)
            - Special custom parts. Sometimes we want a mechanism with a part that we don't have or would be better to make ourselves. When you're designing a subsystem, you figure out which parts these are. — the shape of these parts are wholly dependent on what you want to do and our machining/printing capabilities. (Ex: Likely the MK2 Main Pulley. Another example are the "apostrophes" on our 2019 hatch panel intake.)
    - Fun Details
        - Holes on the MK2 Main Plate. Remember that this is a *subsystem* — it's not isolated, it's going to be connected to a larger robot at some point.

- Fillets on the MK2 Main Plate. Sharp metal is not advised.
- Spaces in the middle of the MK2 Motor Plate (With Chamfers). Any unnecessary metal in the middle of a sheet can be cut out to save weight (which is something we always need less of). They have multiple small spaces to ensure the integrity of the metal.