V Belt and Pulley System

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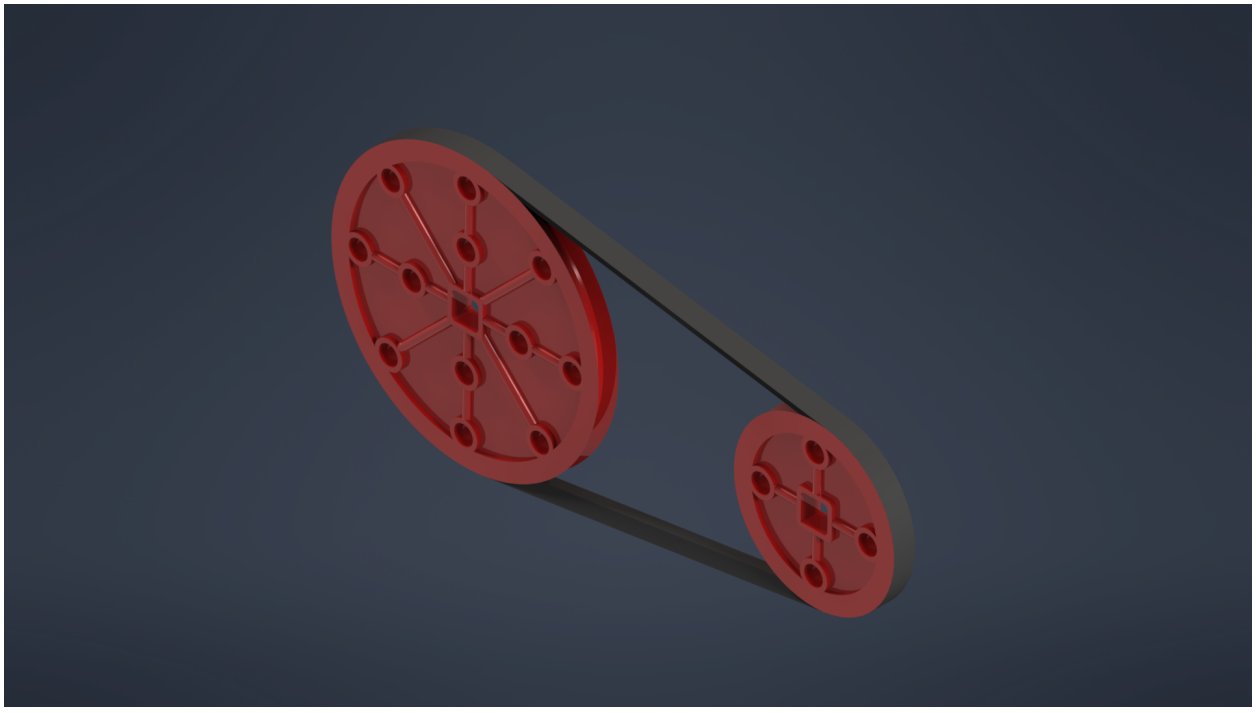

Software Version:
Autodesk Inventor Professional 2022

The problem

The problem I have identified for this project is a form of power transferral. In VEXU the usage of gears, chain and timing belts are the main methods usable to transfer power easily, however none of these systems are effective in overload situations. An example of a situation on our current robots is in the flywheel system. High amounts of inertia is experienced on the flywheel and therefore high rotational speed in the motor. A sudden stop or even backdriving of the flywheel could provide harmful voltage spikes in the motor internals and lead to damage. Current methods of avoiding this issue is ratcheting the flywheel to only transfer power in one direction although these are large and inefficient inelegant solutions. Therefore a method of power transferal with overload protection is ideal.

The Solution

A V belt is a trapezoidal profile belt as pictured in figure 1 allowing it to contact a pulley on three surfaces equally providing adequate frictional grip to transfer power. The reliance on friction rather than shear force of a timing belt means that it is designed for lower loads and capable of slipping without damage to the belt.

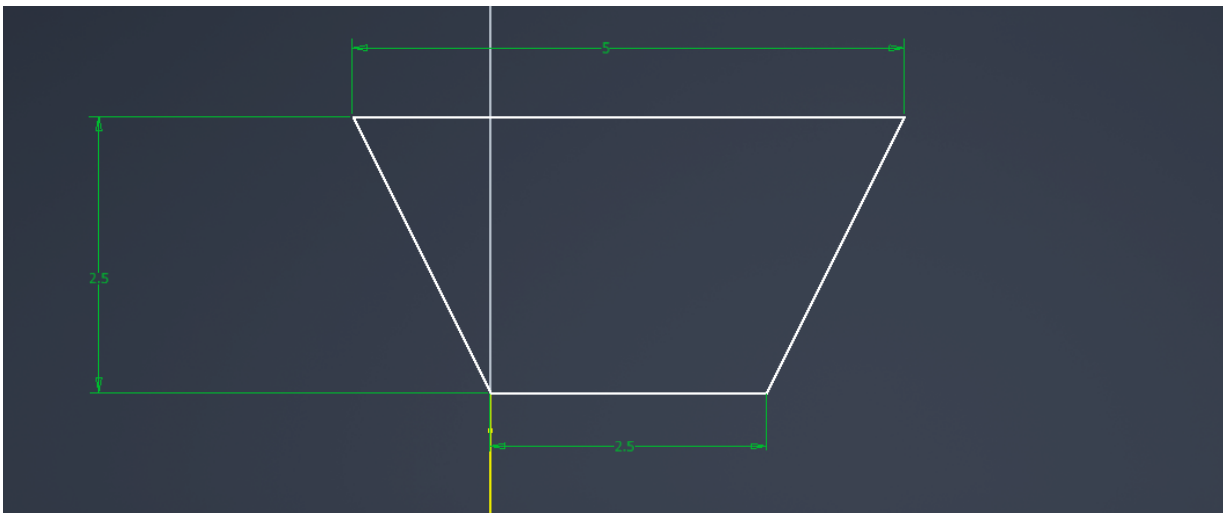

Figure 1: V Belt Trapezoidal profile

This ability to slip, along with the natural damping due to the elasticity of the belt allow for effective shock protection for delicate mechanics on the robot. Coupled with pulleys as pictured

in figure 2 would allow us to power mechanisms with this protection and no risk of breakage such as with a chain design.

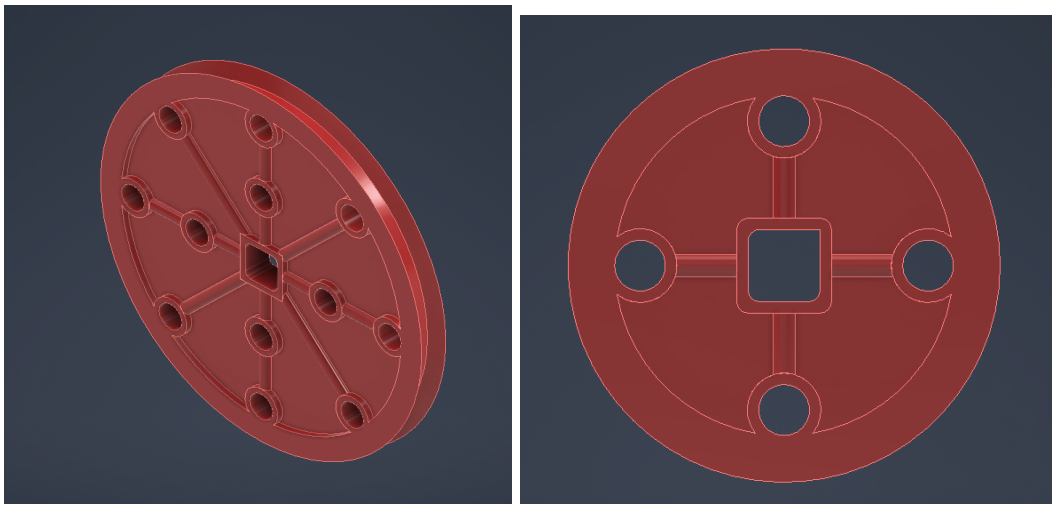

Figure 2: Potential Pulley Sizes

Features used to create the parts

Creation of the pulleys was achieved via extruding a layout sketch of the circular pattern with all holes excluded. An offset plane was created offset from this cylinder and using projected geometry a toothed wall side profile was then created and revolved around the side of the part (Figure 3)

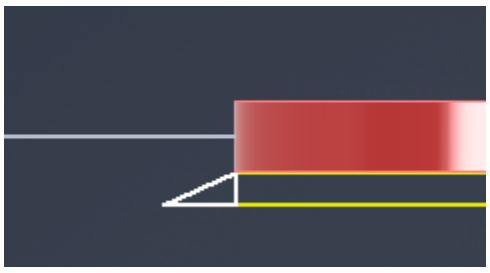

Figure 3: Revolved Tooth Profile

The cylinder inside was then extruded further to match this additional distance, I am aware this could have been done with the initial extrusion but I had decided not to redo this part of the file

at this point. I then created a sketch of the detailing on the front face of the sketch utilizing circular patterns to avoid additional sketches and then used this sketch to make an extruded cut into the part. A 1mm filet was then applied to some of the detailing to smooth sharp corners and improve the aesthetics as seen in figure 4.

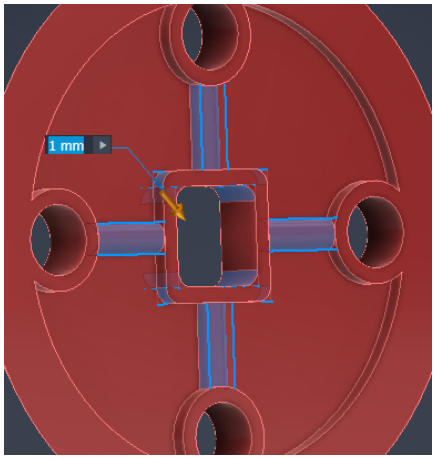

Figure 4: 1mm detail fileting

Finally the side of the model is mirrored to create the other side of the pulley.

Creation of the belt was a relatively simple task, utilizing only a few main features. The sketch was created using two arcs and two lines all connected via tangential constraints to make a shape that can be suited to the sprockets. A tooth profile sketch is created as seen in figure 1 attached to projected geometry of the belt path. The belt path sketch is intentionally left unconstrained at this point. To form the belt a sweep operation is utilized to generate a smooth solid around the path using the tooth shape. To form the belt to size the sprockets are placed into an assembly file with the belt. The belt is edited inside of the context of the assembly and the arcs are constrained by the pulley diameters creating a smooth formation around the sprockets.

Conclusion

This project allowed me to play around more with features I am less experienced with in solidworks such as editing parts in context of an assembly, sweep functions and utilizing circular patterns. These are all invaluable tools and will be useful in my final year of university along with my career as a mechatronics engineer. I have already worked as a mechanical cad technician and so know how important these skills are to have in the role of a full time design engineer. I have also learnt to restart part creation or sketches to make a tidier file rather than try and push on with a non-ideal sketch

Credits and References

All CAD was created by Jacob Church using inspiration from the vex high strength Sprocket kit: https://www.vexrobotics.com/hs-sprockets-and-chain.html