VEX 242A

VEX Robotics Online Challenges

Make It Real CAD Engineering Challenge

15 January 2019

VEX Linear Actuator

The VEX Linear Actuator converts rotational motion into linear motion. The linear actuator is designed to substitute the pneumatic system. With the linear actuator, only one motor is required to create linear motion as opposed to the two motors lost with use of pneumatics in the VEX competition rules. The design of the linear actuator is focused on compactness, which results in the VEX V5 motor being placed beside the linear motion tower. In addition, the base of the actuator has four mounting holes (two on each side) that line up with holes on the VEX parts and metal. These holes allow the actuator to be placed on any VEX metal part, and therefore is extremely versatile. The linear motion conversion is accomplished by utilizing a lead screw and lead nut. The torque from the V5 motor is transferred down a shaft and through two intermeshing spur gears. The second spur gear then spin the lead shaft, which turns while the lead nut's position is stationary due to the square shape of the motion tower. Then, the lead nut is attached to the tube insert and moves vertically along the guided path. The path lets the motion tower move up and down, creating the desired linear motion from a single VEX V5 motor. The tube insert has one hole at the top that can be connected to any VEX part to transfer the linear motion.

The linear actuator was CAD modeled using Autodesk Inventor Professional 2019. The design was created around a VEX V5 motor file, downloaded from vexrobotics.com as a STEP and imported into Inventor. Custom parts were modeled and placed into the full assembly, remembering to assign a material to each for future physical data. All other mounting hardware used in the design was imported from VEX to use in the assembly. Everything was properly constrained to allow for correct movement and behavior. The motor can be turned in the CAD environment and all parts of the assembly will properly move and show the tube insert rising and falling. Finally, stress tests were run on the assembly to ensure the model would withstand the forces applied. Before 3D printing the model and building it, a comprehensive overview of how each part would fit into the other was complete. The review made sure once the parts were printed they can be put together correctly without any faults. The linear actuator was then printed out on Ultimaker 3 3D printers. The tolerance was adjusted on the printed models to ensure the parts still fit together with the slightly overexpanded plastic that occurs with 3D printing. The other parts that were not VEX or 3D printed were purchased from McMaster Carr. These parts included: a lead nut, a lead screw, and a shaft coupling. Finally, all parts were assembly with reference to the CAD model to ensure all parts were placed in the correct spots. The design was tested extensively to prove the viability and effectiveness of the assembly.

At the conclusion of this project, our team came away with two critical takeaways. First, we realized the importance of using more 3D design in the future to put our ideas into a virtual environment and try new concepts without building in the real world. We found that this engineering technique allows for a faster and more accurate way of designing and building. Second, our team learned the importance of trial and error and how mistakes can often lead to design improvements. Finally, learning Autodesk Inventor was very helpful to our team since many of us will become mechanical engineers and likely use CAD in our everyday jobs.