SENIOR DESIGN PROJECT: BAJA CVT MECHANICAL ABSTRACT

This project focused on the design and manufacture of the mechanical systems for the electrically controlled variable transmission (eCVT) for Tech's Baja SAE team car. In previous car designs, the Baja team has used a mechanically actuated continuously variable transmission (CVT) to transmit power from the engine into a final drive gearbox. This system uses power from the engine to shift through a continuous range of gear ratios and is not easily tunable. While it is possible to get the mechanical CVT to be responsive, there are tradeoffs associated with this and time required to tune it. The goal with the electronically actuated version is to accelerate the tuning process while giving more control for tuning, and to utilize batteries to give more power from the engine to the wheels since we no longer use the engine to shift. This solution also gives more control while at the competition. To achieve this, we utilized the helix traditionally used on the output of the CVT as a cam to convert rotational motion into linear motion for shifting. Our actuator is a brushless dc motor with a built-in rotary encoder that allows us to drive it like a stepper motor, and the output of that motor is fed into an 80:1 worm drive gearbox. To make the CVT smaller, we moved to a splined shaft so we could fit a very large ball bearing over the shaft to reduce stack-up height while handling the axial loads required to shift.

Another part of the project was to complete analysis with calculating the system forces of the CVT and thermal modeling of the belt and case design. Using the data calculated with the system forces model on MATLAB, we could then use it to compare to the raw data collected from the CVT. Using the raw data, we could then make improvements to the design and efficiency. Thermal analysis for this project was prominently used for case design. A major issue with the CVT was overheating, which was resolved through flow analysis inside SolidWorks to determine the best way to maximize airflow through the CVT as a cooling method. By increasing the flow inlet size, the airflow was able to properly cool the CVT to operating temperatures.

In conclusion, we were able to reduce the total CVT height from 9.86 to 9 inches, which was roughly an 8.7% reduction. Lastly, we were able to keep the weight at 25.09lbs which is 0% heavier than the mechanical CVT with case.