Mechanical Engineering
Carnegie Mellon University

Eccentric Chain Tensioning for Racing Applications

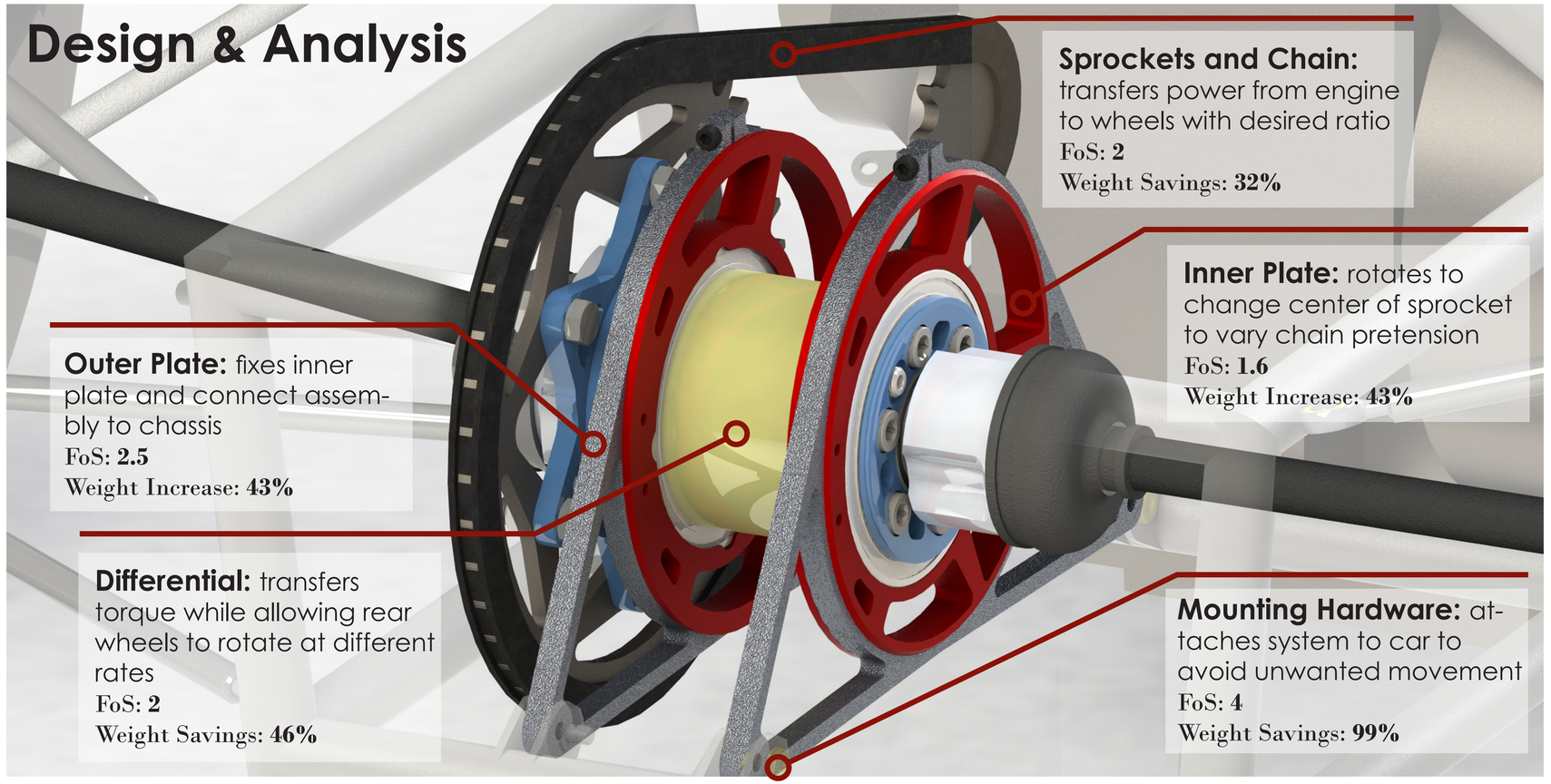
Senior Capstone Design Project
Adam Brecher
Anne Dirkes
Brian Langone
Mike Ornstein
Rob Wojno

Opportunity

Formula Student cars are usually chain driven between the engine and rear wheels. Pre-tension on this chain system is critical for longevity of the chain and power transmission dynamics. Tension is usually provided by the fore-aft translation of the driven sprocket.

The design opportunity is in how sprocket translation is accomplished. In our design the sprocket and inner plate do not share the same center, accordingly rotation of the inner plate translates the sprocket fore-aft. This creates an intuitive user experience while better constraining sprocket motion.

Design & Analysis



Sprockets and Chain: transfers power from engine to wheels with desired ratio
FoS: **2**
Weight Savings: **32%**

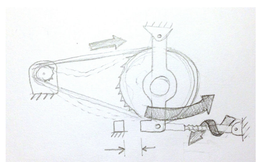
Inner Plate: rotates to change center of sprocket to vary chain pretension
FoS: **1.6**
Weight Increase: **43%**

Outer Plate: fixes inner plate and connect assembly to chassis
FoS: **2.5**
Weight Increase: **43%**

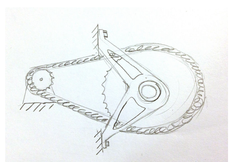
Differential: transfers torque while allowing rear wheels to rotate at different rates
FoS: **2**
Weight Savings: **46%**

Mounting Hardware: attaches system to car to avoid unwanted movement
FoS: **4**
Weight Savings: **99%**

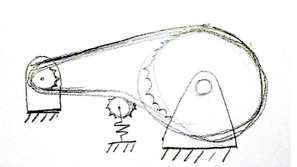
Design Comparison



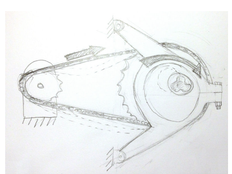
○ Turnbuckle Pivot



□ Hard Mounted

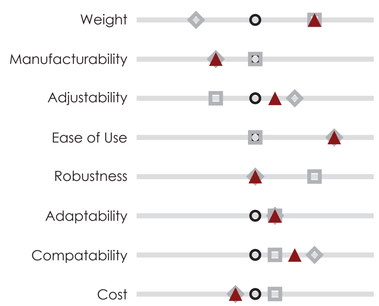


◇ Spring Tensioned

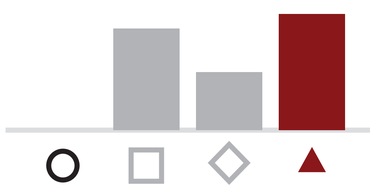


▲ Eccentric Rotating

Selection Criteria



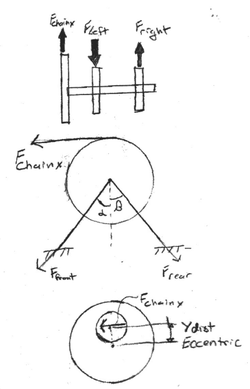
Selection Criteria Score



Analytical Model

System analysis was done using the input chain force of 491lb and the FBD shown. The system was modeled using the worst case of maximum engine torque and static drive shafts.

Chain loads are reacted by the outer plates. Drive torque is reacted by clamped interface.



Conclusion

- New assembly is 41% lighter
- Rotating mass reduced by 76%
- Tensioning system more intuitive and user friendly
- Guaranteed sprocket alignment
- Easy chain removal
- Significantly reduced manufacturing time
- Easy to adapt to different chassis configurations
- Optimized final drive ratio