



# Regenerative Braking Electric Skateboard

Team Members: Brad George, Fawzi Al Hadrab, Brendan DeJonge, Ryan Hawkins

Faculty Advisor: Olivera Notaros

Project Advisors: Bert Vermeulen, Ian Bernstein, Bob Thelen



## Abstract

Modern electric skateboards have increased in popularity, but still have several key areas in terms of safety, reliability, performance, and maintenance which can be greatly improved upon.

As an entrepreneurship project, the team has identified two main areas we believe to add the most value to an electric skateboard.

- Problems with the regenerative braking often leave the board overloaded and shut down
- There is a lack of control regarding steering sensitivity at different speeds, which can lead to accidents

Additionally, other problems with modern electric skateboards include:

- Poor connection to the remote control
- Poor heat dissipation of the battery
- Lack of tunability

All these issues were addressed.

## Adaptive Truck System (Proof of Concept)

First of its kind idea which will constantly optimize stability and maneuverability according to riding speed.

### The Problem

Most trucks can only be tuned to one speed, which can lead to low maneuverability at low speeds or high instability at high speeds.

### The Solution

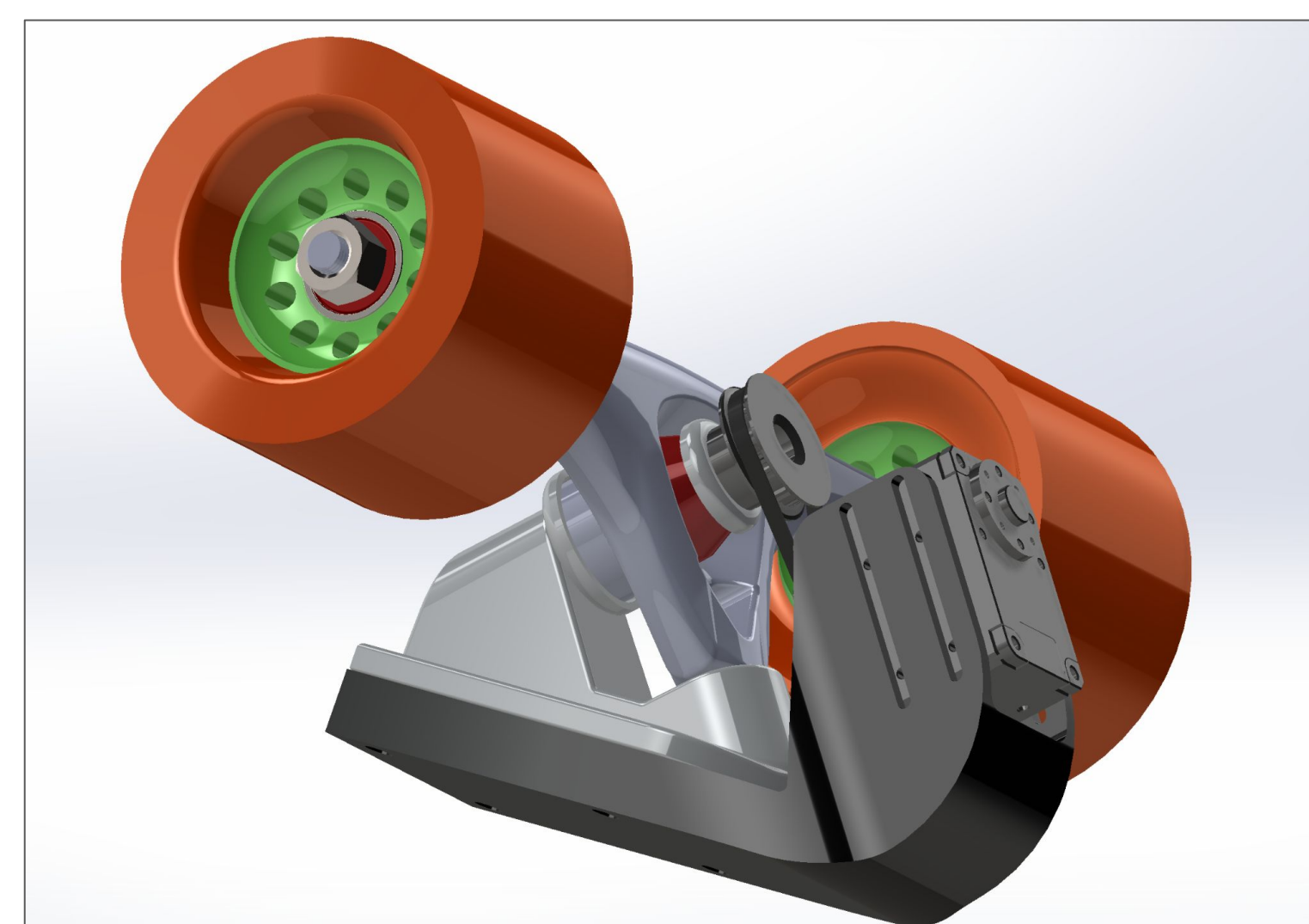
The adaptive truck system will adjust the trucks during riding based off speed input. At higher speeds, the trucks will tighten and become more stable, while at low speeds they will loosen and become more maneuverable.

### Features

- Custom, 3D printed, carbon-fiber reinforced mount
- Top of the line continuous rotation servo motor
- Custom, 3D printed pulleys

### How it Works

1. A speed sensor records board velocity
2. A servo motor rotates the nut on the kingpin of the trucks through a belt drive, changing the sensitivity adaptively



## Mechanical Design

### Enclosure

- Form fitted using 3D scan of the deck
- Fully weatherproofed using custom 3D printed flexible TPU gaskets
- Easy access to electrical components via removable cover
- Quick release straps for simple battery replacement
- Waterjet cut aluminum cover which dissipates heat and protects the electronic components



### Custom Motor Mounts

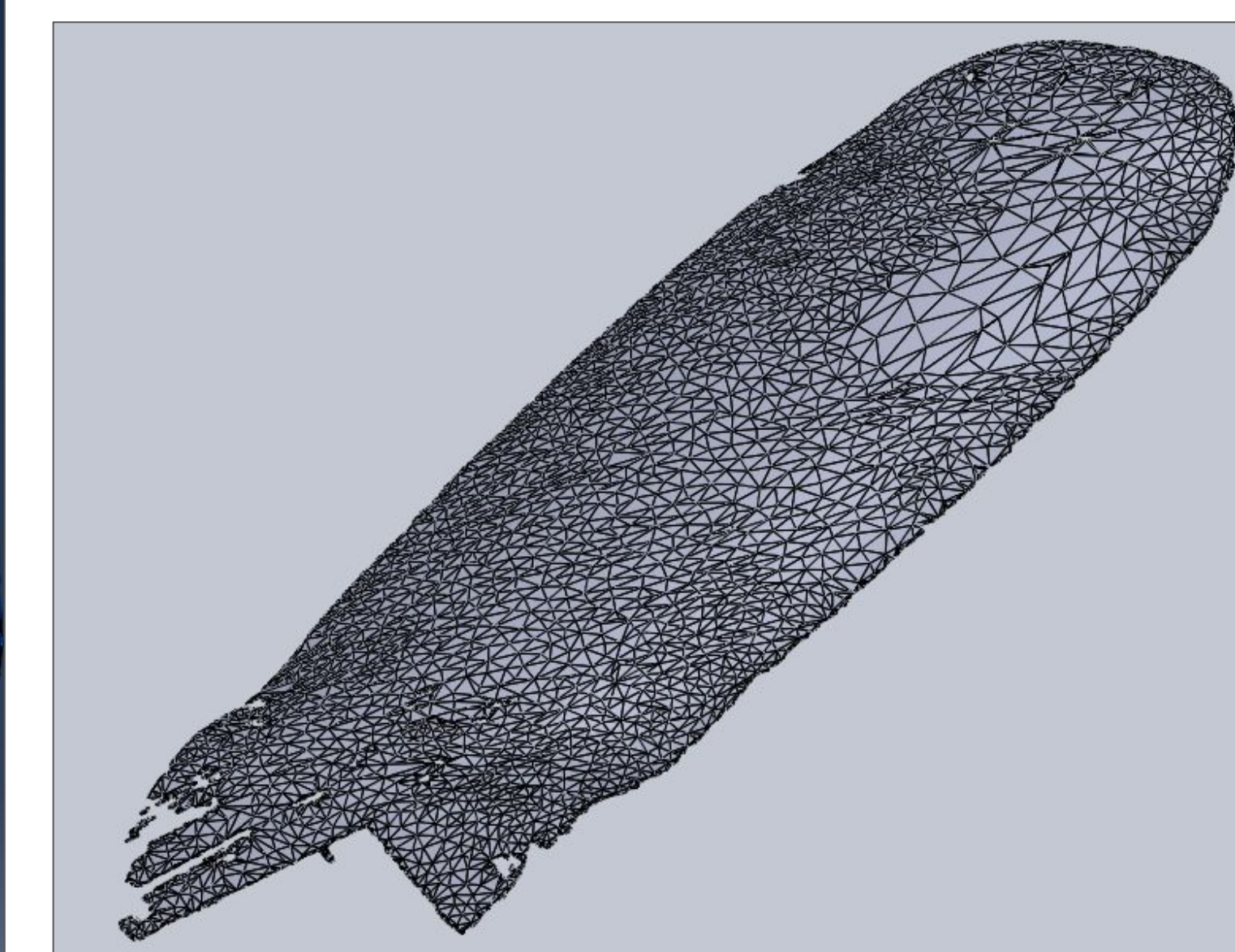
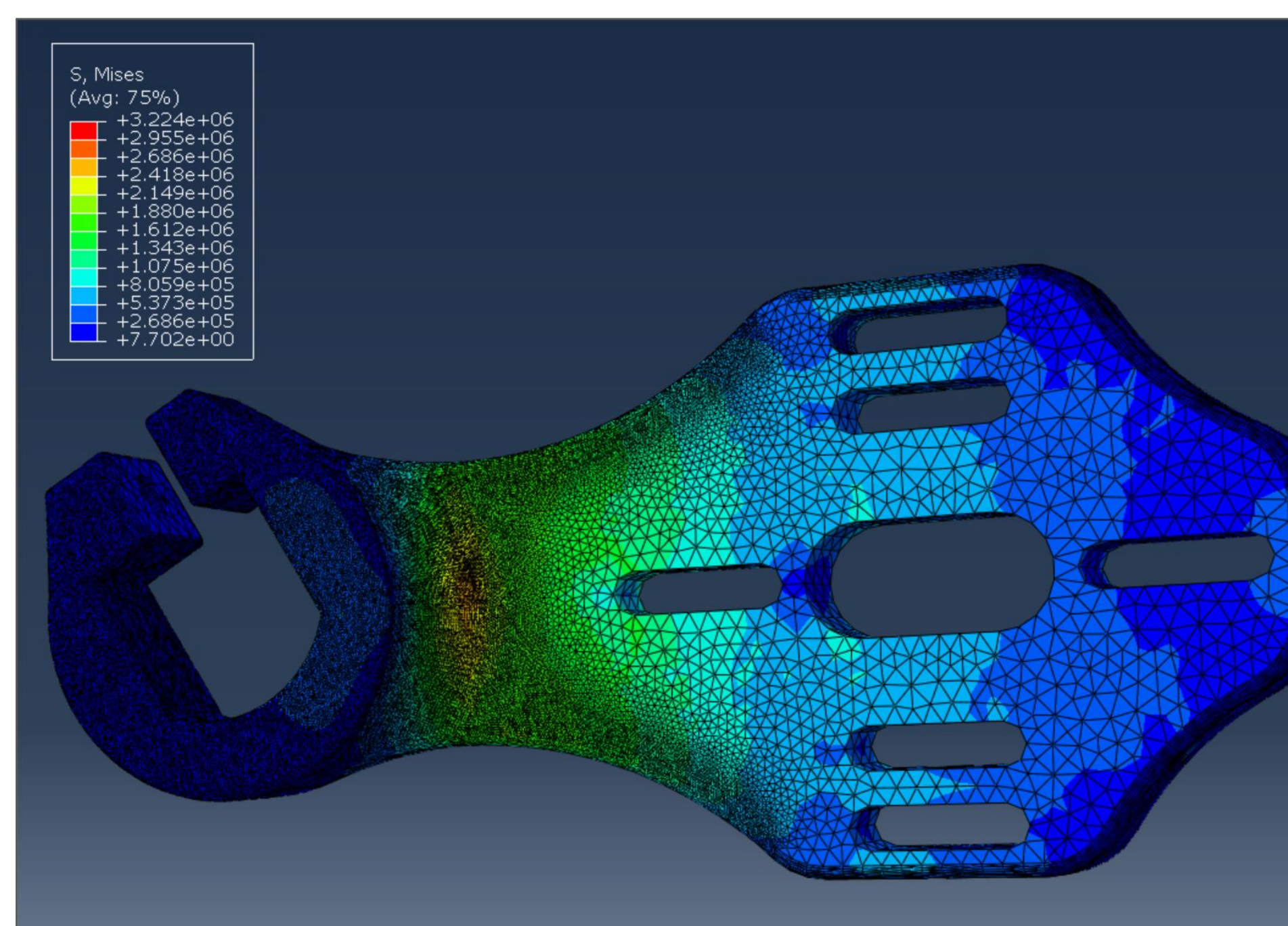
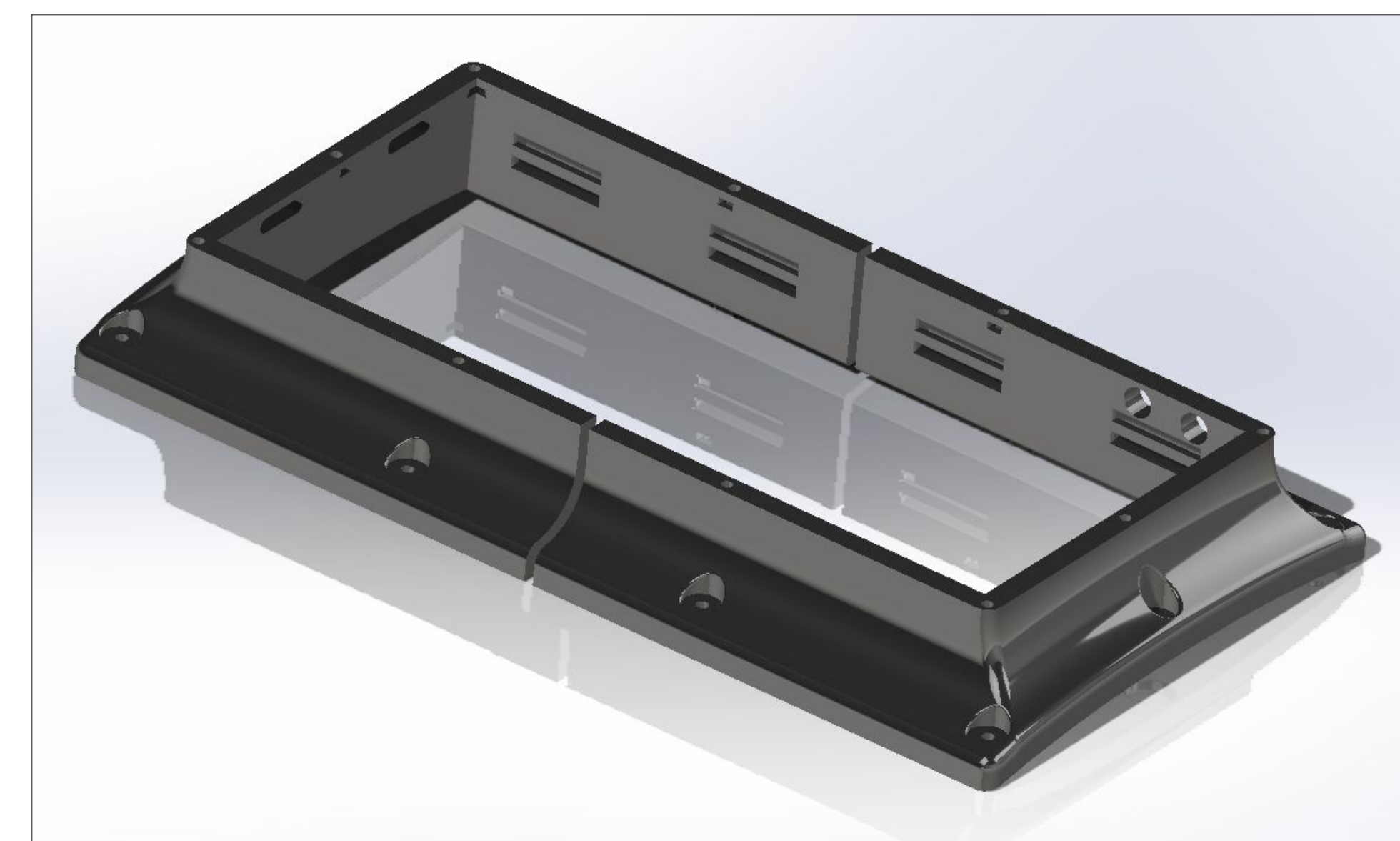
- 3D printed with optimized geometry
- Printed in carbon fiber reinforced Nylon
- Features belt tensioning system for increased reliability
- Performed finite element analysis to identify stress concentrations

### Miscellaneous

- Vibration damping shock pads
- Extended trucks for high stability and large motors
- 6374 Dual Motor system provides ample torque and power
- 10s2p Battery pack ensures for high speed and long range
- Loaded Omakase deck features kicktail for maneuverability without compromising stability due to its long wheelbase and width

### Technology Implemented in Manufacturing

- Waterjet Cutting
- 3D Scanning
- Melt Extrusion Additive Manufacturing
  - Carbon Fiber infused Nylon
  - TPU
  - PLA



## Electrical Improvements

### The Problems

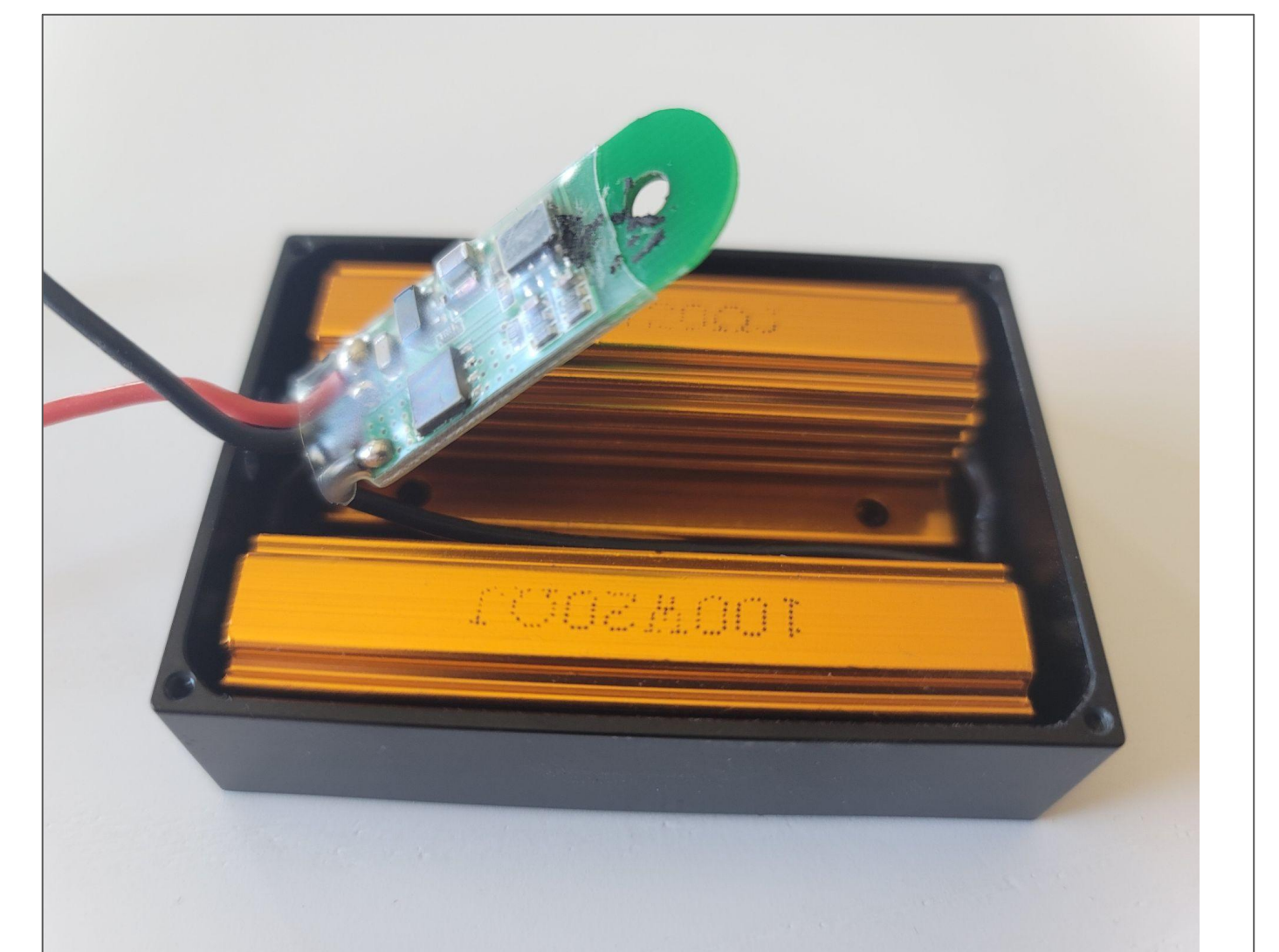
- Most electric skateboards include regenerative braking as a feature. However, when the battery is already full, any generated current has nowhere to go and cause a system shutdown.
- There is also not much in terms of safety features for batteries. The most prevalent issue is an overload of current if regenerating too much current, as well as other smaller issues such as unreliable connections to the Bluetooth remote, uneven acceleration and braking, and overheating.

### Overloading Current

The problems with any overloading current can be fixed by redirecting any excess current to a rheostatic braking resistor which will convert the current into heat and then dissipate the heat through an aluminum plate on the bottom of the board.

### Remote Connectivity

- Bluetooth connectivity becomes unreliable at high speeds due to noise
- Vibrations can cause physical damage to Bluetooth connectivity as well as disconnecting wires
- Power issues can cause the connectivity to reset and disconnect momentarily



### Features

- Redirects current when above 57 volts
- Redirects current when batteries are fully charged
- Disperses heat through custom waterjet cut aluminum cover on the bottom of the enclosure
- Custom high frequency signal and soldered connections increase reliability of controller
- ESC circuit allows regeneration in both forward braking as well as reverse braking quadrants

## Future Work

Improvements to the regenerative braking and mechanical systems must be tested extensively and improved depending on the findings.

The rheostatic braking system must be further developed and tested.

The adaptive truck system must be optimized for actual placement on the board and user testing.

To fully flesh the project out as an entrepreneurship venture, more work would be required before selling an MVP to the market.