Hardware Development of an Improved Remotely Operated Vehicle

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Background and Goals

Existing JHU ROV

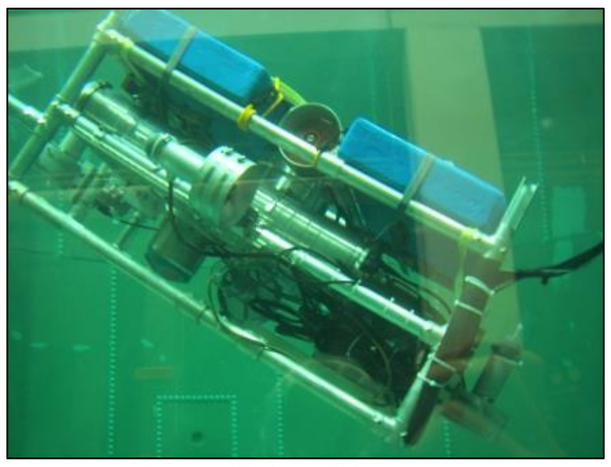
- Robotic testbed for underwater navigation and control algorithms

Goal: design improved ROV

- Autonomous operation
- Improved wiring
- Size reduction
- Easier maintenance
- Part standardization

Subtask outline

1. Design power system
2. Design component housings
3. Design layout and structure



The JHU ROV in the DSCL's test tank

Power System Design

Goal and design considerations

- Enable autonomous ops via onboard power supply
- Goals of low weight and volume, good introspection

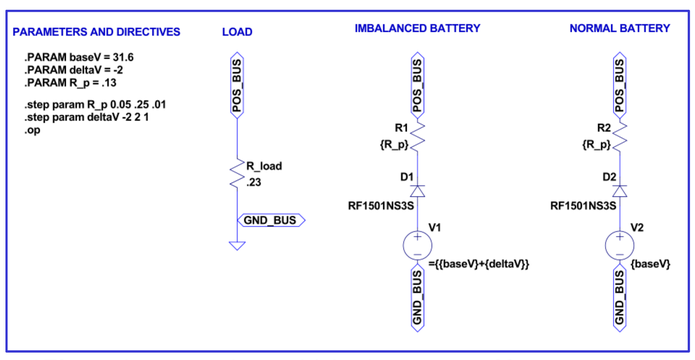
System selection

- Researched high-density options, placed in comparison spreadsheet
- Inspired Energy PH3054 batteries selected

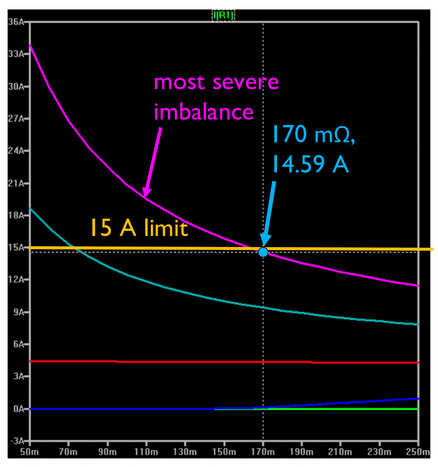
Mitigating battery imbalance

- Imbalances ➞ shorting between batteries
- Strategy: connect diodes and resistors in series with batteries
  - Diodes prevent back-current
  - Resistors prevent over-current

The selected Inspired Energy batteries, with a pen for scale. 30 of these make up the vehicle's power bank.



LTSpice schematic used to model the above strategy. 28 more connected batteries are out of frame. The directives at left step through resistance and imbalance values to create the simulation at right.



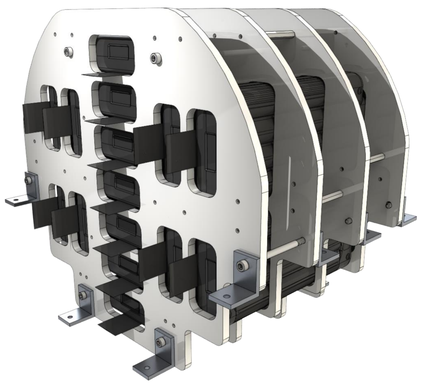
Simulation of model. The batteries' 15 A over-current limit and chosen resistance are shown.

Component Housing Design

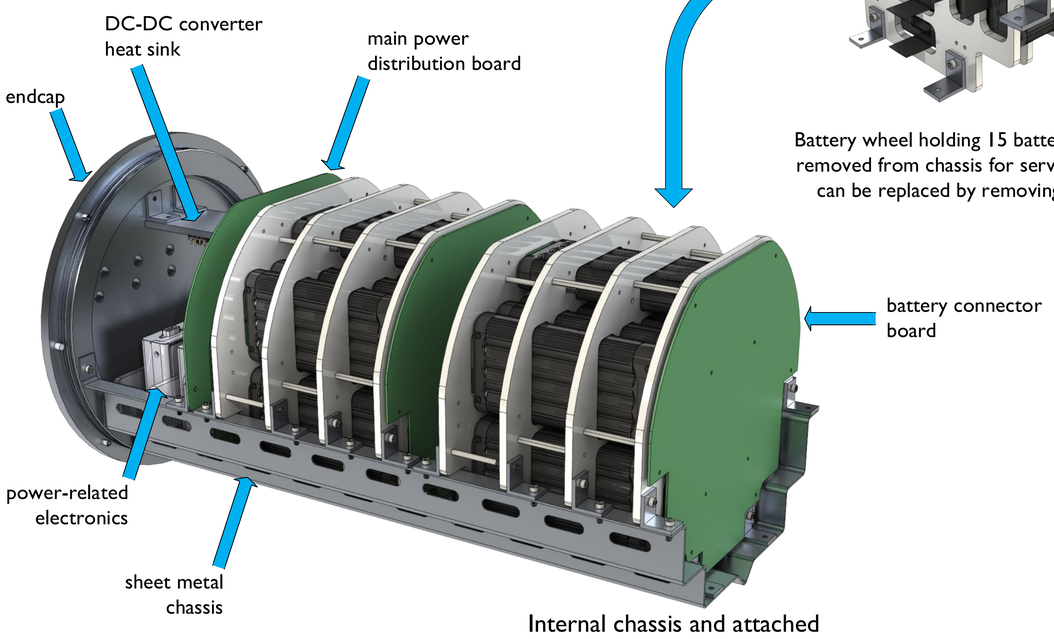
Power housing

Goal and design considerations

- Goal: house batteries and associated components
- Effectively dissipate heat
- Use standard, COTS parts
- Ease access, maintenance
- Simplify wiring
- Minimize size



Battery wheel holding 15 batteries. Wheel can be removed from chassis for servicing, and batteries can be replaced by removing front end plate



Internal chassis and attached endcap of power housing

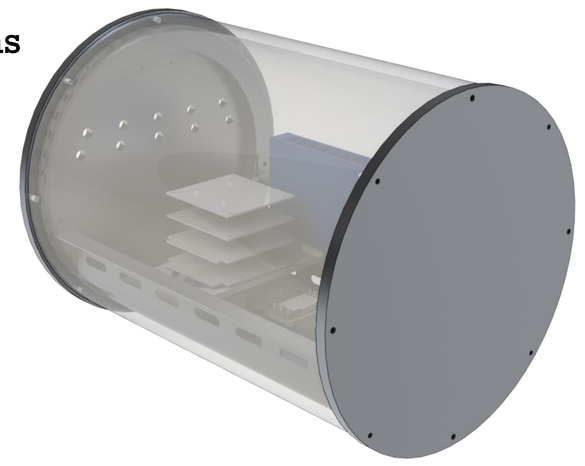
Electronics housing

Goal and design considerations

- Goal: house vehicle's CPU, other electronics
- Design considerations very similar to power housing's
- Must leave room for future additions

Reuse of power housing components

- Endcaps, outer tube, chassis profile standardized, reused



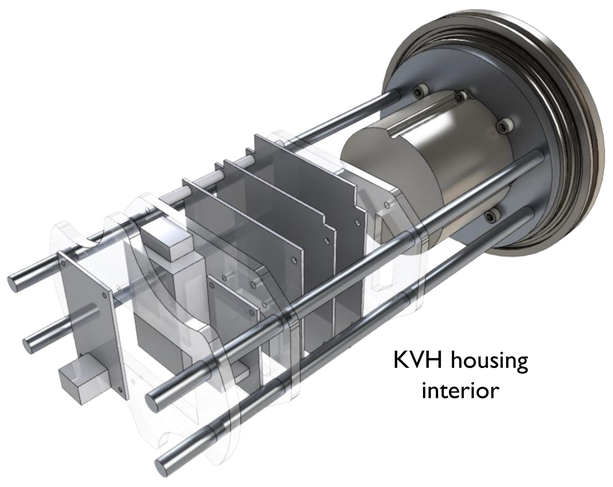
KVH housing

KVH 1775 inertial measurement unit (IMU)

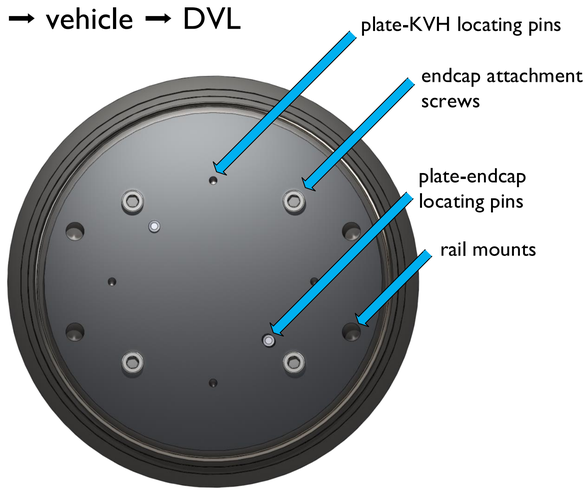
- Lower cost, high-performance IMU

Alignment as design challenge

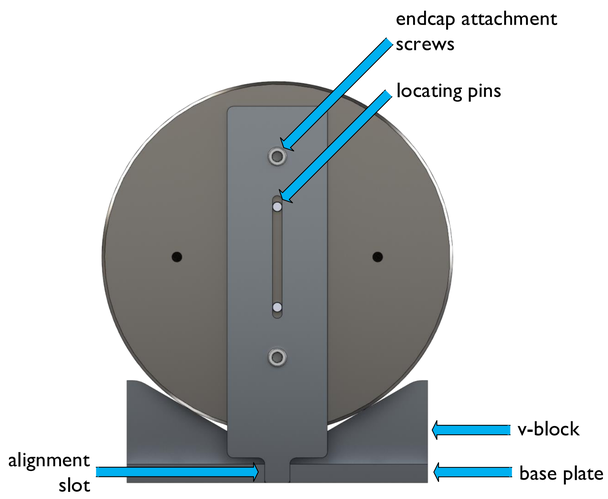
- Must keep KVH aligned with Doppler Velocity Log (DVL) elsewhere on vehicle for accurate position calculations
- KVH is aligned with endcap ➞ base plate ➞ vehicle ➞ DVL



KVH housing interior



Close-up of the mounting plate and endcap assembly. KVH and rails hidden for clarity



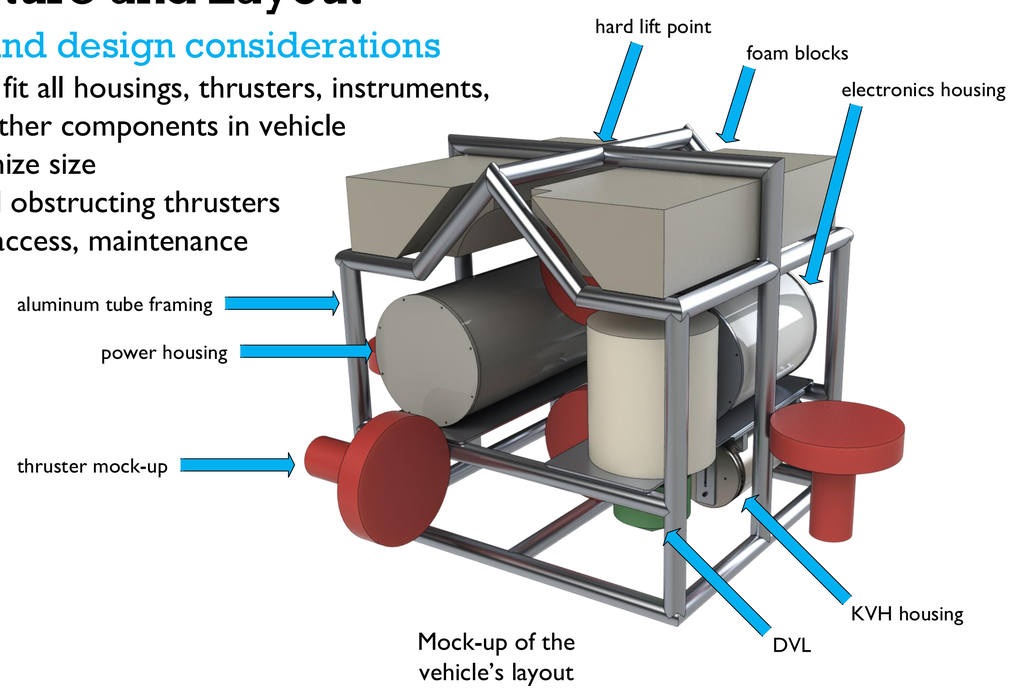
Close-up of connections between endcap and base plate

KVH housing exterior

Structure and Layout

Goal and design considerations

- Goal: fit all housings, thrusters, instruments, and other components in vehicle
- Minimize size
- Avoid obstructing thrusters
- Ease access, maintenance



Mock-up of the vehicle's layout

Acknowledgements

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