Cornell University

Ranger Robot: 9 km walk

Ranger robot at the track

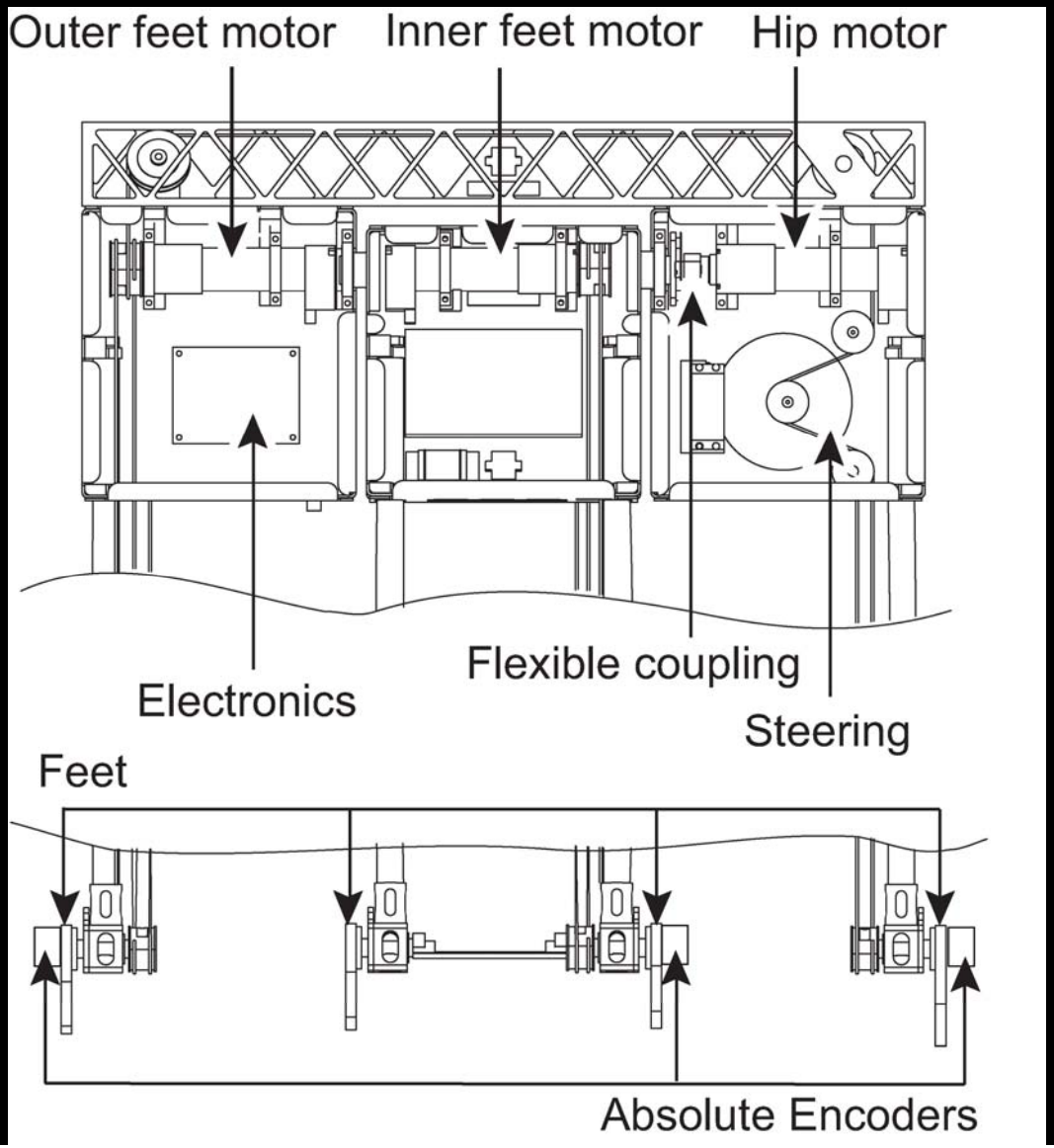
Details:

- 9 kilometers
- 45 laps
- 27,724 steps
- 5 hours 12 min.
- 1.75 km/hour
- 25 watts
- 126 watt-hours
- 8.5 kg
- 0.6 cost of transport (energy per unit weight per unit distance)

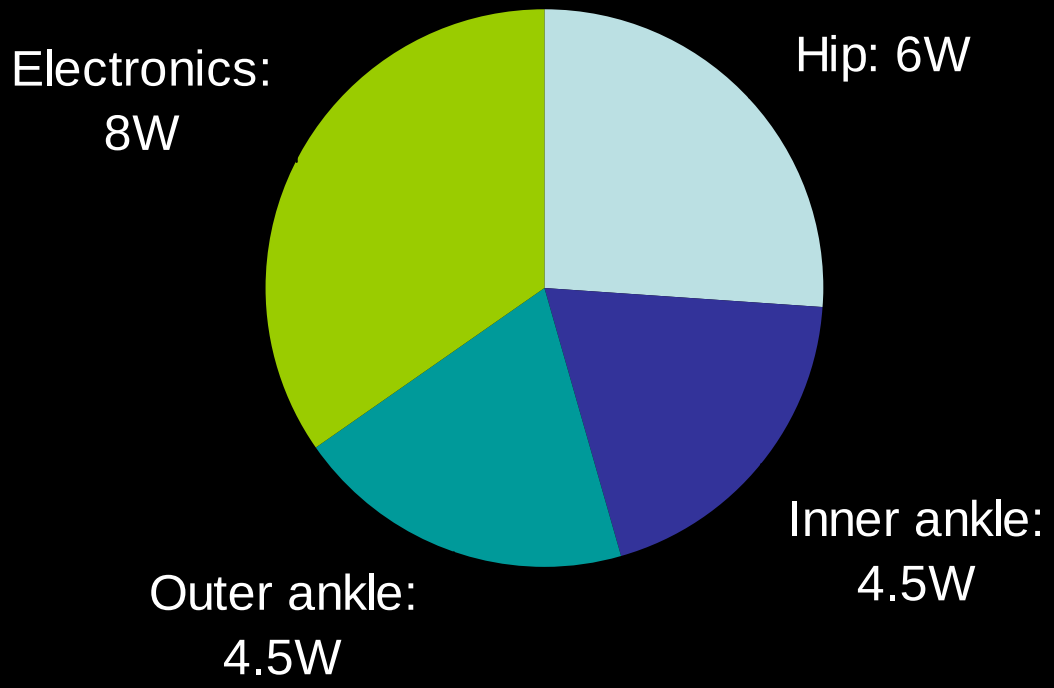
Design goals:

- Low energy usage
- Reliability
- Robustness
- Evolvability

Ranger design: Overview

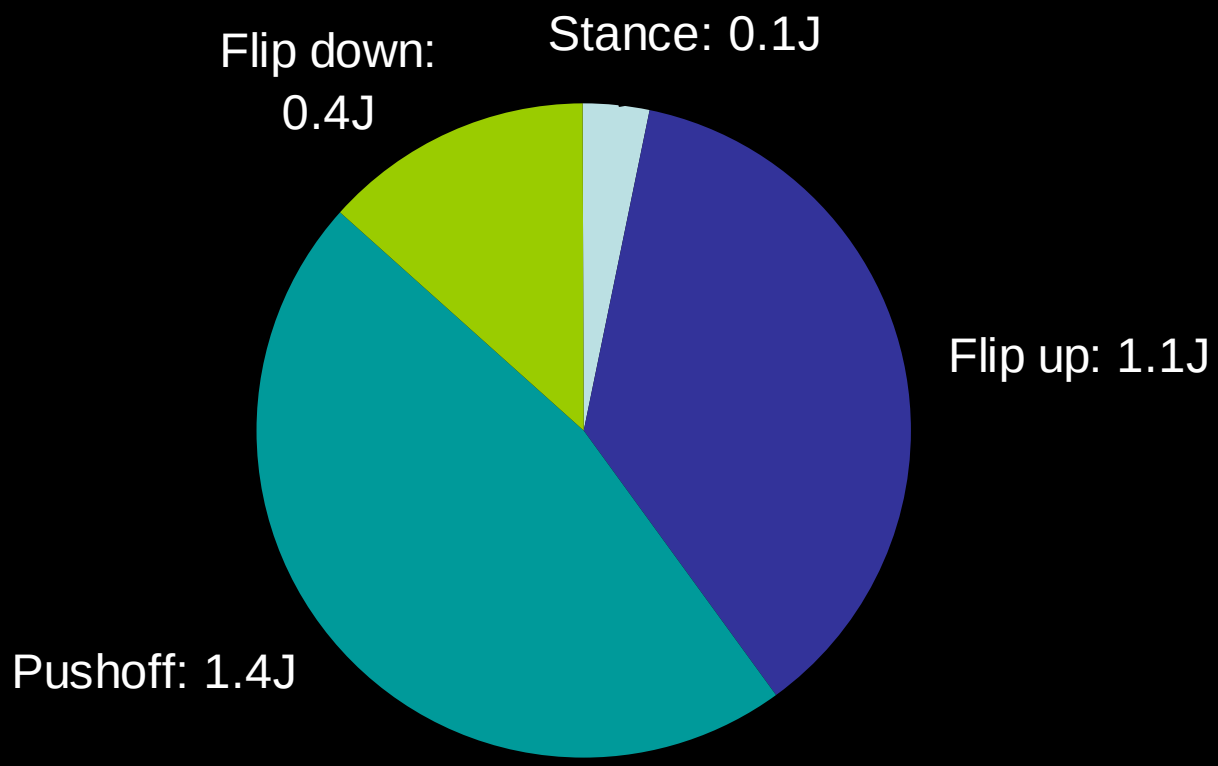


Power usage by Ranger motors and electronics – straight walk



Outer ankle motor power is 7.5W during turns;
the other power values are unchanged.

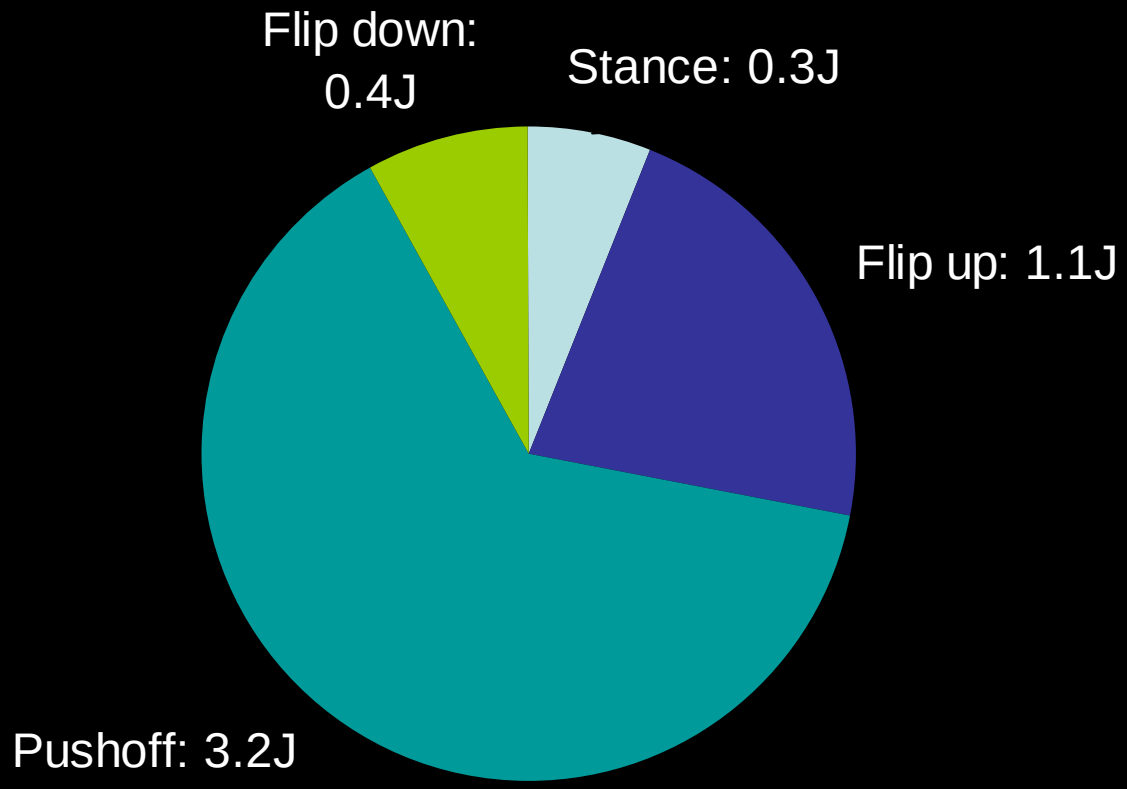
Motor energy use by operation: inner or outer ankle



Straight walking – no turns

Hip swing energy is 4J

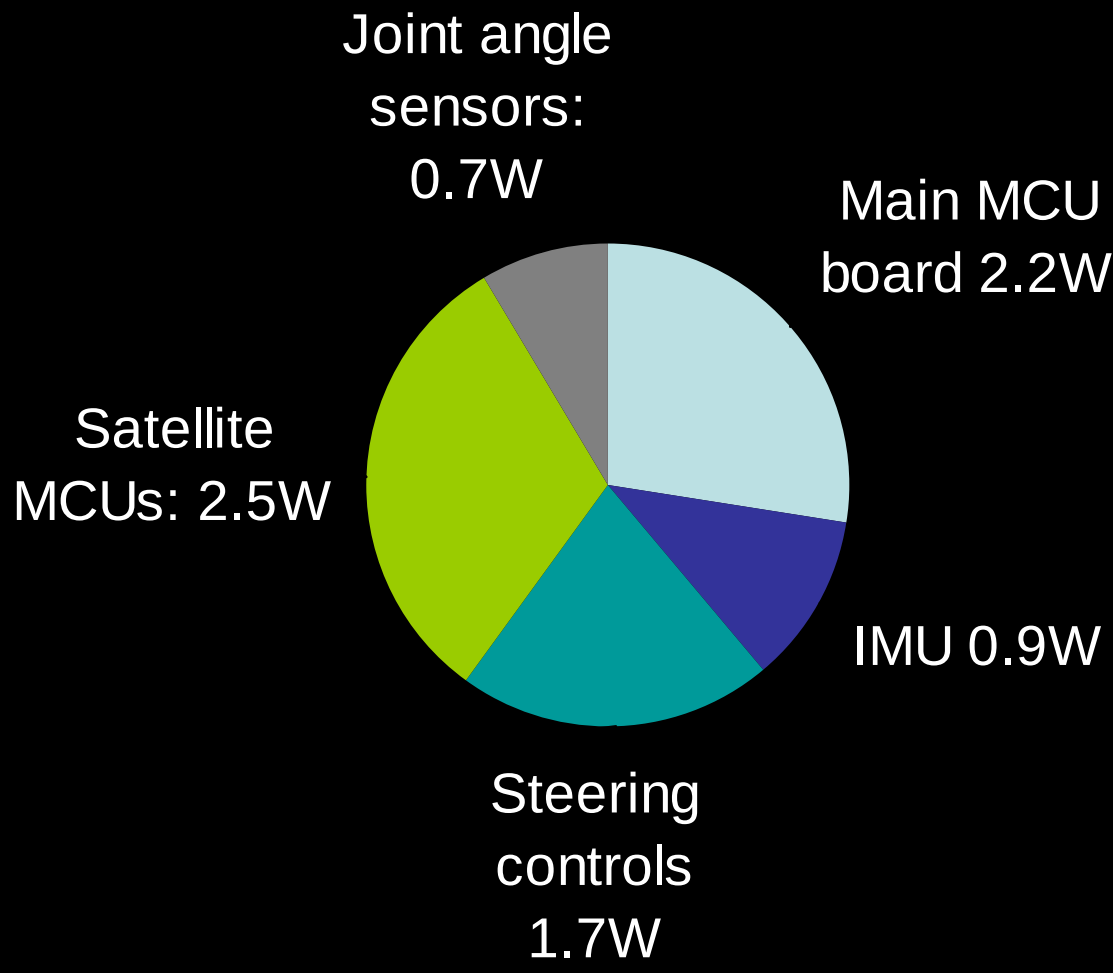
Motor energy use by operation: outer ankles, turning



Inner ankle energy is unaffected by turning;

Hip swing energy is still 4J

Electronics power usage

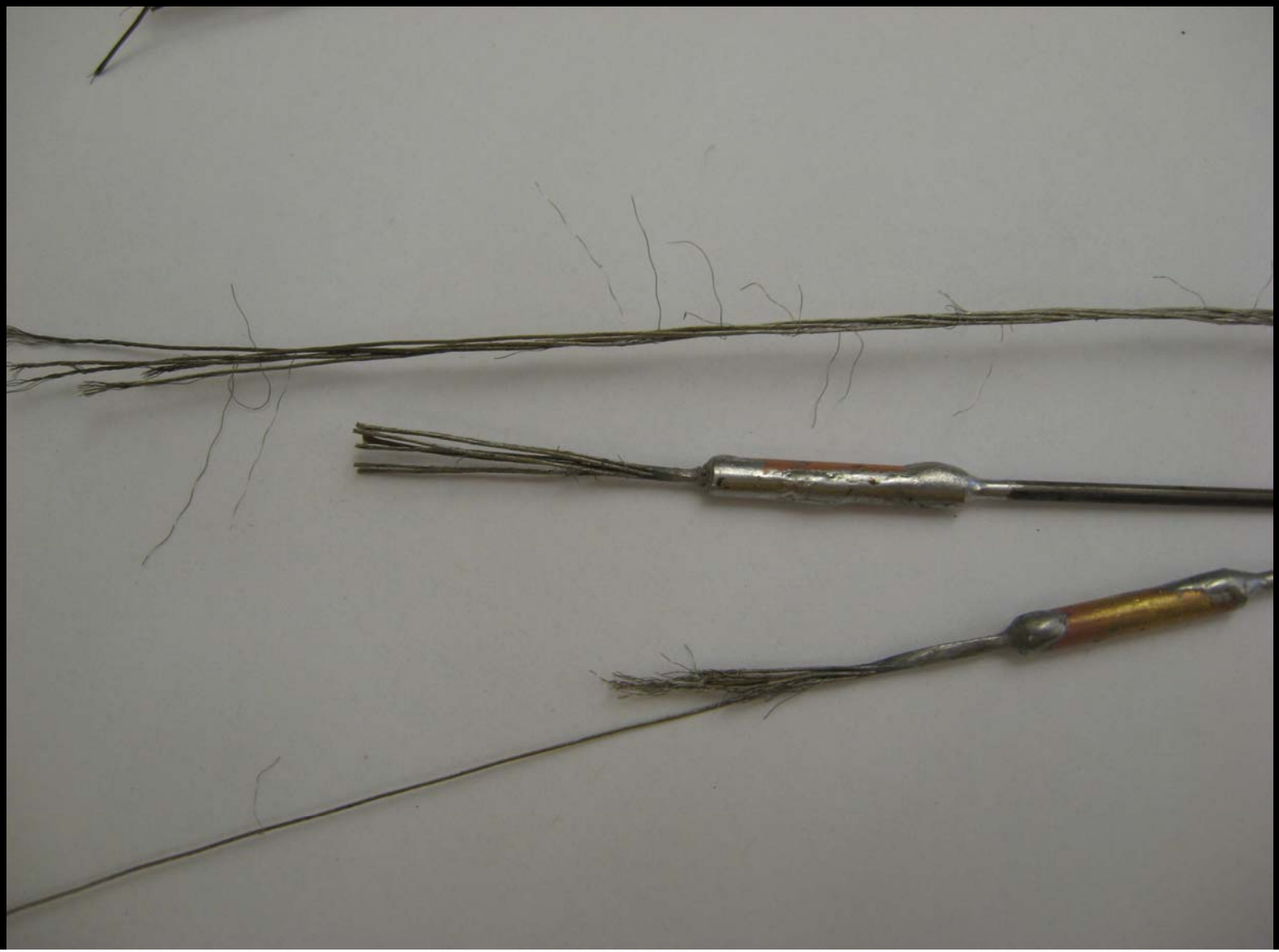


Total electronic control power: 8W

Reliability

- Testing
- Version control
- ESD
- Fall protection
- Connectors

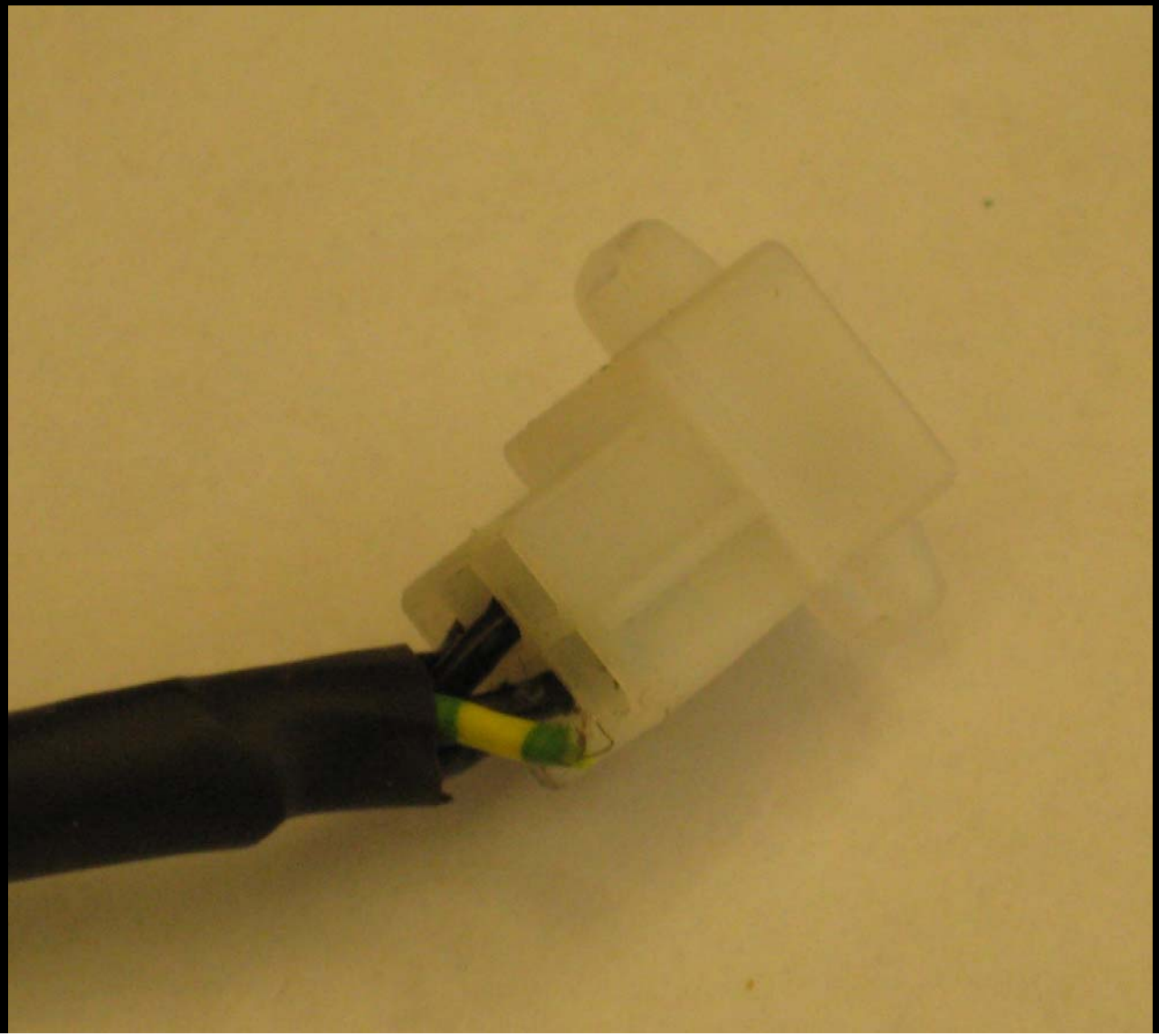
Cable ferrule failure



Epoxy bonding

Shown: Mereco Metregrip 303 and Lord AP-131 primer

Connector failure – inadequate strain relief



Connector with strain protection

Evolvability

- Consistent, reliable, and repeatable
- Easy, fast data analysis
- Documentation
- Modular and hierarchical design
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No branching.

No sensor/actuator saturation

Bells and lights.

Floating point, not fixed.

Tested and reliable.