UCSB HYPERLOOP

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UC SANTA BARBARA engineering

STABILITY

- Pod travels along central I-Beam
- Pair of stability wheels keeps pod on track, prevents rotation around y-axis (yaw)

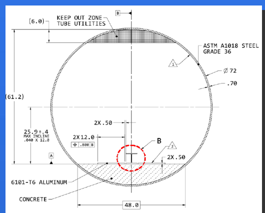

Figure 1: SpaceX Track Cross-Section

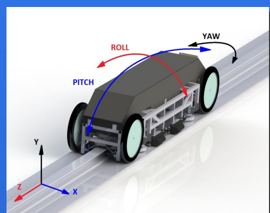

Figure 2: Pod Motion Along Test Track

BRAKING

- Rubber pads clamp onto central I-beam, can slow from a speed of **200 mph in 17 seconds**
- Two pairs of brakes, each pair can stop pod on its own

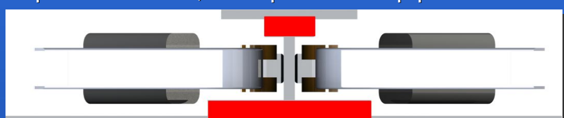

Figure 3: Braking System and I-Beam, Red Keep-Out Zones

HYBRID DESIGN

- Wheels provide best stability at operating speed
- Cart/Payload design:
  - Cart: stable, rigid outer frame, has stability wheels, brakes, and drag racing wheels
  - Payload: Moves vertically along linear bearings. MagLev engines support the weight of electronics and battery banks

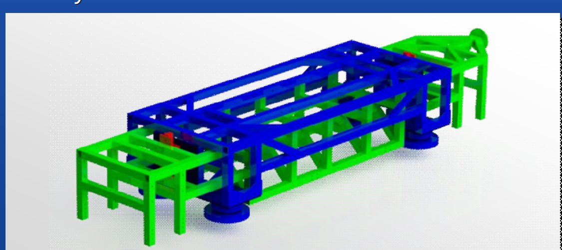

Figure 4: Payload (Blue) Mounted to Cart (Green)

MAGNETIC LEVITATION

- Motion of magnets generates eddy currents in conductive surface, which creates an opposing magnetic force that lifts pod
- Utilizes Halbach arrays, maximizes field strength below pod, minimizes interference with electronics

Figure 5: Arx Pax HE3.0 Engine

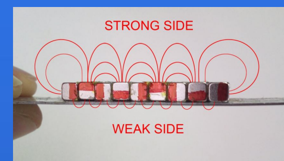

Figure 6: Halbach Array Magnetic Field

- The faster the magnet moves over the surface, the more lift is generated. Engines more efficient when rotating faster and moving at higher speeds over track

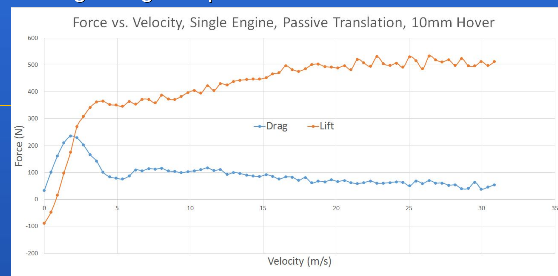

Figure 7: Magnetic Levitation Force and Drag vs. Translational Velocity

THERMAL CONSIDERATIONS

- Heat is sunk into aluminum frame, thermal jackets
- Subsystems individually tested to ensure performance in low pressure environment

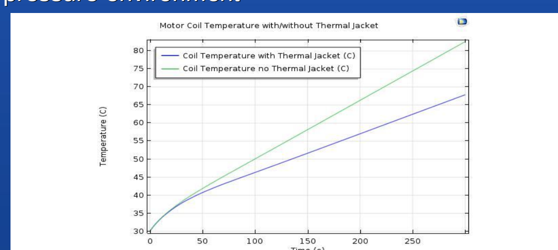

Figure 8: Magnetic Levitation Motor Thermal Profiles

ELECTRONICS

- Powered by lightweight lithium polymer batteries. Batteries source 3.8 kilowatts of power to MagLev engines and subsystems
- Sensor array records pod temperature, power consumption, position, and subsystem status
- Wirelessly transmits information through web app

Figure 9: Hyperloop Web App Monitors Position, Power, Temperature

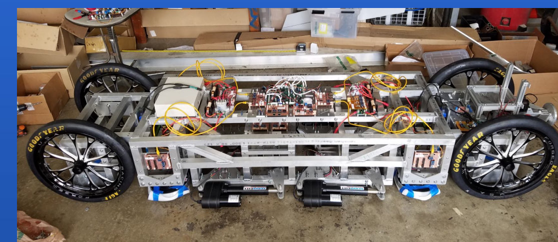

Figure 10: Subsystem Boards and Power Distribution Mounted in Pod

CONTROL SCHEME

- Each subsystem has state machine, ensures all behavior is controlled and characterized
- Braking has most safety checks, only deployed after time/distance threshold surpassed and no longer accelerating

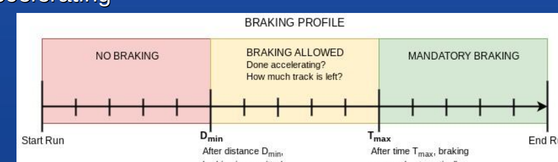

Figure 11: Braking Subsystem Control Scheme

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