High Torque Density Motor

Stephan León | Sean Nelson | Ben Rosenberg | Dana Yuen

ABOVE ALL ELSE

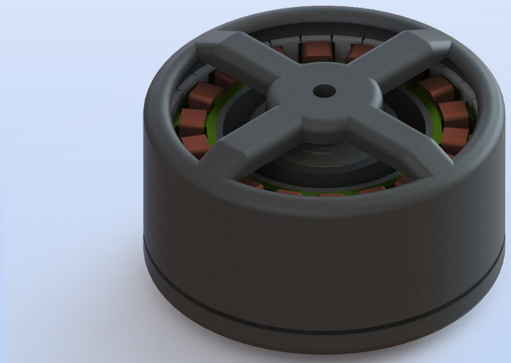
Background

LaunchPoint, a local systems company, wants to add iron core capability to their propulsion systems. Using LP's new motor design software, our group designed, built, and tested an electric motor. We then compared the tested values - basic measures of the motor's performance - to the values predicted by LP's software in order to validate the accuracy of the software.

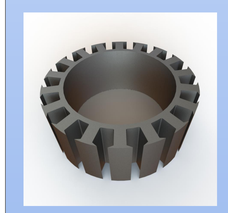
Overview/Design Specs

- Palm sized electric motor
- Outrunner configuration
- Magnets arranged in a Halbach Array
- Features 18 teeth, 16 poles, and 3 phases
- Runs at 4000rpm with 150 W
- Wire chosen to maximize flux through the stator
- Optimizes specific torque for a palm sized motor
- Designed for use with vertical take off and landing as well as short take off and landing drones (VTOL, STOL)

Final Design: LaunchPoint Hyperion

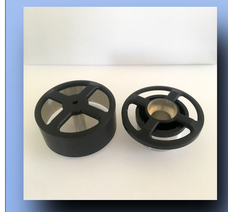


Hardware/Key Components



Stator

- Reduces heat generation and induced circulating currents
- 142 layers of 0.007" silicon steel cut by EDM and adhered together



Housing

- Aluminum is CNC milled and anodized
- Shafts dimensioned to 0.0005" to allow for clearance, loose, and small interference fits

Windings

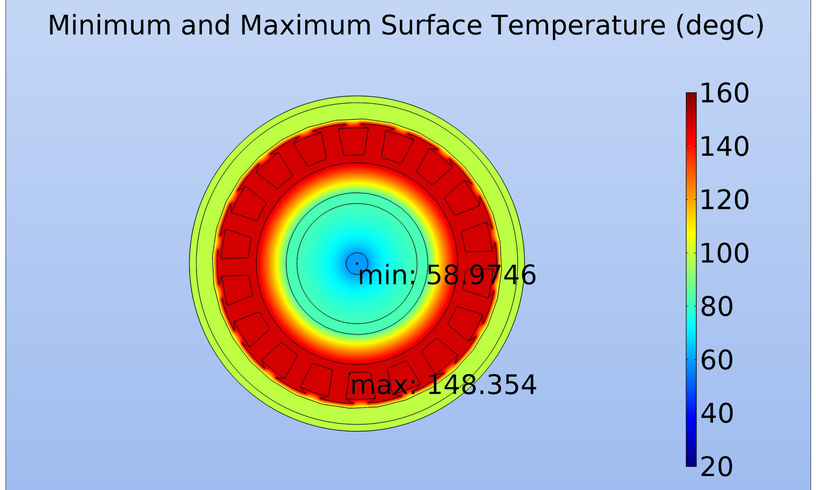
- 21 AWG, 3 strands per wire
- 4 turns per tooth
- Calculated to maximize flux through the stator

Magnet placement

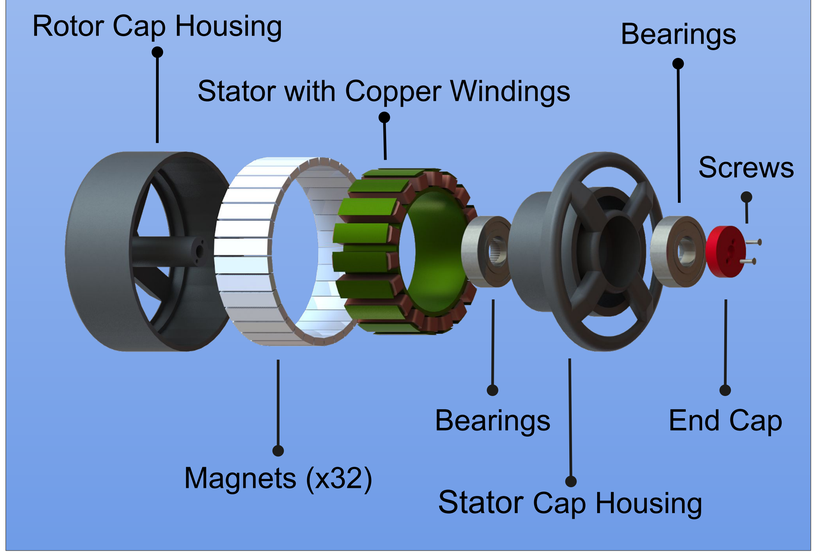
- 3D printed placement device utilizing a press fit
- Arranged in a Halbach array to maximize magnetic field

Key Result: Design Optimization

- Motor heating model to find peak temperature
- Gives safety factor for demagnetization - our magnets demagnetize at 80C
- Helps to estimate the maximum flux in the stator
- Assumes relative permeability of 4000 for iron, 1 for air



Exploded View



Acknowledgements: Andy Weinberg, H & Sons Manufacturing, LaunchPoint Technologies, Limon's Metal Finishing Inc., Premiere Laminations, Proto Laminations, Trevor Marks, Tyler Susko

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