Further 2d Magnetostatic Analysis of Graham's Howard Johnson Motor Idea

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Introduction

Graham wanted to test another idea for the Howard Johnson configuration. I put together a simulation to test this configuration. This brief document contains the results and my conclusions for the simulation I have conducted.

Simulation and Analysis Procedure

The simulation in this document is conducted using 2d magnetostatic analysis. The permanent magnets are simulated with Grade 40 NdFeB material. Parametric analysis is done by moving the rotor through the gate by creating 16 solutions per inch of movement. The results of the parametric solving are then exported for analysis using Matlab. In Matlab an area plot is generated. The trapezoidal integral is calculated for the area plot to produce the total area under the entire force curve.

The following figure shows the track that was simulated. The stator magnets are in blue and the rotor magnets are in red. The arrows inside each magnet show the magnetic orientation of the magnet. A small amount of steal (in green) was placed around the stator magnets as Graham specified. All magnets are 1" X ½". The gap between each stator is 3.25". The gap between the rotors is 3.25" as well. The smallest gap between the stators and the rotors is ½".

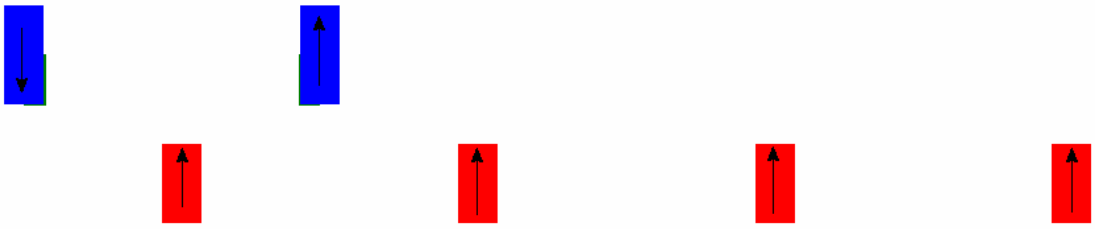

Figure 1 Test track for Graham's Second Idea

Simulation Result

The next figure shows the simulation result from the track. I culled some data from the far ends of the graph to make the result more clear.

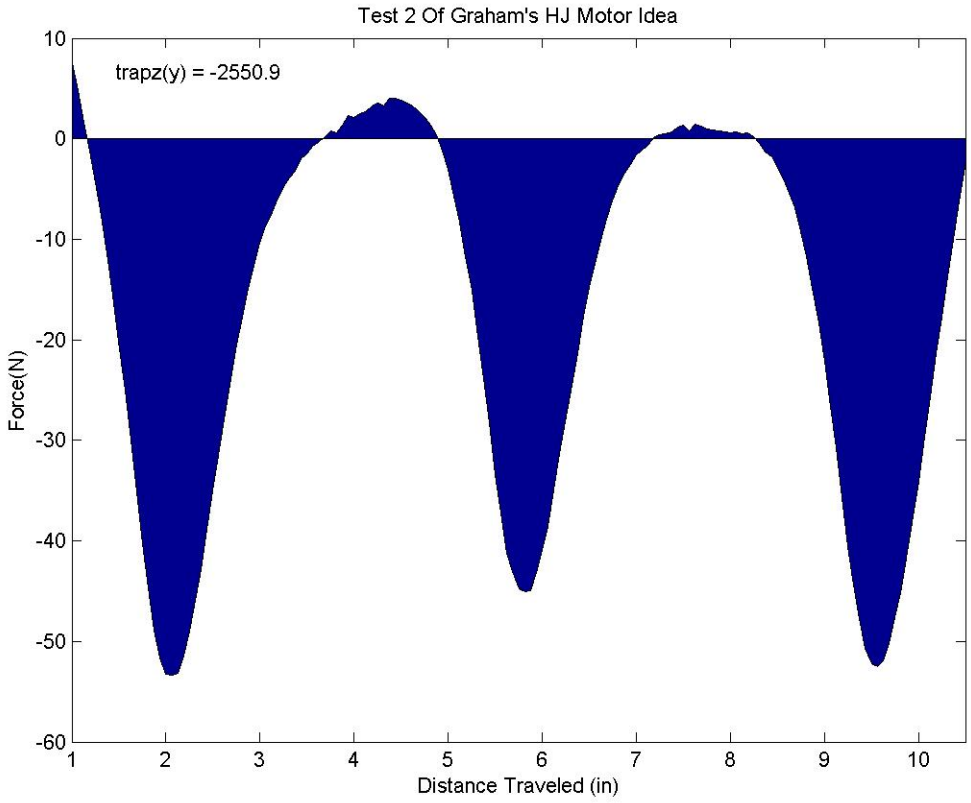

Figure 2 Simulation Result

Conclusion

The second track shows the same effects as the first track. The idea of using many rotors with one stator pair should prove useful to several reasons. First a magnetic motor can be built from this idea much easier. Second this idea will employ less magnets overall making any motor designs on the concept more economical to build. Third it should be much easier to solve eddy current problems with this approach.

I have more ideas I want to test for this configuration. I think it is possible to mirror another stator pair below the rotors to both enhance the effect and balance out the forces on the y axis enabling high RPM in some potential motor designs. Also I believe the steel shielding can be shaped differently to significantly enhance the effect as well. I will be conducting further simulations to test out these ideas.