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

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Introduction

Graham came up with a good idea on how the Howard Johnson motor might work. I put together a simulation to test his idea out to see if it had any potential. 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 permanent 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".

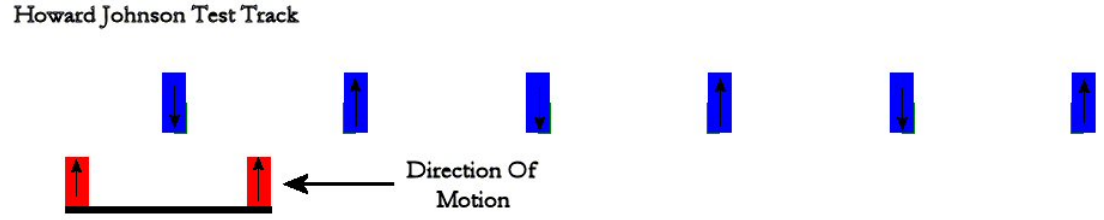

Figure 1 Test track for Graham's Idea

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.

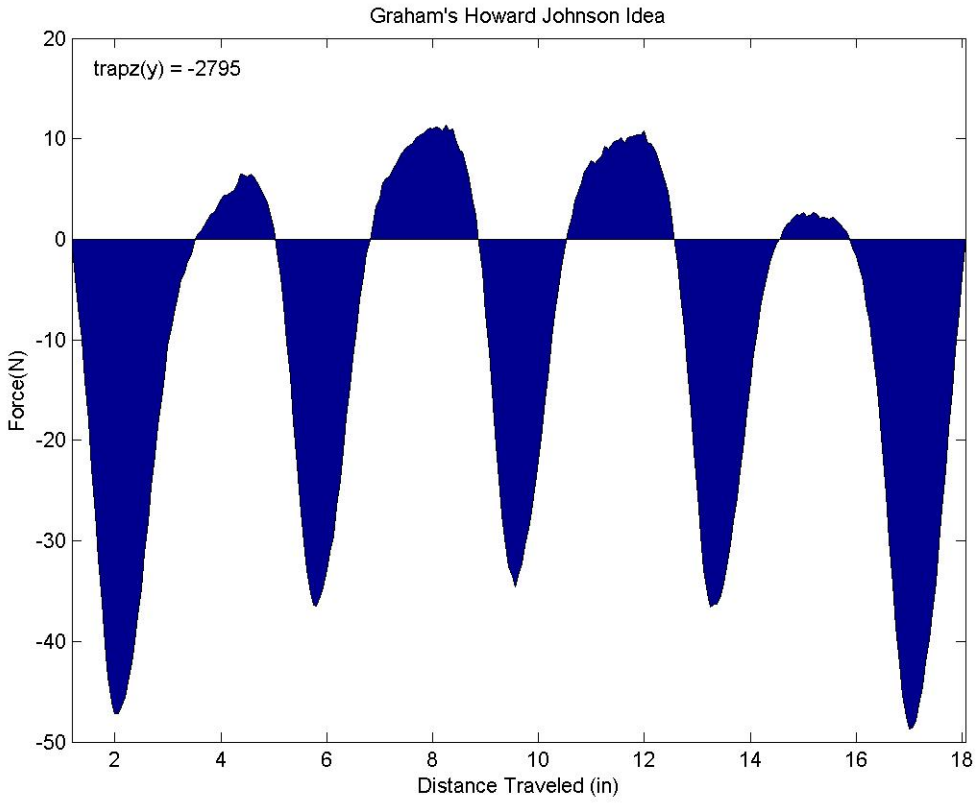

Figure 2 Simulation Result

Conclusion

Graham's idea shows potential. In the above graph the positive force represent a net attraction and the negative forces represent a net repulsion. The graph clear shows there is much more repelling force over the length of the track than attracting forces. Once the rotors get an initial start they should accelerate for the length of the track. I believe the track might be self starting even in the central parts of the track as well.

More analysis should be conducted for this configuration. The shape of the steel should be explored to enhance the effect this configuration exhibits. Other factors that should be tested are magnet shapes, gap between rotors and the stators, gap between the stator pairs and the rotor pair. A longer track should also be tested to see the effects. We should also explore ideas of how this concept can be implemented into a motor.