PROJECT RYU

Contents

This is the first post detailing the design of a high performance wide range driver intended for short front loaded horns. There are many loudspeakers implementing a large horn with a very fast expansion rate pattern fitted with a full range driver. This kind of horn will give a boost in the low mid-range but it will not help the high frequencies and such, to naturally equalize the response, a driver for such an application should have a rising frequency response.

This rising frequency response can be obtained with an overdamped system and selecting the resonance frequency carefully. Overdamping means a low Qts so the starting point will be a a strong motor. I will use the F144 form and I will remake the central pole piece and the top plate. Because this driver is meant to be used in a horn with a complementary LF system, the resonance frequency can be chosen higher and Xmax will not be a big concern so we can have a shorter magnetic gap and still be an underhung motor.

A 38 mm voice coil seems like a good start, small enough for low inductance and mass but large enough to allow for high magnetic flux density in the gap. F144 originally had a 31mm voice coil and F144B will be fitted with 38mm ones.

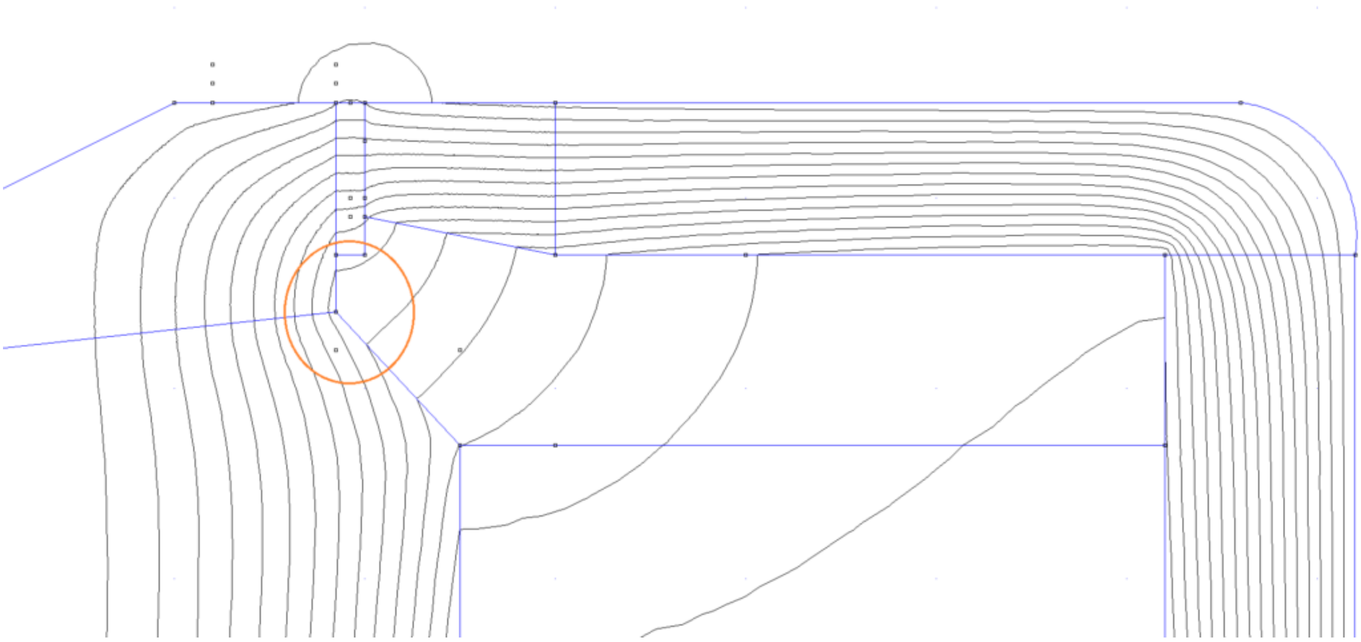

Figure 1. Gap Geometry

Modeling the magnetic circuit begins with a 8 mm thick top plate to which we will bevel one of the inner hole’s edges to a 6mm thickness. This is to make sure the top plate doesn’t saturate before the gap. Figure 1 shows roughly the geometry. First results indicate we can obtain around 1.5~1.7T flux density. We could probably fit around 8, maybe 10 meters of wire in the 6mm gap so BL will range between 12 and 18Tm. At this point I am aiming for the higher value. In figure 2 we plot the |B| value along the gap length with x=0 being the internal edge.

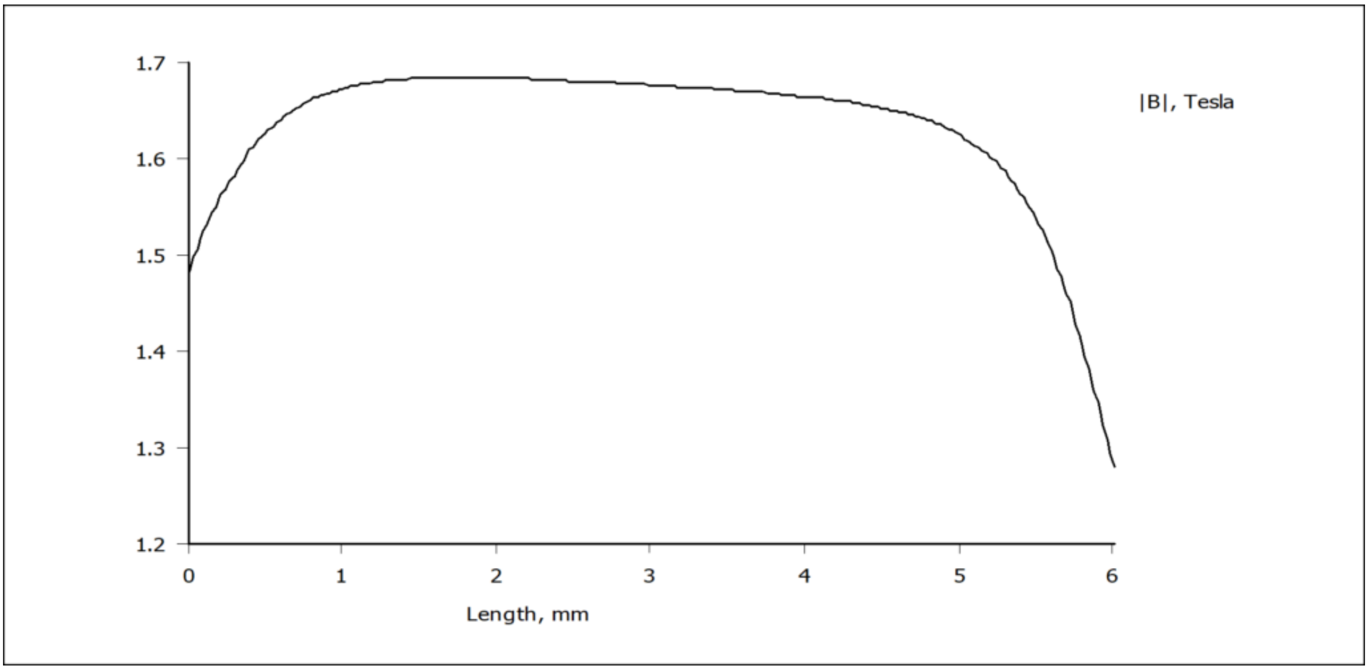

Figure 2. Magnetic Flux Density for figure 1 geometry

After a few simulations it seems a B value of 1.6-1.7T is the best in terms of linearity. Still in figure 2 we can see it is slightly tilted towards x=0 mm. This makes sense, because the field is stronger in the space between the top plate and the field coil marked with orange in figure 1. We will first try to modify the bevel in that area to see if we can reduce |B| at x=0mm. Figure 3 shows the new geometry and figure 4 plots the result.

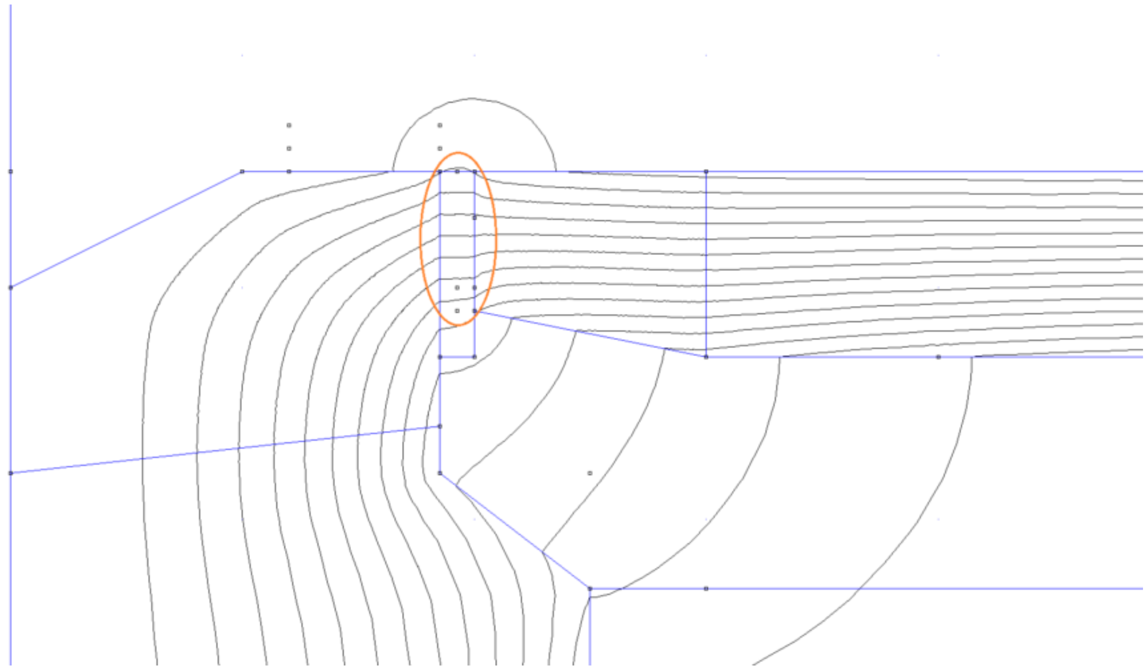

Figure 3. Modified Gap Geometry

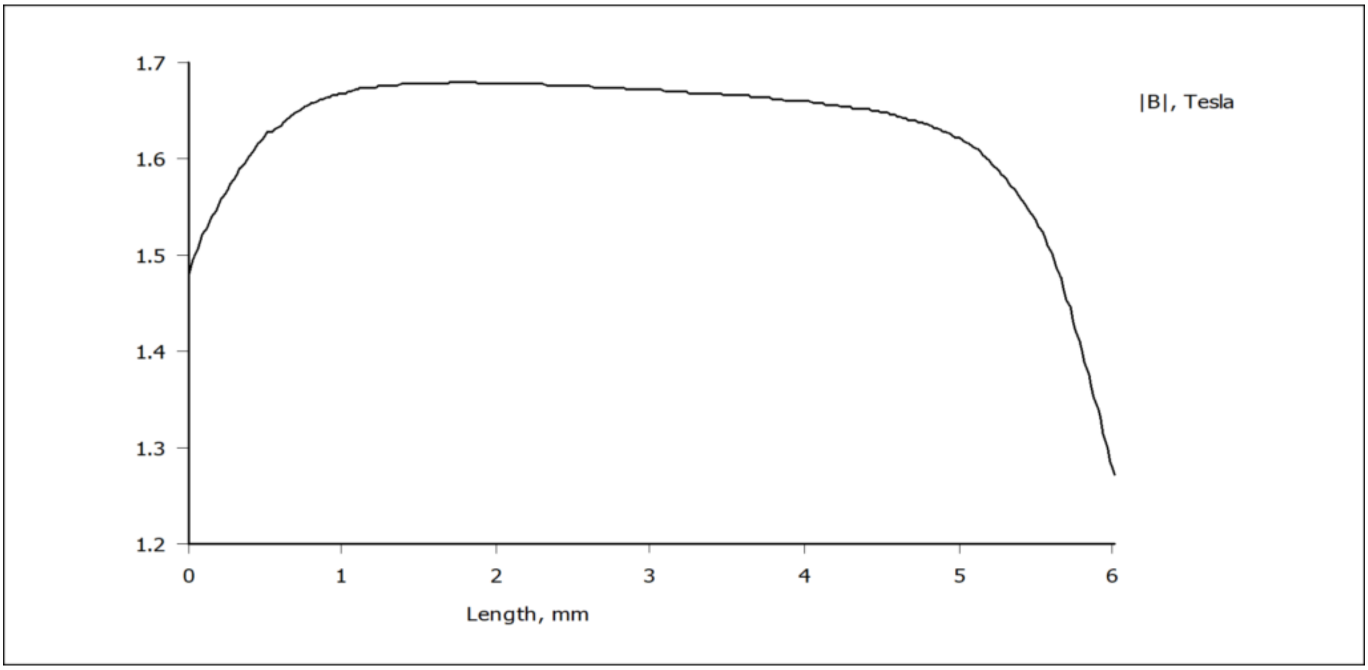

Figure 4. Magnetic Flux Density for figure 3 geometry

We can see that the modification on the central pole piece bevel indeed lowered the |B| at x=0mm but not enough. Looking a bit more carefully at the magnetic flux lines in figure 3, the area circled in orange shows the reason why at x=6mm the flux density is lower with the flux lines arcing over the gap. Extending the central pole piece a little bit above the top plate should lower the |B| at x=0mm by increasing the area.

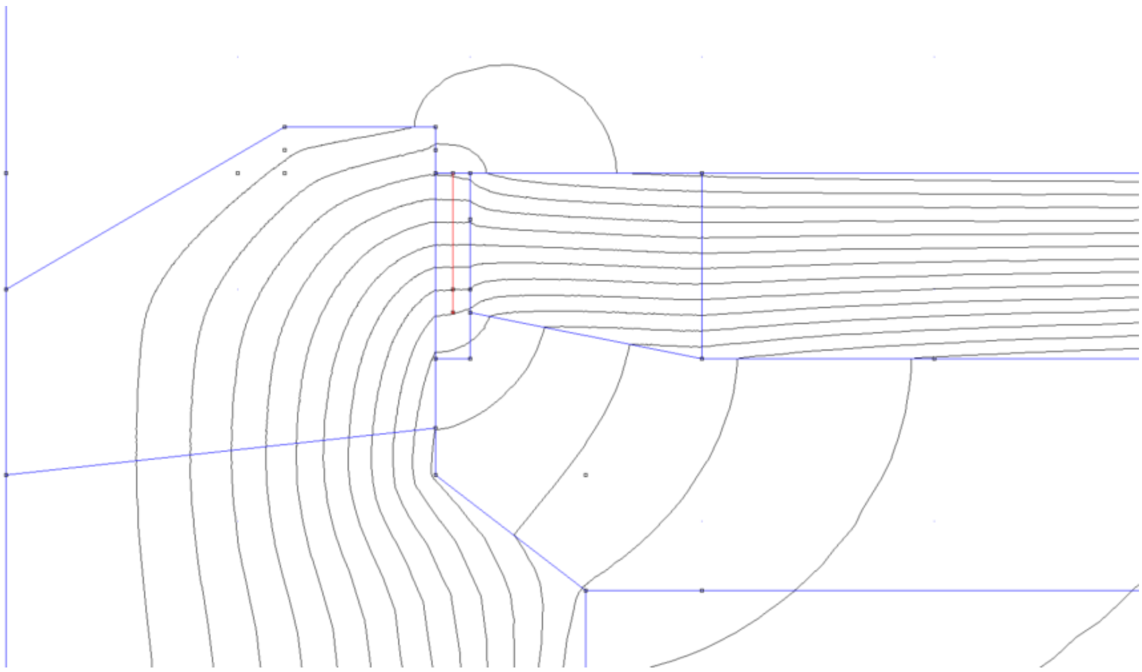

Figure 5. Improved Gap Geometry

We can now see the flux lines are better distributed in the gap. The |B| plot shows the flux density is lower but much more linear so it is a good result for now. We extended the central pole piece by 2 mm and this increased the area through which the flux lines pass decreasing the density but bringing the level in the gap at a better value.

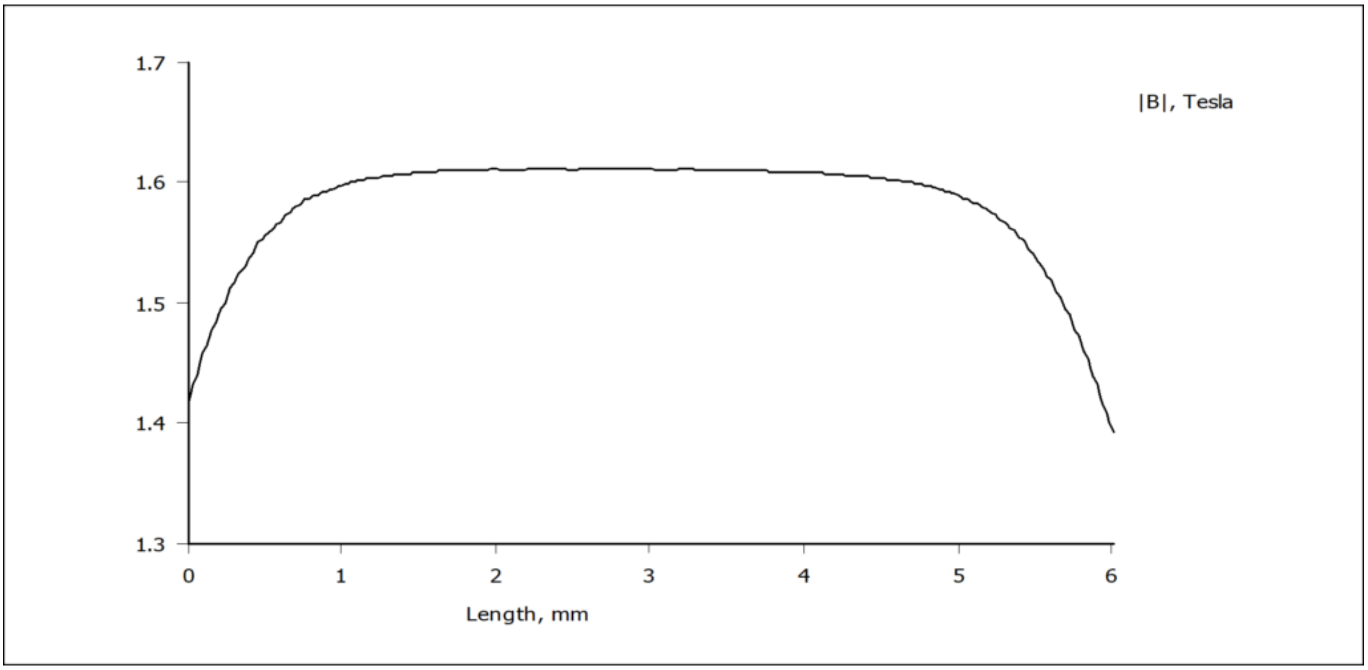

Figure 6. Magnetic Flux Density for figure 5 geometry

With B=1.6T we can expect a BL=12.8~16 which should help overdamping the whole system. We should also note the with an underhung system BL curve is the same as the curve in figure 6. Thank you so much for your attention and in the next post we will work on this circuit more and calculate the field coil and voice coil.