The Differential Form of Faraday’s Law is shown in Eq. 1. This tells us that the curl of the electric field is given by the negative change over time of magnetic flux density. In other words, a flux density changing with time will induce an electric potential (voltage) in a coil of wire!

(1)

A more helpful form for the study of Linear Variable Differential Transformers will be:

(2)

Where induced voltage is equal to the number of turns times the change in magnetic flux with respect to time. Since an alternating current is applied to the primary coils, a sinusoidal magnetic field will be induced through cores of the three coils. Using FEMM, flux through a surface can be measured

(3)

Wow, way easier. Now the phasor form of flux can be measured by taking the surface integral of flux density. The surface we will use to approximate the flux captured by each secondary winding will be the surface at the center of each winding. Here we are assuming that for the purposes of modelling a simulation of a generic LVDT, that the flux captured by the center of the winding multiplied by number of turns (3) will accurately represent the behavior of winding.

(4)

Since the problem in FEMM is axisymmetric, this can be simplified to:

(5)

Where Bn is the component of B normal to the surface of integration. Since this is axis symmetric, this is also the component of B normal to the line integral from the axis of symmetry to the inner radius of the coil. Fortunately, this last integral is an operation that FEMM can do! This means that using Equations 5 and 2, python, and FEMM, we can simulate the magnitude (and even phase shift) of the secondary could knowing that they are counter wound so that

(6)

Provided that the primary 10 turn coil has a current of 1A operating at 60 hZ, each secondary coil has 5 turns and is counter wound in series. These combined with physical dimensions and simulation allows us to find the total voltage across the secondary winding as a function of physical position of the core.