Mathematical Model

Smythe first proposed a mathematical model that includes two distinct torque regions. Below the critical speed, the torque vs. speed relation is approximately linear, and the high speed region approaches some constant. This model was the further expanded and improved by Smythe (1950).

Wouterse (1991) proposed a model for the induced torque at the critical speed, as the torque in this region cannot be expressed simply as a function of magnetic flux and disk speed.

Baum and Eberhardt (2016) proposed a model for the performance of an ECB with two pole pairs on a rotating conductive disk. This model builds on the work of Smythe (1950) and Wouterse (1991) to take into account the saturation of the disk and the demagnetization effect of the induced magnetic flux on the magnets. This results in Equation 2.6 for the low speed region and Equation 2.7 for the high speed region. The critical speed is found by equating these two equations.

$$F_{LowSpeed} = n_{pairs} \cdot \sigma \cdot v \cdot {B_0}^2 \cdot A_{magnet} \cdot t_{disk} \tag{2.6}$$

$$F_{HighSpeed} = n_{pairs} \cdot \frac{1}{v} \cdot t_{magnet}^2 \cdot \frac{B_0^2}{\mu_0^2} \cdot \frac{1}{\sigma} \cdot \frac{2D_{magnet}}{t_{disk} \cdot \delta d_{magnets}} \tag{2.7}$$

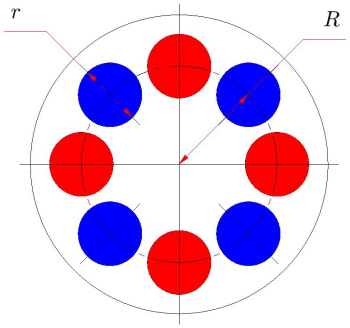

Figure 2.6: Eddy Current Brake Dimensions (To be changed ...)