Semi-Linear Induction Motor

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Objective

The objective of this project was to investigate the 2016 Linear Induction Motor Capstone Project to identify design deficiencies. After identifying any deficiencies we would use magnetic analysis to design a new rotor for the motor.

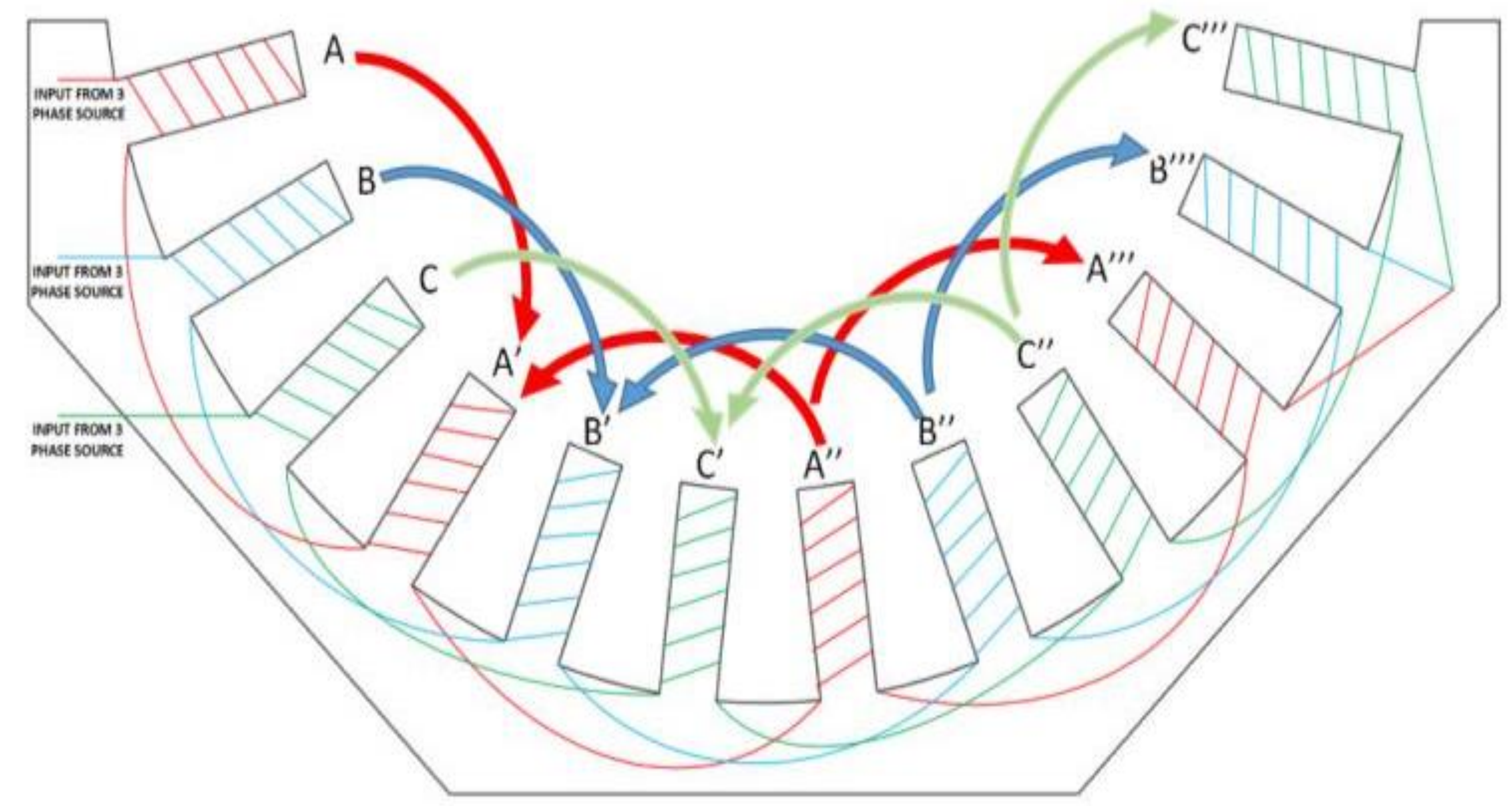
Applications

- **High-Speed Magnetic Monorails**
- **Roller Coasters**
- **Rail Guns**

Acknowledgements

Special thanks to Laser Laminations for fabricating our new rotor. We would also like to thank Terry in Bradley's machine shop for his assistance mounting the copper track onto the rotor itself.

Map of magnetic field



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Inductance Computations

$$L = \frac{N(\mu_r \mu_o A_p A_{ag} A_{rotor} A_B)}{2l_p A_{rotor} A_{ag} A_B + 2l_{ag} A_{rotor} A_p A_B \mu_r + l_{rotor} A_p A_{ag} A_B + l_B A_p A_{ag} A_{rotor}} \quad (1.9)$$

μ_r = relative permeability
μ_o = permeability of free space
A_{rotor} = cross-sectional area of the rotor[m^2]
$A_{p1} = A_{p2}$ = cross-sectional area of the pole[m^2]
$A_{ag1} = A_{ag2}$ = cross-sectional area of the air gap [m^2]
l_{rotor} = length of the rotor[m]
$l_{p1} = l_{p2}$ = length of the pole[m]
l_{ag} = length of the air gap [m]
l_B = length of the base (stator) [m]

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Inductance Computations

- These equations proved that output power is directly proportional to the value of inductance
- Old rotor was resulting in really small values of inductance

$$P_{out} = 6.66 * P * f_m * \Phi_{ag} * T_{ph} * K_W * I_{ph} * \eta * (P.F.) \quad (1.11)$$
$$P_{out} = 6.66 * P * f_m * \lambda_{ph} * K_W * I_{ph} * \eta * (P.F.) \quad (1.12)$$
$$\lambda_{ph} = T_{ph} * \Phi_{ag} \quad (1.13)$$
$$P_{out} = 6.66 * P * f_m * \frac{\lambda_{ph}}{I_{ph}} * K_W * I_{ph}^2 * \eta * (P.F.) \quad (1.14)$$
$$P_{out} = 6.66 * P * f_m * L_{ph} * K_W * I_{ph}^2 * \eta * (P.F.) \quad (1.15)$$
$$P_{out} = K * L_{ph} \quad (1.16)$$
$$\text{Where: } K = 6.66 * P * f_m * K_W * I_{ph}^2 * \eta * (P.F.) \quad (1.17)$$

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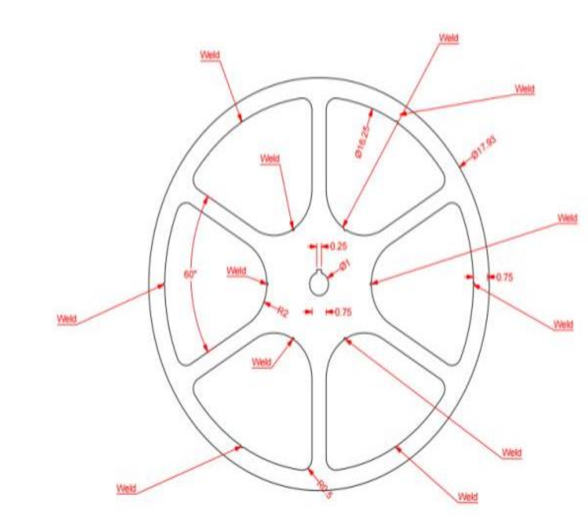
Final Rotor Design



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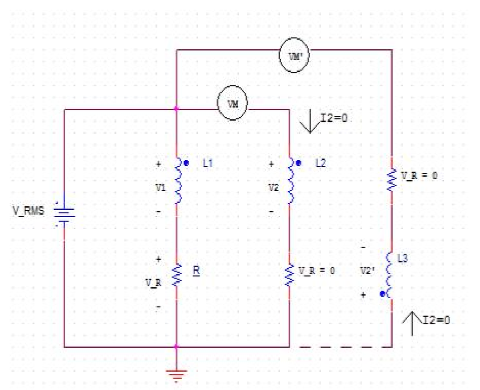
Coil Orientation

- Arranged coils to match the configuration shown in Fig [].
  - If results didn't match, we would further Investigate their orientation
  - Confirming the dot notation was crucial
    - If the notation wasn't correct, voltage supplied would be reduced



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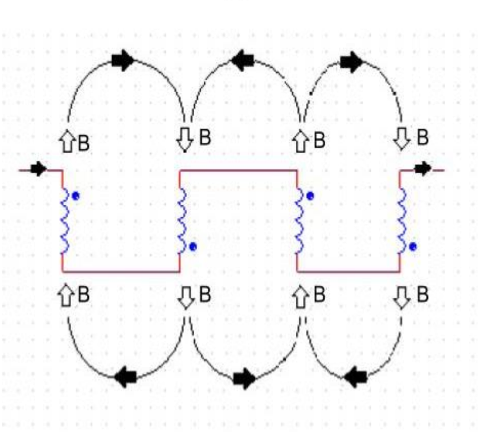
Coil Orientation with Magnetic Field for One Phase



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Rotor Redesign

- New design based on results of magnetic analysis
- Why redesign?
  - The preexisting rotor was initially designed to work as part of a magnetic levitation capstone project
  - The rotor didn't produce acceptable results
  - Minimal rotation occurred

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SLIM with new rotor

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