Investigating the Effects of Heating on DSLIM Efficiency: A Novel Approach to Undersea Magnetohydrodynamic Propulsion

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Magnetohydrodynamic thrusters produce silent, propellorless thrust, but they have significant drawbacks that restrict their commercial use. Conduction based MHD, which sends an electric current through the seawater, leads to corrosion and gas bubble formation due to electrolysis, which reduces the efficiency of those thrusters, and induction based MHD motors, which are simply 3 phase linear induction motors with seawater acting as the secondary, produce low thrust due to the low conductivity of seawater. This investigation aims to identify the relationship between increased conductivity due to heating and the efficiency of double sided linear induction magnetohydrodynamic thrusters. A total of 5 experiments were conducted using the ElmerFEM and OpenFOAM softwares. Instead of directly calculating efficiency with a power output to power input ratio, an efficiency multiplier was calculated as the ratio between force and power input to eliminate the need for velocity as a second independent variable. A control scenario where the conductivity of the seawater was 4.62 S/m was first conducted, resulting in an efficiency multiplier of 4.29%, meaning the true efficiency is 4.29 multiplied by 15.65 m/s, which gives approximately 66%. When increasing temperature to 25 degrees celsius, the efficiency multiplier increased from 4.29% to 4.46%, which is a 3.93% increase, thus increasing efficiency to 70% When increasing temperature to 40 degrees celsius, the efficiency multiplier increased from 4.29% to 4.68%, which is a 9.1% increase, raising efficiency to 73.25%. This demonstrates the effectiveness of heating in induction systems. Future work includes the analysis of the effect of other variables like pole pitch, geometries used, and angular frequency of the alternating current.

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