# High Speed Linear Induction Motor Efficiency Optimization

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The U.S. Navy has relied on steam-driven catapult systems to launch aircraft from aircraft carriers for over 40 years. The first steam catapults used to launch aircraft from a ship were developed by the British, with the first installation going on the HMS Perseus. This system was subsequently tested by the US Navy to launch US Naval aircraft, and the design was approved for installation in the USS Hancock, making the USS Hancock the first steam catapult equipped aircraft carrier in the US Navy. These catapult systems have changed little since their introduction by the Royal Navy in the 1950s, with the only real innovations being in the method of controlling the steam pressure to the piston. With the next generation aircraft carrier, CVN-21, the catapult system will no longer be steam operated but rather electromagnetically operated. This Electromagnetic Aircraft Launch System (EMALS) will utilize a linear motor to effect aircraft launches.

Linear motors have been around for nearly a century, and yet are still in their early stages of development. Because of their relatively large airgaps, high flux leakage, and low power factor, they have a relatively low efficiency when compared to conventional rotary motors. As a consequence of this, they have not been considered viable design options for many high-speed linear motion applications.

Recently, linear motors have been getting a second look by a variety of users that require a traction force by means of something other than friction. High speed trains and monorails as well as EMALS are just a few of the recent designs using linear motors. All of these design applications struggle with the inherently poor efficiencies of these machines. The research presented in this thesis is meant to guide the design of future EMALS-type launchers by proposing a means of optimizing a linear motor design for the purpose of launching aircraft.