First Insights Into a Novel Synchronous Reluctance Electric Motor Design

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With the goal of achieving greater environmental and economic sustainability, the automotive industry has begun transitioning to electric vehicles (EVs). However, the challenge is that the permanent magnets in EV motors have several inherit sustainability and implementation issues. Consequently, motors without permanent magnets have been investigated in literature, with the synchronous reluctance motor (SynRM) being a favorable design. SynRMs have limited EV applications though as they lack the high magnetic saliency required to match the performance of permanent magnet motors. Thus, the investigation aimed to evaluate how the torque and efficiency characteristics of SynRMs are affected by a novel design approach for creating magnetic saliency. In the investigation, the novel SynRM was tested for its torque and efficiency using different rotor geometries and across several rotational speeds. The motor was then reconfigured as a traditional SynRM, and the tests were repeated. The results showed that at the highest performances of both configurations, the torque and efficiency across the entire speed range tested was higher in the novel configuration. To confirm that such performance increases were correlated to improved magnetic saliency, another test was conducted that isolated the theoretical principle under which the novel design operates, and these tests confirmed that the novel design improves magnetic saliency, especially at high power settings. It is therefore reasonable to conclude that the novel design can increase the magnetic saliency of SynRMs, which correlates to higher torque and efficiency characteristics. It also warrants further investigation as an alternative to permanent magnet motors in EVs.

Awards Won:
First Award of $5,000
George D. Yancopoulos Innovator Award
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Office of Naval Research on behalf of the United States Navy and Marine Corps: The Chief of Naval Research Scholarship Award of $15,000