REGENERON WESEF 2019
The Westchester Science & Engineering Fair

Finalist: **Rachel Joseph**

School: **Somers High School**

Title: **Maximizing Energy Efficiency: Improvements in Litz Wire Designs in the Megahertz Range**

Abstract:

Litz wire consists of numerous individual strands of insulated magnet wire, tightly wound around one another to form a woven pattern. This woven pattern is the factor that makes litz wire a viable option for a wide range of technological applications. The geometric configuration of the individual strands has a large impact on the efficiency of wire by reducing the proximity and skin effects. Unfortunately, when companies mass-produce litz wire, little attention is paid to the order in which the strands are placed. Therefore, commercially used litz wire designs and modeling have little impact on electrical efficiency for higher frequency ranges where the skin depth equals the strand diameter. However, this can be challenging since making litz wire more efficient often requires reducing the strand diameter, and this tends to be very costly. This research focuses on scenarios when the skin depth equals the strand diameter by utilizing different geometric configurations of wire strands within the litz bundle. This study demonstrates that the benefits of litz wire can extend into higher frequencies than indicated by previous models. Litz wire efficiency in high frequency ranges is especially important since most modern-day technologies perform optimally in the megahertz range. A new configuration of litz wire was designed and engineered in this study: dielectric core, or "hollow" litz. This is a structure in which individual strands are positioned and confined to the perimeter of the wire with a center that consists of dielectric material. After testing, it was concluded that the hollow litz model is superior to standard litz designs in terms of reducing power loss as well as its superior performance in high-frequency range designs.