Faster Than Light: Voltage and Resistance Phenomena on a 1 km Loop

Kusher, Logan (School: Spartanburg Day School)
Srivastava, Cam (School: Spartanburg Day School)

The US Energy Information Administration reports that 5% of all energy generated by national power stations is lost to grid infrastructure. Resistance in transmission wires is responsible for a large portion of lost energy via heat. When current is induced in opposition to established flow, resistance increases and loss of energy occurs. We sought to establish a relationship between separation distance of a wire and induced current to correlate effects of transmission line separation and grid energy loss. 1,000 meters of 24 gauge copper wire was supported by PVC pipes. Test separation distances were 25 cm, 20, 10, 5, and 1 cm. A 1 kohm resistor was connected to the circuit, and a square wave generator provided an output of 5 V. Oscilloscope probes across the resistor provided V for current calculation. Measured current varied as wire loop gap varied. Maximum current was produced at a separation distance of 1 cm and decreased by approximately 39% from 1 to 5 cm, 19% from 5 to 10 cm, 26% from 10 to 20 cm, 25% from 20 to 25 cm. Means were significantly different. Our initial hypothesis attributed the initial spike in voltage to inductive principles. A derivative of Biot-Savart and Faraday's law resulted in an expected 1/d2 correlation. However, the poor coefficient of correlation to 1/d2 illustrated that current induction alone cannot explain the relationship our data showed. Future studies should develop a model that describes the relationship between induced current and separation distance to find the optimal distance for wire spacing.