

The time Domain, Superposition, and How Electromagnetics Really Works

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Electromagnetic engineers and scientists normally work in the frequency domain. We take advantage of the principle of superposition to break down problems into small, manageable, harmonic components, thus greatly simplifying the analysis of an electromagnetic system. This talk examines what happens when we consider electromagnetics from the time domain, looking at instantaneous instead of time-averaged behavior. This talk further considers what happens when the effects superposition allows us to ignore are added back in to our electromagnetic worldview. The resulting perspective leads to some surprising and counterintuitive conclusions. For instance:

- The source of radiation energy is not necessarily localized with accelerating charges.
- "Near" fields may be present in free space, even arbitrarily far away from sources or scatterers.
- Radio waves, or at least their associated energy, can "bounce" and interact with each other, even in free space.

This perspective has already been of value in making precise indoor location systems and may help lead to more robust antenna designs in the presence of multipaths in the field of nano-antennas.