

Transmitting a Baseband Signal Through an Electrically Small Antenna

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Based on the fundamental limits of antennas, an Electrically Small Antenna, ESA, is a high quality factor leaky resonant structure. The bandwidth limitation at VLF, LF, and even HF bands makes transmitting a signal with a reasonable data rate impossible in the linear time-invariant (LTI) paradigm. It has been shown that, using non-LTI techniques, one can transmit a signal with a bandwidth of much wider than what the fundamental limits allow. This presentation introduces a non LTI technique to transmit a baseband signal through an ESA.

A tuned electrically small antenna, ESA, is shown to be equivalent to a RLC tank resonator with L and/or C as leaky component/s. Generally, L and C leak electromagnetic energy however, we are interested in the structures that only one of the reactive components leaks energy for the purpose of this work. The stored energy in the reactive near field of the ESA is exchanged with the stored energy in the matching circuit (reactive tuning component) in its alternative form, every half a cycle. This property is used to develop an antenna which is able to transmit a baseband signal.

In the resonant state, one can use a switch to guide the stored energy in the tuning lumped component to another lumped component instead of the leaky component, and as the result, oscillation continues while the reactive energy in the near zone of the antenna stays at zero value. After one or more cycles, the stored energy in the reactive tuning lumped element can be guided back to the leaky element and radiation process happens one or more cycles, as long as the leaky element is a part of the resonant structure. This way one can transmit ones and zeros by turning the antenna ON and OFF.