Langston, William, “Time-Domain Current Propagation on a Microstrip Line Excited by a Finite Source”

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Time-domain pulse propagation on microstrip transmission lines excited by a finite-gap voltage source is investigated with special attention given to the dispersive effects associated with the individual components of the transmission-line current.

The electromagnetic analysis is first developed in the frequency domain including material losses. Phase and attenuation constant results from the subsequent model show that, for structures that support a leaky mode, the leaky-mode loss is the dominant loss factor when it is physical. The frequency-domain results for total current show that the leaky mode causes severe signal loss and oscillations in the total current due to interference between the bound mode and the continuous spectrum.

The time-domain analysis, an extension of the frequency-domain analysis using Fourier theory, is applied to three open and covered microstrip structures for two different pulses to show a broad range of dispersive effects. It is shown that for structures supporting a strong leaky mode there is significant distortion including broadening (and eventual splitting) of the pulse as it propagates and a loss of signal energy. Distortion early in time (near the leading edge of the pulse) is primarily due to the continuous spectrum but late-time distortion (near the lagging edge of the pulse) is primarily associated with the bound mode. When a leaky mode is strongly excited, the leaky-mode response makes up a large portion of the continuous-spectrum response and radiates energy as it propagates. It is also shown that for structures that support a leaky mode only at very high frequencies (relative to the frequency spectrum of the pulse), the distortion is almost exclusively due to the bound mode and hence is accounted for by CAD formulas based on the bound mode, when such are available.