

**Abstract:**

This paper introduces models of the time-domain echoes generated by faults in transmission lines excited by test signals, e.g., as in applications of time-domain reflectometry (TDR). Faults considered here include local modifications of the propagation characteristics of a transmission line. It is shown that the responses of faults are strongly dispersive in nature, which implies that the peak of their echo is far from providing an accurate measure of the severity of the fault, as it heavily depends on the frequency content of the test signal as well as on the length of the fault. It is argued that fault detection in transmission lines is an ill-posed problem that requires a priori knowledge on the fault itself. These results are important for applications of TDR methods, particularly for early warning monitoring of potentially critical faults from their onset, since it is shown that echoes from faults tested at relatively low frequencies can lead to underestimate their actual severity.