Inclusion of "Carl's Law" in Intentional Electromagnetic Interference Susceptibility Analysis

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The sequence of events in testing an electronic system to intentional electromagnetic interference (IEMI) stress can be described as a series of transfer functions: source, antenna, propagation, external coupling, internal coupling and the effects on the electronics. All of these transfer functions are very sensitive to the frequency content of the waveform emitted by the source. Effects tests are designed to explore the sensitivity of the effects to various parameters describing the transmitted signal as well as those describing the test object.

The effects portion of this sequence is often difficult to handle analytically because the system effects are sensitive to frequency and waveform characteristics not just in the usual coupling sense but also manifest large and abrupt changes in state which represent upset and damage. The response curves are therefore not smooth functions. Since there is no useful theory for this part of the system response, it is usually handled empirically with the test operators exposing the target to different waveforms and observing the various state changes. This process links the source/antenna part of the transfer sequence directly with the effects end state giving information about the coupling part of the sequence only as a filter that is sampled in the process. The most transparent part of the coupling filter is in the resonant region of the system response, but requires very dense sampling to characterize in the resonant region unless one has additional information.

Carl's Law observes that all systems useful to people will have characteristic dimensions near that of the human hand. If that is true the distribution of hand sizes and useful control sizes gives us a reasonable distribution of the useful pass band of the coupling part of the filter. If we concentrate our testing on a combination of the probability distribution of the source characteristics, the operating characteristics of the target system and that observed in coupling region then we can show a much more compressed test matrix. This matrix will not have to be as dense because we do not have resolve the particular system resonances as carefully.