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Strengths and limits of reliability assessment methods - Illustration in the field of EMC

The proper functioning of electronic systems threatened by electromagnetic interferences (EMI) is prone to uncertainties that may arise at several levels: polarization and angle of incidence of electromagnetic waves, system configuration such as placement of electronic devices and routing of cables, material electric parameters, ... These uncertainties may cause severe degradations of the electromagnetic compatibility (EMC) performances of these systems (susceptibility, emission, crosstalks) and quantifying their effects on outputs of simulation models, also known as observables, is therefore of practical importance in many engineering applications.

When high safety level requirements or standards are imposed, it becomes necessary to estimate probabilities that critical systems fail w.r.t. a given failure criterion or set of criteria, e.g. currents, voltages or powers above/below prescribed threshold values. The talk will review the most efficient reliability assessment methods for estimating low failure probabilities, covering both approximation methods (FORM and SORM) and sampling methods (Monte Carlo, subset simulation). A specific focus will also be put on adaptive surrogate models (namely support vector machines) based on very recent developments, of practical importance in applications involving expensive-to-evaluate numerical models used in a non intrusive way. Some examples in the field of transmission lines will illustrate the talk and highlight the strengths and limits of reliability assessment methods.