TECHNIQUES RELEVANT TO THE ANALYSIS OF ELECTROMAGNETIC INTERFERENCE EFFECTS ON ELECTRONIC SYSTEMS

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ABSTRACT

The High Power Microwave (HPM) community has engaged in a multi-decade research initiative aimed at understanding and predicting Electromagnetic Interference (EMI) Effects of HPM on electronic systems. With varying degrees of success, multiple groups within the community have demonstrated an ability to predict Effects in very controlled situations. By controlled we are referring to the electromagnetic environment which includes the test facility (anechoic chambers, reverberation chambers, direct injection, open area test sites, et cetera), HPM source location and output, and the wiring topology (both external and internal) of the electronics under test.

One of the analysis techniques that have shown the most promise as of late is Multivariate Logistic Regression (MLR). MLR is a statistical technique, and as such is most appropriately applied to large data sets. The MLR technique assumes a specific functional form for the Probability of Effect (PE) and fits the empirical Effects data to this model. Because it is an empirical technique it is fraught with all of the problems associated with empirically based methods. In particular, it is not practical to attempt an extrapolation outside of the experimental data sets. This translates into a limitation in the utility of the fit. Any test condition deviations including electronic configuration changes, test environment changes, and source changes may not be covered by the MLR fit. However, recent developments in the application and interpretation of the MLR technique in conjunction with physics have led to a modified MLR fitting process that yields less restrictive fits.

While promising, the modified MLR process still has many limitations including its restriction to large data sets. Hence, it is necessary to develop analysis techniques relevant to data sets with either limited amounts of data, and/or multiple parameter variations. These techniques generally begin with simple trend analysis, and evolve from there. For data sets with limited data and only one or two parameter variations, the analysis is usually quite straight forward. However, for data sets with multiple parameter variations, one often observes a detached application of statistical techniques for identifying variable dependencies. Without keeping ones foot firmly rooted in physics, these applications can lead to incorrect conclusions.

This paper will discuss both the modified MLR technique as well as other, more general statistical techniques. The discussion will be centered on the analysis of an HPM Effects data set. Both the strengths and weaknesses of the techniques will be born out through example, as well as discussions of future work which should serve to improve the analysis methods for HPM EMI Effects data analysis.