Evaluation of HPEM Effects of Electronic Equipments in Actual Environments

Jin Soo Choi, Jongwon Lee, Jiheon Ryu, Cheonho Kim, Seung Ho Han, and Sung Hoon Hong
The 4th R&D Institute
Agency for Defense Development (ADD)
Daejeon, Republic of Korea
jschoi@add.re.kr

***Abstract*— It is hard to solve the susceptibility of electronic equipments to high power electromagnetics (HPEM) in practical environments due to the complicated parameters such as coupling paths, external interference, and random effects. In this work, we propose the methodology to predict HPEM effects of electronic equipments in the actual building. We first model and simulate the electromagnetic propagation into the building with two stories. We then measure the HPEM susceptibility of electronic equipments in the building structure. The compact high power electromagnetic source developed in ADD is used to validate the HPEM effects.**

Keywords*— *high power electromagnetic effects, actual environment, electronic equipments, susceptibility

I. Introduction

Electronic equipments are very important to the modern life and military systems. Since the equipments are vulnerable to high power electromagnetic waves, the HPEM effects of the electronics have been researched in past decades. However, due to the unclear parameters such as electromagnetic coupling path and stochastic effects of malfunctions, it is difficult to accurately evaluate HPEM effects in real environments.

To discover the algorithm for HPEM effects of electronic systems in actual environments, we firstly measure the electromagnetic waves penetrated into the actual building with two stories. The system developed by ADD in [1] is used as the HPEM source. The penetrated waves are numerically and experimentally validated. We then analyze the HPEM effects of electronics such as computers, networks, and cameras.

II. Signal Penetration

A. 3-D Modeling and Simulation

Fig. 1(a) illustrates the 3-D computer model of the actual building structure. As shown in Fig. 1(b), the distribution of penetrated electric fields is computed by using finite-difference time-domain method.

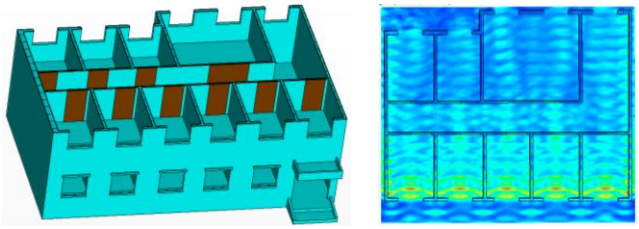
B. Measurement of Electromagnetic Penetration

We measure the electromagnetic signals simultaneously in various positions like at front windows and at the rooms of the building. Here D-dot sensors are used to obtain pulses from the ultra wideband source. The measured data are compared to the simulation results.

III. Effects of Electronic Equipments

To validate the HPEM effects of electronics, various computers and network devices are installed at each room in the two-story building. The high power wideband radiators which can generate high electric field are installed outside the building. D-dot sensors and electrically shielded cameras are set up at each observing points. The signals from network devices are regularly transmitted through the optical cable. By using this monitor system, we are able to measure the electric fields and observe HPEM effects of electronic equipments in the remote shielding room. We can also watch the malfunction of network devices.

A number of test results are systematically and statistically analyzed to evaluate the susceptibility of electronic equipments as shown in Fig. 2.



(a) (b)

Figure 1. 3-D modeling and simulation of signal penetration

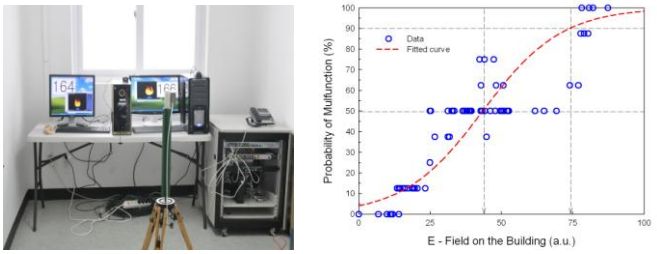


Figure 2. Test Equipments in the Building and results of HPEM tests.

References

[1] J. Ryu, J. Lee, H. Chin, J.-H. Yeom, H.-T. Kim, H.-O. Kwon, S. H. Han, and J. S. Choi, "A high directive paraboloidal reflector antenna for high far voltage in an ultra wideband source system," IEEE Trans. Plasma Sci., vol. 41, no. 8, pp. 2283–2290, Aug. 2013.