

# RELIABILITY-BASED DESIGN AND EVALUATION OF ELECTROMAGNETIC SHIELDING AND ABSORBING STRUCTURES

## ABSTRACT

The rapid proliferation of electrical/electronic products has indeed benefited the modern society but with a rider to control the risks associated with electromagnetic emissions and its interferences. The Electromagnetic pollution associated with the deployment of such products not only involuntarily disrupts the normal operation of electronic/electrical devices in its vicinity but also detrimental to human health. Besides, the electromagnetic wave absorption has become an indispensable requirement in modern warfare for stealth technology to elude a vehicle or structure from its detectability through modern technology. The stealth technology ensures high mission accomplishment rate and survival in the antagonistic province.

Therefore, to shun undesirable consequence resulting from the electromagnetic interference (EMI) and detection, the EMI shielding/absorbing structures and materials have taken a paramount importance in the design and development of such structures. Literature indicates that the design approaches employed for shields overlook the factors' interrelationship, manufacturing uncertainty and effects of random variables. Additionally, absorbers' design comparison and incorporation of uncertainty in variables (design and/or operating environment) also require proper methodology to address such issues.

This thesis is an attempt to provide various formulations and solutions approaches for EMI shield and absorber design problems under various (deterministic and/or probabilistic) constraints. In this thesis, the interrelated factors and materials parameters have been systematically accounted and analyzed in the EMI shield design optimization problem with a specified shielding requirement. In order to address issue of manufacturing/measurement uncertainty in the design variables and associated randomness in design problems formulation, it is scholar's maiden endeavor to employ **Reliability-based Design methodologies** in the area of EMI shield/absorbers design. An alternative approach (hybrid genetic algorithm) than the approaches existing in the literature has been implemented for the optimization of multilayer absorbing structures' design, and performance based reliability has also been evaluated to compare absorbers' designs alternatives in a quantitative way. The issues of uncertainty in the design variables and external random variables/parameters in absorber design have also been addressed with the proposal of **Reliability-based Design Optimization** approach in the design of multilayered EMI shielding and absorbing structures.

In this thesis a series of composite materials for EMI shielding and absorption are manufactured under different processing conditions. The electrical properties of these composite materials are investigated as a function of frequency and volume fraction of fillers. Besides, the proposed theoretical models have been experimentally validated using the materials properties and database of developed materials. The manufactured composite materials will have their possible applications in charge storing devices, EMI shielding and absorption techniques.

**Keywords:** Electromagnetic shielding, Electromagnetic Absorption, Performance-Based Design, Reliability-Based Design Optimization, PVDF/Metal Composites