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Analytical Modeling explains some Critical Behaviors and Performances of Electronic and Photonic Materials and Systems

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Introduction

Merits, attributes and challenges associated with the application of analytical "(mathematical)" predictive modeling in electronics and photonics materials science and engineering are addressed. The emphasis is on some practically important, yet often paradoxical, i.e., intuitively non-obvious, materials behavior and reliability related phenomena. It is shown particularly how such modeling can be effectively used to quantify human performance in various "human-in-the-loop" situations, when equipment/instrumentation reliability and human performance contribute jointly to the outcome of a vehicular (aerospace, automotive, railway or maritime) mission or an off-normal situation. It is concluded that all the three basic approaches of applied science and engineering- analytical modeling, computer simulations and experimentation (and, particularly, accelerated testing) - are equally important to understand and to quantify the reliability physics of the materials behavior and the attributes of human performance: as they say, "if your only tool is a hammer, all the problems look like nails to you", do they not? The major concepts are illustrated by numerical examples.

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