

Preface

Design of contemporary antenna structures heavily relies on electromagnetic (EM) simulations. Accurate reflection and radiation responses of many antenna geometries can be obtained only with discrete full-wave EM simulation. On the other hand, the direct use of high-fidelity EM simulation in the design process, particularly for automated parameter optimization, results in high computational costs, often prohibitive. Other issues, such as the presence of numerical noise, may result in a failure of optimization using conventional (e.g., gradient-based) methods. In this book, we demonstrate that numerically efficient design of antennas can be realized using surrogate-based optimization (SBO) methodologies. The essence of SBO techniques resides in shifting the optimization burden to a fast surrogate of the antenna structure and the use of coarse-discretization EM models to configure the surrogate. A properly created and handled surrogate serves as a reliable prediction tool so that satisfactory designs can be found at the costs of a limited number of simulations of the high-fidelity EM antenna model. The specific SBO techniques covered here include space mapping combined with response surface approximation, shape-preserving response prediction (SPRP), adaptive response correction (ARC), adaptively adjusted design specification (AADS), variable-fidelity simulation-driven optimization (VFSDO), and surrogate-based optimization enhanced by the use of adjoint sensitivities. Multi-objective design of antennas is also covered to some extent. Moreover, we discuss practical issues such as the effect of the coarse-discretization model fidelity on the final design quality and the computational cost of the optimization process. Our considerations are illustrated using numerous application examples. Recommendations concerning application of specific SBO techniques to antenna design are also presented.

Antenna Design by Simulation-Driven Optimization

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