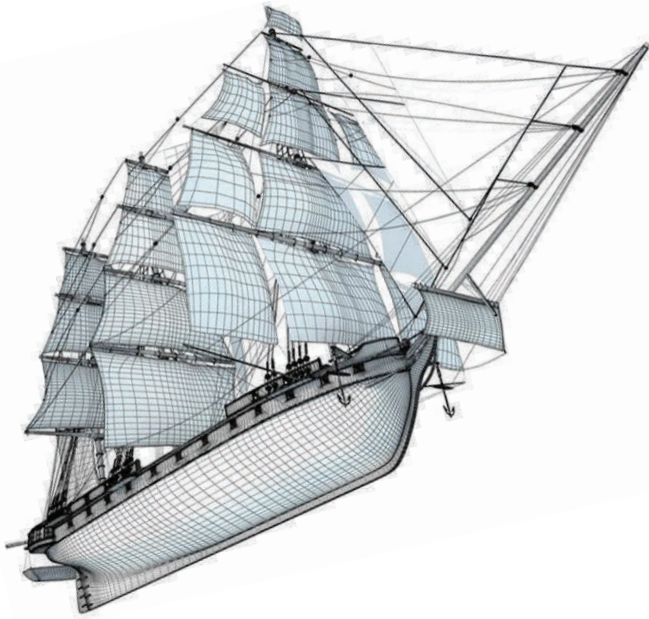# CHAPTER 9

APPROACH TO NUMERICAL SOLUTION OF ELECTRODYNAMICS PROBLEMS
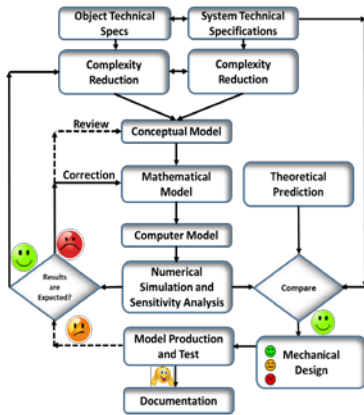
OK, so the computer has understood, but what about me?
Eugene Wigner, Nobel Laureate

The sciences do not try to explain, they hardly even try to interpret, they mainly make models.
John von Neumann

You can learn in Chapter 9

Earnestly, in the chapter, we are not going to teach you. We will just attempt to help you breach the numerical fence hiding the solutions of Maxwell's equations from clear observation. Unfortunately, the computer simulation quite seldom increases our understanding the problem and physics behind it. Evidently, the first step in any simulation is the model development of some physical object (antenna, filter, circulator, etc.) that comprises several sub-models: theoretical, conceptual, mathematical, computer imaging, statistical, etc. The saddest moment that any of such sub-models as well as the final model are not the real world entity but just a set of computer images, mathematical symbols and linking all of the equations that are supposed to help us better understand the surrounding world but do it rarely. Evidently, the surrounding world is so diverse and complex that the procedure of the model construction that is entirely adequate to a real object is extraordinarily challenging or just unattainable. As a result, the thorny path to well-posed models typically consists of several iterations, as the block diagram on your left illustrates.

We devoted the most part of the chapter to the theme how to choose the "best-fit" for your particular task EM modeling software or manage the currently available in your organization. As of the date of the publication, we found, probably, more than hundred different tools. Nevertheless, the single "best-fit" method for all circumstances is a recurring and lucid dream despite the fact that new software variations are continuously developed. The heart and brain of any EM computational code are the evaluated in this code "digital image" of Maxwell's equations and the path to their solution. We consider in short just several numerical approaches like MoM, FDTD, and FEM that allows you to understand multiple interconnections between them and possible variations.

The final section is devoted to the methods of acceleration of numerical simulations. That will go mainly about FDTD method that naturally lends itself to parallelization on high-performance computers.

Chapter Contents