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EDITOR'S MESSAGE

Microwave Modelling and Simulation

High efficiency, high rate, uniform heating, and other especial effects, are terms often presented as advantages of microwave processing in conferences and manufacturers' brochures. People interested in developing processes based upon these effects would like to have a quantitative idea about them. If the system for a given application is already designed, it should be possible to obtain data by direct measurement. However, when the intent is adapting a system for a new purpose; or scaling it up; or when everything in the process is new, there is no data that can be measured, no facility to visit, and no design to copy.

Although small things could be investigated by conducting experiments in the laboratory, developing new designs or scaling -up using this method is often unpractical, and even if practicality were not the issue, not everything can be manufactured for testing. Handbooks, manuals, and an engineering background are sufficient to create system designs in common situations, while in less common situations (such as megastructures, nanostructures, and aeronautics, among others), the only way to succeed is a combination of experience and knowledge to produce information about how a system performs without actually having to produce it. This information can be obtained through the application of a powerful discipline called "simulation".

Simulation is achieved through a model, which can be physical, mathematical, statistical or any other that deals with the relationship between the causes and effects in a quantitative manner, and is utilized to produce results that reproduce the observed behavior of a system and, more importantly, by testing different operating conditions can generate predictions useful for decision-making, or didactic demonstrations as well, during the design and manufacturing of a variety of systems and devices.

Since models often require extensive mathematical operations, simulation is often associated with computers that rapidly perform the necessary calculations and present the results in an understandable manner. Since the strength of simulation deals with its ability to formulate predictions, a simulator cannot be accepted until a comparison is made with experimental results. Simulation has become, in some cases, a controversial issue: there are many simulators with good reputations, but there is a strong tendency, in some areas, to validate a simulator by comparison with other simulators without taking into account the limitations of each.

This condition means that the simulator is not truly tested, and thus may have an effect upon the discussion of its results.

All the models have limitations because: only the most important phenomena are considered since every phenomenon involves an equation, and every equation involves variables, which are often interdependent. A complete model requires that "all" the phenomena are considered, but this is impossible, so the wisest action is choosing the most important phenomena that describe most of the system being studied; then simplify when possible, remembering that over-simplification leads to an insufficient model that, most probably, will not predict anything useful. It is a compromise between something that is manageable and something that provides results that closely fit reality.

Simulation is not an easy task; good scientific and mathematical backgrounds, as well as reliable source of data for validation are necessary. There are many potential sources of error: computer precision, over-simplification of the parameters, and relations based on regressions, among others. A simulation is validated if its results are close to the experimental results. The first thing that a good simulator provides is the general behavior of the system, meaning that if a simulator does not provide the general behavior, it is impossible to find a set of parameters that can be adjusted and keep their physical meaning.

Depending upon the limitations of the model, the results can be taken as estimations (the weather forecast for instance), or as good models for measurements, as is the case of the classic mechanics models. Many equations, related with microwave processing are well established, but are concatenated with parameters that are affected in multiple ways, while experimental conditions are hard to maintain.

Measurement is a very important part in the validation of a simulator, therefore it would be useful to merge works that provide very good, carefully taken, data from extensive experiments, with other work involving strong theoretical foundations. JMPEE is committed to provide space for exposition of intellectual work, careful reports, and intelligent discussions to be considered and evaluated by microwave engineers and researchers for designing of efficient and safe devices.

Dr. Juan Antonio AGUILAR-GARIB
Universidad Autónoma de Nuevo León
Facultad de Ingeniería Mecánica y Eléctrica
San Nicolás de los Garza, NL, México