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Giving a Little Thought to How We Think

Gary Breed
Editorial Director

In the U.S., 3.1 to 10.6 GHz is allocated for unlicensed ultra-wideband (UWB) applications. With this extremely wide bandwidth, UWB antennas are an interesting engineering problem; they must cover this very wide band with low VSWR to avoid distorting the transmitted signal, and must have a sufficiently uniform radiation pattern, in both amplitude and polarization, for reliable transmission. This issue includes an article on UWB antenna design by professor and consultant Anitoliy Boryssenko.

A characteristic of many wideband antenna structures is complex geometry, necessary to create current paths at the various frequencies that result in the desired feedpoint impedance and radiation pattern. At first reading, Dr. Boryssenko's paper offers an interesting way to group families of antenna structures by identifying the features that make the family members similar. To do this, he borrows a technique from the biological sciences: *taxonomy* (or *classification*), the creation of groups. These groups are defined by certain similarities, such as straight line boundaries, curved line boundaries, linear structure, loop structure, etc. Another technique is the use of an identifying mechanism by which one family member is changed into another. The simplest are alterations in length, width or thickness. More complicated means include linear displacement or rotation to define a three-dimensional structure. These adaptive processes are identified by examination, analysis, and experience, and are called *heuristic* (or *knowledge-based*) rules. They provide a list of processes for manipulating the structures within the families, not only to analyze existing structures, but to generate new structures as well.

This sounds abstract and complicated! Well, it is abstract, and while it may involve a large number of antenna structures, it is not really complicated. These techniques provide an orderly, rules-based approach to discovering potential new antenna structures. We should expect it to work—engineering is inherently orderly and is definitely based on rules.

So, we can look at this article and see two levels of thought. The first is simply an outline to help develop designs for a particular type of antenna, which is certainly a useful purpose. The second level is the methodology, the classification of a number of pertinent data points, manipulated by a set of rules to uncover new data. These methods may also be an interesting way to look at other engineering problems.

As they say on TV, “But wait, there’s more!” Dr. Boryssenko has added a third level of value—insight into how we think. And he notes that such things are rarely, if ever, taught in universities.

It’s not always necessary to ponder a design task in such a philosophical manner, but this paper’s approach will surely encourage some of us to stop and think about the way we figure things out. All of us admire engineering designs that exhibit unusual intuition or creativity, which sets them apart from those that simply “meet the spec.” Sometimes we wonder how the designer came up with the idea—and even he may wonder!

I’ll leave it to each of you to decide how important this subject is to your own work. As noted before, it can be a specific tool, an adaptable method, or an idea that piques your curiosity.

Things We Didn’t Learn in School

Let me expand briefly on Dr. Boryssenko’s comment that creative or intuitive thinking is rarely taught in colleges and universities. I’ll disagree mildly, since most of the required humanities courses attempt to show how great authors discussed important matters, or how the decisions and behaviors of figures in history affected future events. Unfortunately, the lessons of these required courses are largely ignored by undergrad engineering students, and the courses are only occasionally taught by the most inspiring professors.

Another problem is that the intense engineering curriculum has little room to explore such concepts. Perhaps the best approach for teaching creative problem-solving is simply to remind students that such skills are necessary to advance from entry-level career positions into more responsible supervisory and management roles—but those skills need to be developed individually, combining innate ability with personal interest. Among engineers with a strong creative reputation, reading and other explorations of a wide range of subjects outside engineering seems to be a common habit.

The engineering profession deals with precise mathematical solutions to complex problems. Yet, the best engineers sometimes reach those solutions by routes that are anything but precise. I believe each of us should admire that ability and spend some time thinking about what helps us think!

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