Electromagnetism, Electrical Engineering and Mathematical Structures

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Ideally physics and engineering should be built above rigorous mathematics, but the very elementary university level textbooks in physics already suggests that mathematics is not employed as the logical foundations for the reasoning. Instead, mathematics is often understood as a useful construction that is needed when the purpose is to produce numbers. Still, there is no other logic, or more precisely no other model of logical relations between abstractions (free of instances) available than mathematics, and in this sense it can be understood as our most immediate tool to analyze the universe around us. Consequently, one may ask why so many adopt a view of mathematics as a device to form numbers and also put the emphasis on this.

In the structural sense mathematics consists of theorems that form axiomatic systems. The axioms themselves are the entry points to the theorems and once some object fulfills the axioms, mathematics guarantees that whatever follows from the axioms is correct. Physics, of course, includes the very same principle; Given some well established starting point the models in physics are meant to logically extrapolate as many consequences as possible. The very idea of logic is involved in the assumption that under the same conditions the nature “behaves” always the same way.

Here we approach electromagnetism and electrical engineering from this viewangle. Electromagnetism is, or should be very much about applied mathematics in which we create instances of mathematical structures for specific needs. In electrical engineering we exploit such instances and evaluate the logic behind the construction by real numbers. The presentation explains in more details and demonstrates what this kind of reasoning implies into science and engineering.