ECE Headline News

Rao renames Web site on "Teaching and Learning Electromagnetics" in reverence for Maxwell

By Charlie Johnson, ECE ILLINOIS
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When was the last time you thanked James Clerk Maxwell? If you're anything like ECE Professor Emeritus N. Narayana Rao, you do it every day.

N. Narayana Rao

For most of his academic career, Rao, the Edward C. Jordan Professor Emeritus of Electrical and Computer Engineering, has been teaching and writing undergraduate textbooks on electromagnetics, a field ushered in by "Maxwell's equations," named after James Clerk Maxwell. But Maxwell is more than just a name on a PowerPoint slide to Rao. He's an inspiration.

"Maxwell is a man whose work underpins devices everyone uses today. Yet most people are unaware of it, and those who know about it generally take it for granted. I consider it my duty and privilege to spread Maxwell's message to the world, in engineering education," said Rao.

Rao has been operating an open access Web site with resources he developed, teaching Maxwell's equations and the fundamentals of electromagnetics (EM) over the many years of his academic career. On the site are class notes, instructional materials, presentations, and video lectures, available to any person worldwide who desires to learn a bit more about Maxwell or electromagnetics. The Web site was titled, EMFware, where EMF stood for "EM fundamentals," until Rao decided recently on a name change, in reverence for Maxwell.

James Clerk Maxwell was a Scottish theoretical physicist and mathematician most known in the scientific community for his famous Maxwell's equations that showed that magnetism, electricity, and light are all part of the same phenomenon: the electromagnetic field. His work in the field of electromagnetism set the stage for over a century of research and understanding of electromagnetism. He is frequently named in lists of the 100 most influential people, and it is said that Albert Einstein kept a photo of Maxwell over his desk alongside Michael Faraday and Sir Isaac Newton. To honor his achievement, IEEE recently installed a plaque bearing his name and famous equations at Maxwell's family home, Glenair House, in Kirkcudbrightshire, Scotland, and a second one at King's College, London.

ECE Professor James Coleman was present at the plaque unveiling at Glenair and mentioned to Rao that he thought of him during the ceremony. When Rao asked him why, Coleman responded, "When I think of Maxwell, it is only logical that you should also come to mind. I'm delighted to hear--and not surprised--that you are still spreading Maxwell's message to those young people in India."

"I decided when I saw the plaque and heard those words that it was time to change the name," said Rao. The Web site, now titled "MEFware: Open-Access Materials for Teaching and Learning Fundamentals of Electromagnetics (FEM) Using the Maxwell's Equations First (MEF) Approach," is only a small part of Rao's career spent educating generations of students on Maxwell's equations and electromagnetics. More than 10,000 students have graduated from Illinois alone learning from his textbooks, taught by ECE faculty.

Rao wrote his first textbook "Basic Electromagnetics with Applications" in 1972. This book approached electromagnetics with a "statics first" approach. Students spent a large amount of time focusing on learning statics and quasistatics, but only reserving a little time for Maxwell's equations that govern the larger, dynamic spectrum of study.

"I realized this approach wasn't a good one for the times, after the book was published. In 1974, I initiated a new approach that started with Maxwell's equations right in the beginning. Learn the equations that govern the whole spectrum, and then go from there," said Rao.

Rao went on to publish a new text titled "Elements of Engineering Electromagnetics" in 1977. This focused on teaching Maxwell's equations first and then expanding the students' knowledge building on them. "The new book essentially sent the first book to the shelf as a resource, but that's what you have to do to progress," he said. It was groundbreaking at the time, and if you ask Rao's students, the new approach paid off.

"I remember taking Professor Rao's course when his book was still typewritten and with handwritten notes. He clearly had a way of simplifying the concepts and getting right to the issues in electromagnetics. I thoroughly enjoyed his classes then over 30 years ago," said DSL pioneer John Cioffi (BSEE '78), a student in Rao's classes in 1976-1977, now Hitachi America Professor of Engineering at Stanford, a Marconi Fellow, and winner of Marconi Prize in 2006.

"Though I had previously taken a number of electromagnetics courses at Rose-Hulman as an undergraduate student, I *really* learned electromagnetics from Dr. Rao's course notes," said Keith Hoover (MSEE '73, PhD '76), former graduate student and TA for the first course using the MEF approach in 1974, now the Herman A. Moench Distinguished Professor of Electrical and Computer Engineering at Rose-Hulman Institute of Technology. "These enlightening notes are the very ones that are now posted on the MEF Web site! What a neat blast from the past!"

In addition to the textbooks and the open access Web site, Rao regularly returns to his native India to teach Maxwell's equations and electromagnetics, as a service for the benefit of the innumerable young minds, in the engineering education pipeline, present and future (see the story here).

Rao believes in being grateful more than anything else in life. He dedicated the Web site in gratitude to the three legendary personalities of ECE ILLINOIS: William L. Everitt, Edward C. Jordan, and Mac E. VanValkenburg. The Web site also contains a quote from a late spiritual guru: "Gratitude and appreciation are the key virtues for a better life. They are the spell that is cast to dissolve hatred, hurt and sadness, the medicine which heals subjective states of mind, restoring self-respect, confidence and security."

"Everyone should be thankful to James Clerk Maxwell--the Mahatma (Great Soul) of Electromagnetics--every day," Rao said. As for himself, it is more than just being thankful. He has a mission for the rest of his life: Work to make Maxwell's equations the most "admired" equations, particularly in his native India.

Editor's note: media inquiries should be directed to Tom Moone, communications coordinator, at moone@illinois.edu or (217) 244-9893.