

MIT CCSE Virtual Symposium

Monday March 15, 2021 | 1 PM ET

<https://cse.mit.edu/events/symposium21>

MIT FACULTY TALKS

Raffaele Ferrari

Cecil and Ida Green Professor of Oceanography

Wim van Rees

Assistant Professor of Mechanical Engineering

Bilge Yildiz

Professor of Nuclear Science and Engineering

Professor of Materials Science and Engineering

KEYNOTE

Nick Trefethen

University of Oxford



ANNOUNCEMENT OF CSE MATHWORKS RESEARCH PRIZES

STUDENT POSTER SESSION

Keynote:

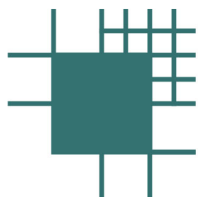
FROM THE FARADAY CAGE TO LIGHTNING LAPLACE AND HELMHOLTZ SOLVERS

Professor Nick Trefethen, University of Oxford

We begin with the story of the Faraday cage used for shielding electrostatic fields and electromagnetic waves. Feynman in his Lectures claims the shielding is exponential with respect to the gap between wires and that it works with wires of infinitesimal radius.

In fact, the shielding is much weaker than this and requires wires of finite radius (which is why it's hard to see into your microwave oven). How can we compute the field inside a 2D cage?

This brings us to the numerical heart of the talk. When the boundaries are smooth, series expansions (going back to Runge in 1885) converge exponentially. When there are corners and associated singularities, the new technique of lightning Laplace and Helmholtz solvers, depending on rational or Hankel functions with poles exponentially clustered near the corners, converges root-exponentially. The name "lightning" comes from the fact that this method exploits the same mathematics that makes lightning strike at sharp points. Lightning solvers and the related AAA approximation algorithm are bringing in a new era of application of rational functions and their relatives to PDEs, conformal mapping, and other numerical problems. A variant known as "log-lightning approximation" offers the prospect of even faster exponential convergence.



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