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A Couple of Steps Removed from Weather Prediction

FROM THE SIAM PRESIDENT

By Nick Trefethen

"What do you do for a living, Nick?"

I get the question all the time, and last night it happened again. My mother's friend went on, "I know you're a mathematician, and I know I probably don't have a chance of understanding anything you really do, but is there just a little bit you could tell me that I might understand?"

I explained that, well, actually it's not so hard to say what I do because I'm a guy who does mathematics on computers. Most mathematicians, I said, aren't very interested in numbers like 8.66032 . . . , but I'm one of the ones who are. I spend my time figuring out how to calculate things.

"So when they tell us that the unemployment rate went up half a percent this quarter, say, is that the kind of thing you do, with statistics?"

I explained that, well, actually maybe an example closer to my interests would be weather reports on television. A few decades ago the weather reports weren't so reliable, but now they're excellent, all because of big computations on computers, and I work on developing the kind of mathematical algorithms that have made this possible.

"So do people come to you for help in solving problems like weather prediction?"

I explained that, well, actually I'm a couple of steps removed from weather prediction and I work more on algorithms at the foundation. I started to say that people don't really come to me for help in solving problems, and then I remembered that people come to me for help in solving problems all the time!—but the problems are a long way from anything you'd see on the evening news. I tried to explain this a bit.

The conversation went well. My sister mentioned large matrices, and her husband offered orbits of spacecraft as another example of the kind of area that depends on the contributions of people like his brother-in-law. Meanwhile, I was quietly wondering whether there's a weather newscaster on earth who's heard of me, or of SIAM. The station gets its numbers from an agency, which gets them from simulations based on big codes written by people one or two of whom might have a copy of Trefethen & Bau on their shelf. . . .

"But if you don't mind my asking, how are you able to have dinner with us this evening? Aren't you supposed to be teaching at Oxford?"

This brought us to the peculiarities of Oxford's short terms and the vagaries of academic life in general, which kept us amused for a while. But then the conversation came back to mathematics, and I told them that what was on my mind just now was my exciting plane flight yesterday. I'd spent the time working on a project started just two days earlier, when a sharp undergraduate noticed an unexpected numerical instability of the barycentric formula when applied for rational interpolation in the complex plane, and how much fun he and I and a postdoc were having writing a short paper on this, which we plan to submit with beautiful color illustrations to SISC. (OK, I told them half of that.)

"So when you three work together, what do you do? Do you stand at a blackboard and write formulas?"

As a matter of fact, we do, I said, or rather it's at a whiteboard, but that's just a part of it. Numerical experiments are crucial too, experiments on the computer. We're experimenting all the time, and the results guide us along. What got us going on this paper was the surprise of a computer plot that didn't look as we expected. The minute we saw that plot, we knew there was something to be figured out.

The discussion was reminding me that we'd have to change a few lines of code in Chebfun to get around the instability by taking ratios of polynomials computed with a modified Lagrange formula rather than the rational barycentric formula, but that maybe there might be also a more fundamental approach that would be stable based on a proper generalization of the barycentric idea. I was wondering where to start to find such a generalization and also thinking about new numerical experiments we might carry out to further delineate the nature of the instability.

It was five magic minutes related to my mathematical world, or maybe ten—a good feeling. Then the moment passed and we were back to Obama and Perry and Palin.