Athanassios S. Fokas

Professor A. S. Fokas holds the Chair in Nonlinear Mathematical Science at the University of Cambridge in the UK. He has a BSc in aeronautics from Imperial College, London, a PhD in applied mathematics from Caltech, and an MD from the University of Miami.

ENGenious: What inspired you to become an applied scientist?

Fokas: When I was growing up in Greece, it was thought that a mathematician could not find a job. This is why my first degree is in aeronautical engineering; I was told that the two most mathematical engineering degrees are aeronautical and electrical engineering, and I thought aeronautics sounded more interesting. I graduated top in my class, and I was offered a scholarship for a PhD in aerodynamics. Since I was going to work in a theoretical area, I thought I should strengthen my mathematics, so I decided to take a year off to get a master’s in applied mathematics. This is when I discovered that the applied mathematics department at Caltech was born out of the aeronautics department. Thus, I thought that Caltech would be an ideal place to get a master’s in applied mathematics. I finished my PhD in applied mathematics and then stayed at Caltech a year longer as a fellow.

ENGenious: Why did you also decide to get a medical degree?

Fokas: I had some correspondence with the late Israel Gelfand, one of the greatest mathematicians of the last century, and I noticed that he was located in the department of biology. Thus I presumed that he was doing mathematical biology (which actually he was not the case), and, hence, I decided to take a couple of years off to study biology and medicine. This finally led me to the PhD–MD program of the University of Miami. I enjoyed medicine much more than I expected, and it became a difficult decision whether to follow a residency at Stanford University, where I was doing my internship, or to return to mathematics. In any case, I consider this investment in medicine the most important and most useful investment I have ever made in my professional life. Studying medicine has given me a completely different perspective in life and also has led me to a lifelong fascination with the function of the brain. It should be noted that perhaps the only positive thing about getting older is that our understanding deepens, and this I believe happens by continuously establishing new connections, which is actually a reflection of how the brain is organized. Perhaps this suggests the importance of trying to become a polymath, because the more diverse areas you are aware of, the more connections you can establish, the deeper understanding of various phenomena you can achieve.

ENGenious: How has your Caltech education influenced you?

Fokas: I have been privileged to have had faculty appointments at some great institutions. But in terms of quality density, there is no doubt that Caltech is the best. Unfortunately, you appreciate this fact only after you leave. All of a sudden, you realize that you were in paradise. Taking into consideration the size of Caltech, what it achieves is absolutely phenomenal! Perhaps, as Chair Ares Rosakis has noted in a recent interview, the small size is an advantage: it promotes interdisciplinary approaches, it ensures extremely high-quality faculty, and it allows for a much closer relationship between students and the faculty.

ENGenious: How would you describe your professional life and contributions?

Fokas: Although I am considered an applied scientist, my mentality is closer to that of a pure mathematician, in the sense that the main criterion for choosing a research project is not usefulness but aesthetics. Of course, there is a deep relation between aesthetics and the truth—recall the Latino motto pax hominibus sicut um viri (“beauty is the seal of truth”)—but also a relation between aesthetics and function. Perhaps this is the reason why some of my contributions appear to have also a commercial value. In particular, our quest with Gelfand to explore the beautiful formalism of the so-called Riemann–Hilbert and D-bar methods led to the completely unexpected derivation of an analytical formula for the inversion of the attenuated Radon transform. This transform plays the same fundamental role in the important medical imaging technique of single photon emission computed tomography (SPECT) that the classical Radon transform plays in computerized tomography (CT). This has led to improved image reconstructions not only in SPECT but also in positron emission tomography. Similarly, aesthetics was crucial in my work on electro-magneto-encephalography, whose related patent was financed by Cambridge Engineering. So until very recently, I had thought investing in this project was a mistake, but apparently it wasn’t. Overall, perhaps the message is that work quality sooner or later gets recognized.

ENGenious: What does the future hold for you and your work?

Fokas: I have done two crazy things in my life. One was to study medicine, because I went from being an associate professor to being a student in an area that I knew absolutely nothing about. The other was six years ago, when I made the decision to start working on the most famous open problem in the history of mathematics, namely the Riemann hypothesis, which is considered a problem in pure, as opposed to applied, mathematics. However, actually was not as ironic, because the Riemann hypothesis is related to the Lindelöf hypothesis, which is a statement about asymptotics, and asymptotics is certainly part of applied sciences. Actually, most of my life I have been involved with asymptotics. In any case, we have developed new remarkable mathematical structures and have established deep connections among the most fundamental mathematical entities. Let us not forget that establishing new connections is what science in particular and life in general is all about! Thus, we are hopeful.