Roland Glowinski: The Unconventional and Unexpected Path of a Mathematician

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More than 10 years have elapsed since the conference, "Computational Science for the Twentieth Century", was held in Tours, France. The Tours event honored the 60th birthday of Roland Glowinski. The world has witnessed many changes in the last decade, but Roland and his lovely wife, Angela, seem to barely have changed at all. Indeed, they are like fine French wine or Tennessee whiskey; they improve with age. As we reflect upon the career of Roland, it is important that we not underestimate the role of Angela. Everyone knows the old saying,

Beside every great man stands a great woman.

The quote becomes more complete, and perhaps appropriate, if we include Voltaire's addendum,

a surprised mother in law.

Angela Glowinski is the first lady of Franco American mathematics. She serves as Roland's tireless confidante, supporter, cheerleader, and at times, task master. Roland never expected to become a professor and renowned scientist. Only at the urging of his wife did Roland make the decision to return to the academy and enroll at the Institut Blaise Pascal. For that, the applied mathematical community, as well as Roland, owes Angela a profound debt of gratitude. In fact, we think that if Jacques-Louis Lions had not existed, Angela would have found a Lions.

The event celebrating Roland's 70th birthday was a peripatetic one, taking place at the University of Houston in Houston, Texas; University of Jyväskylä in Jyväskylä, Finland; and Xi'an Jiaotong University in Xi'an, China. Roland has friends and collaborators across the globe. Many old, loyal friends and some new were present at the gatherings. However, the joy at these events was dampened by the sad realization that some old friends were missing and will

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not return. In particular, we pay tribute to Professor Jacques-Louis Lions. He was an inspiration and mentor to us all. His torch will now have to be carried by Roland and his fellow *lionceaux*.

We will not deign to give a full discussion or even a list of the research achievements, distinctions, and accolades of Roland Glowinski. We will say that over the course of his career Roland has authored or coauthored over 250 scientific articles, has written or edited about twenty books, has served on a panoply of editorial boards, advised numerous students and post doctoral fellows, and has collaborated with scientists across the globe. Among other honors, he has been elected to the French Academy of Science and is a member of the French Legion d'Honneur at the level *chevalier*.

The eminent German poet and author Johann Wolfgang von Goethe once said,

> Mathematicians are like Frenchmen: whatever you say to them they translate into their own language and forthwith, it is something entirely different.

Although Roland is, and always will be, quintessentially French, the corpus of his work serves as a marked counterexample to the sentiments Goethe expressed. If there is a common thread running through the large and broad corpus of his work, it is his four-step approach:

1. Identification of the model
2. Determination of the structure and mathematical properties of the model
3. Development of numerical methods that take advantage of the model's mathematical properties, while at the same time making optimal use of available computing resources
4. Validation and verification of the numerical results

It has always been Roland's concern to construct portable methods that can readily be adapted by other scientists in different contexts. Today, applied and computational mathematics is in vogue. Academic institutions compete to develop it. This was not the case when Roland began to follow his muse. Pure mathematics was the mode and even applied mathematics tended to be highly theoretical. Roland's decision to engage the applied problems of industry, engineering, and science was both unconventional and bold. His work has always been in mathematics and scientific computing and their application to mechanics, physics, aeronautics, engineering sciences and, more recently, biology. He has made seminal contributions in the areas of methods for science computation, fluid mechanics, numerical controls for distributed parameter systems, and solid and structural mechanics, as well as shape optimization, stellar motion, electron transport, and semiconductor modeling. Indeed, Roland's work demonstrates that Goethe should have paid attention to the words of Leonardo di Vinci,

> Mechanics is the paradise of the mathematical sciences because by means of it one comes to the fruits of mathematics.

Roland's scientific journey began in the late fifties with his education at the elite École Polytechnique. Air France awarded Roland a traineeship at the Boeing Company in Seattle, in 1960. This is significant in two ways; one, it gave Roland an introduction to aviation and aeronautics, and it introduced Roland to the United States and kindled his affection for life in the United States. Roland fulfilled his military obligation in the French Army serving in Algeria during the period of trouble. Roland then worked as a telecommunications engineer for ORTF (the French Broadcasting System) from 1963–1968 and became well grounded in electromagnetism, as well as learning FORTRAN.

Roland's decision at Angela's urging to enroll in Professor J.-L. Lions' Post DEA Course in Numerical Analysis at Institut Blaise Pascal proved to have a major impact upon Roland's subsequent career. This course is made notable by the careers that it launched. The list of those who have benefited from it includes: J. Cea, A. Bensoussan, P. A. Raviart, J. C. Nédélec, G. Chavent, L. Tartar and O. Pironneau. Roland grabbed Lions' attention and came under his influence. In 1967, Professor Lions hired Roland at l'Institut de Recherche en Informatique et en Automatique (IRIA). Roland excelled and rapidly became a Scientific Director in 1971, serving until 1985. On the academic side, Roland was elevated to a professorship at the Université de Pierre et Marie Curie. Following the dictum of Lions, Roland, as did other disciples of Lions, maintained close connections with industry and government agencies (be they French or, more recently, American) in the areas of aeronautics, nuclear energy, space exploration and hydrocarbon recovery.

Roland's career path is both unconventional and unexpected. It is unconventional by virtue of his decision to become involved in the applied problems of industry, engineering, and science at a time when pure mathematics was the mode. His applied orientation is well illustrated by his highly acclaimed collaboration with Dassault Aviation as leader of the Glowinski–Bristeau–Pironneau–Perrier–Periaux–Poirier GB4P team. This effort culminated in the finite element simulation by least squares techniques of the 3-D shocked transonic flow around a complete Falcon 50 business jet geometry.

In the 1980s, Roland made a series of major contributions in the domain decomposition and fictitious domain methods. This work was initially motivated by large scale industrial applications in aeronautics and the oil industry, and extended recently to applied electromagnetics the identification of the signature of coated materials on aircraft, ships, submarines or mobile phones. The latter work applied exact controllability methods derived from the Hilbert Uniqueness Method of J.-L. Lions. Roland's important contributions to the numerical solution using Lagrange multiplier methods are documented in his paper, Augmented Lagrangians and Operator Splitting, which he coauthored with P. Le Tallec. He subsequently, in collaboration with D. Joseph and T. W. Pan, extended this to the theoretical description of the fluidization and the sedimentation of particular flows.

If there is a feature in Roland's background that distinguishes him from most of his contemporaries in applied mathematics, it is probably the fact that

he began by obtaining experience as an engineer in aeronautics at Boeing telecommunications ORTF and then undertaking the study applied mathematics and numerical analysis with J.-L. Lions and other distinguished mathematicians. All of this background was coupled with a native intelligence, an open mind, and relentless curiosity. Roland's affable personality, constant good mood, patience, and willingness to listen, together with his innate ability to interact and collaborate with people across a wide spectrum of scientific and engineering disciplines, have enabled his putting together an impressive international network of friends and colleagues.

In the administrative area, Roland served as Director at CERFACS, Toulouse, from 1992 to 1994, a unique experience with EC and Aerospatiale. Although Roland first came to the United States on an internship with Boeing in the early 1960s, the American portion of his career began in 1985, with his assumption of the M. D. Anderson Professorship of Mathematics at the University of Houston. Roland subsequently became the Hugh and Roy Cullen Professor of Mathematics and Yuri Kuznetsov assumed the M. D. Anderson Chair. Roland's presence at the University of Houston has had significant impact on the development of applied mathematics in Houston and in Texas. Under Roland's leadership and guidance, we have developed into a major node on the international applied and computational network. Many well known scientists joined our faculty – to name a few: Mary Wheeler, Yuri Kuznetsov, Tsorng-Whay Pan, Ed Dean, Jiwen He, Ronald Hoppe, Jeffery Morgan, Robert Azencott and Sunčica Čanić. We will not even attempt to list the visitors who have streamed through Houston. It will suffice to say that one can expect to hear French, Russian, German, Chinese, Spanish, and Croatian, as well as the Texas drawl, along the corridors of the mathematics department. It is fair to say that Roland was a bellwether for the State of Texas. Subsequent to his arrival, both the University of Texas and Texas A&M University have emerged as major centers of computational mathematics. Texas can now be known for computational science, as well as horses, cattle, oil and barbecue.

We find ourselves on the threshold of a new era with interesting and challenging problems concerning the areas of medicine, life science, the environment, energy, information technology, communications, and materials science. Now more than ever, we will need scientists like Roland with innovation, vision, and ability to work across both disciplinary and national boundaries.

We conclude with the last stanza of a poem dedicated to Roland by Professor Zhong-Ci Shi of the Institute of Computational Mathematics in Beijing:

> You earned your success and you should feel very confident with yourself for all that you have achieved.