

Adélia Sequeira

by João Janela* and Jorge Tiago**

Adélia Sequeira (<https://www.math.tecnico.ulisboa.pt/~asequeir/>) was born in Lisbon on 14 March, 1951. She is a Full Professor of Mathematics at the IST (Instituto Superior Técnico), Universidade de Lisboa, was Director of the Research Centre for Computational and Stochastic Mathematics — CEMAT/IST-ULisboa (2017–2021) and has been the Scientific Coordinator of CEMAT’s Mathematical Modeling in Biomedicine Research Group (since 2010).

She has a PhD (thèse de 3ème cycle) in Numerical Analysis from École Polytechnique, Paris, in France (1981), and a second PhD in Mathematics from the Faculty of Sciences of Universidade de Lisboa (1985). She obtained a further degree (Habilitation) in Applied Mathematics and Numerical Analysis from IST in January 2001. She was awarded First Prize for the UTL/Santander Totta Scientific Awards for her research in the area of Pure and Applied Mathematics in 2010. In 2011 she received the Medal of Merit of the Faculty of Mechanical Engineering of the Czech Technical University in Prague. In November, 2018, she was elected as a corresponding member of the Lisbon Academy of Sciences, Class of Science, and in 2019 she was selected to be one of the *Women in Science* by *Ciência Viva* of the Portuguese Agency for Science and Technology (<http://www.cienciaviva.pt/mulheresnaciencia/segunda-edicao/>).

Currently, her research interests are in the area of cardiovascular mathematical modeling and simulations of closely connected problems of clinical relevance associated with vascular diseases, namely: patient-specific cerebral aneurysms progression and biomechanical and biochemical actions in blood vessels, with application to thrombosis and atherosclerosis processes. She also has a research interest in mathematical and computational fluid dynamics, with a particularly focus on viscoelastic non-Newtonian fluids, hemorheology and hemodynamics studies.

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Your career as a mathematician started in the late seventies, at the École Polytechnique, Paris, in France. What is your recollection of that period?

That was a wonderful time for me, one of the best in my life. I went to Paris on the 3rd of October 1977, by train, full of dreams and with many plans. This was a real adventure for me, in all perspectives. It provided me with the possibility to studying mathematics, specializing in the field of Numerical Analysis, where I had the opportunity to meet new people and experience living alone in a foreign country, I was 26 years old, and I had an open mind to everything that was new and challenging. I met my husband later on, in 1981, who had also gone to Paris to study for his PhD. We got married there in 1982, and our first daughter was born in Paris in 1983. I returned to Portugal in 1984, after having concluded my thesis at École Polytechnique in 1981 (thèse de 3ème cycle). Later, I concluded my PhD in Portugal in 1985. Overall, I have spent more than six years in Paris and my connections to Paris are so strong, that I consider Paris to be my second town.

Those were also changing times here in Portugal. How was it to be a Portuguese young woman in Paris, during that time?

I left Portugal in 1977, three years after the “25th of April” revolution, which was a period when it was naturally impossible not to experience political connections and hard to forget the incredible changes that happened to Portugal as a result of the Revolution. During my first years in Paris, I also had the opportunity to meet other Portuguese colleagues and we organized various meetings and established strong links with the association of Portuguese emigrants in Paris. In addition, many activities were held jointly with a similar association in Brussels to keep alive the spirit of “the 25th of April”.

Was mathematics a passion since your high school times? Was it already an indisputable choice for the future?

Yes, as far as I remember, Mathematics has always been a real passion for me. I always had good grades, and I considered Mathematics to be one of the most fascinating subjects. However, when I finished high school, I wanted to study Medicine, as I was attracted to the idea of a career as a doctor. When it came to the time to choose what to study at university, my father thought medicine was not appropriate for a woman. Later on, he came to recognize that he was wrong, but by then it was too late. I then decided to follow my passion, and I went to the Faculty of Sciences of Universidade de Lisboa (FCUL), to study Mathematics. I graduated in 1973 and my first full job was as an Assistant

at the Department of Mathematics of FCUL. Then the revolution took place in April 1974, all lectures were stopped, and I became involved in many political events. Interestingly, I was elected Chair of the Management Board of FCUL in 1975, along with 17 others (6 faculty, 6 students, and 6 members of staff). For two years the Faculty was ‘governed’ by our group. Although some lectures were resumed, during that period most of the time was spent in meetings and discussions. I was tired of spending the days doing that, and decided to change my life ... first I tried to enter the Faculty of Medicine, but this was not allowed for those who had already had a degree in another subject. Next, I was offered a scholarship from JNICT (now FCT), and decided to go to Paris to study for my PhD in Mathematics.

You are now internationally known for your contributions in computational modelling and simulation, with emphasis in cardiovascular modelling, a topic in which you have been awarded with several international projects. But it wasn’t always like that. You had previously worked with more fundamental mathematics, before drawing your attention to, in your own words, “bloody mathematics”. What motivated such a shift?

The start of my working with Numerical Analysis was in Paris, with P. A. Raviart, at the Laboratoire d’Analyse Numérique, Univ. Paris VI. This was an initiative of J.P. Carvalho Dias, who sent a group of young graduates to study for their PhD’s in Paris and contacted renowned French mathematicians who were working in different fields. After studying for the DEA (Diplôme d’Études Approfondies) with P.A. Raviart, I then moved to CMAP-Centre de Mathématiques Appliquées, École Polytechnique, Palaiseau, where I worked with J.C. Nédélec, who became my thesis supervisor. First, I developed a numerical method to approximate the Stokes system in an exterior domain and obtained numerical results. After coming back to Portugal, I worked for a while with more fundamental mathematics, as you have observed, but always in the field of mathematical fluid mechanics, including Navier-Stokes equations and different types of non-Newtonian fluid models (inelastic and viscoelastic). As soon as I discovered that blood is a non-Newtonian fluid, I realized that I could apply my mathematical background to blood flow problems. For me, being able to apply Mathematics to Medicine was like turning a dream into reality! This phase in my career took place during the nineties, however it was only after I obtained my Habilitation in Applied Mathematics and Numerical Analysis in 2001, that I started to contact clinical physicians. This was due to Prof. F. Ramôa Ribeiro, who was a member of the examination panel, and became very interested in my work. From then



onwards, right up to today, I have worked non-stop with “bloody mathematics”, as I call it! I established international and national joint research agreements with many specialists from around the world, and realized that academia is confronted by so many fascinating problems in this field, that I will never change my research topic.

You were one the principal investigators in a very successful RTN European project -Haemodel - in the beginning of the millennium (2002 – 2006). Do you think that the fruitful scientific collaboration with the other partners (EPFL, INRIA, MOX, Imperial College, Univ Graz) established a point of no return towards Applied Mathematics and, more specifically, the mathematical modelling and simulation of the human cardiovascular system?

In fact, one can say that this truly was “a point of no return”, as I’m still working on cardiovascular mathematics to this very day. I started some very important joint research in this field in collaboration with the RTN European Haemodel project, and under the auspices of this project I was able to contract several postdoctoral researchers to work with my group in Portugal. The leader was Alfio Quarteroni from École Polytechnique de Lausanne (EPFL) and Politecnico di Milano (MOX) and the project was entitled “Mathematical and Numerical Modelling in Haemodynamics”. This project

was followed by further very successful, national and international projects, all of which were funded by FCT, in particular the “Cardiovascular Imaging, Modeling and Simulation – SIMCARD” (2009-2012) project, carried out within the framework of the UT Austin|Portugal international partnership, with the group of Tom Hughes and C. Bajaj, and also the EXCL “Mathematical and Computational Modeling of Human Physiology – PHYSIOMATH” (2013-2016) FCT project. By means of all these projects, my group was able to establish strong national and international links with mathematicians, engineers, computer scientists and in particular clinical physicians, most of whom had outreached and proposed very challenging medical problems which required the interdisciplinary collaboration of my group to solve them.

You organized a few conferences and summer schools in collaboration with CIM, in the late nineties. Can you tell us something about these events and their importance in your scientific growth?

These events, consisting of three summer schools, took place during June-July 1999, under the umbrella title of “Thematic Term on Theoretical and Computational Fluid Dynamics”: Summer School on Industrial Mathematics, IST, Lisbon, June 7-12; Summer School on Navier-Stokes Equations and Related Topics, IST, Lisbon, June 28 – July 3;



Adelia Sequeira with students and collaborators in Azores, 2011

Summer School on Computational Fluid Dynamics, campus of the Astronomical Observatory, University of Coimbra, July 12-17. Top level mathematicians from different countries were invited to lead study modules during these summer schools and they exercised a very strong scientific influence on the participants, especially young researchers and PhD students. In addition, some short research assignments (e.g., 'Research in Pairs' which lasted two or three months) also took place during the Thematic Term, which enabled fruitful international collaboration resulting in the publication of several common scientific papers. These activities were supported by CIM, with special funding from Fundação Calouste Gulbenkian.

You were elected a corresponding member of the Lisbon Academy of Sciences in March 2018. Do you see this as a recognition of the role of Applied Mathematics and, particularly, of computational modelling?

Yes, I was elected to be a corresponding member of the Lisbon Academy of Sciences (Mathematics Class of Sciences) in March 2018, in virtue of my experience in Applied Mathematics, being the first member ever elected from the area of computational modelling. For me this distinction was very meaningful, for apart from the personal recognition, this election also represented an appreciation

for my research field, in particular computational modelling of cardiovascular flows.

The fact that you worked in different areas of Mathematics, allowed you to collaborate with an impressive number of mathematicians from different continents. Besides the obvious inspiration for new ideas in Mathematics, this should be also a very fruitful personal experience?

To be sure, I developed very deep personal relations with mathematicians from a great variety of countries who had experience of working with both fundamental and applied mathematical problems. I have maintained these friendships to this very day, and even if we don't see each other very often, or don't make contact very frequently, I can truly say that "good friends live forever". At this stage I would like to mention two outstanding mathematicians who have now sadly passed away, both of whom were very close friends: Jindřich Nečas and Olga Ladyzhenskaya.

Nowadays my work is entirely devoted to cardiovascular mathematics, however I still consider my colleagues whom I met 35 years ago, when I was working on mathematical fluid dynamics, to be good friends, and I know that I can always count on them, if needed. Furthermore, working on this subject for decades, quite often with colleagues from all over the globe (including Central and Eastern Europe, Northern

Africa, the United States, Japan, China, India, Brazil, and many other locations), has given me a broader vision of the world and of life itself.

As a mother of two, was it easy to comply with your family life?

We can say that all the travelling and sleepless nights made you stronger?

Balancing both responsibilities is a great challenge for any woman: to combine professional and family life, while trying to do one's the best in each case. I genuinely feel that I did my best, and I rest assured that my family recognized that. This makes me feel very happy, as we often think that we can always offer more to our children than we have done in practice. I attended a great many conferences and travelled a lot, however I always made a conscious effort to be 100% present when I was with them, even if some mathematical problem was puzzling me in the back of my head, or if a certain difficulty involving one of my colleagues at the university was keeping me awake at night. In fact, I'm used to sleeping just four to five hours a night, which is very little, I must say. Perhaps I will suffer from the consequences of sleep deprivation, but I must confess, I work well at night, and I'm already really used to it.

One of your daughters also pursued a career in research and is currently living abroad. Do you think your influence was determinant in her choice? Do you have mixed feelings about being now away from your daughter and grandchild?

Yes, I think it was. My husband and I both had a strong influence on our daughter's career. She is a biologist, not a mathematician like me, or an economist like my husband. In any case, I know that she appreciates my work, because she already said that. In particular, I will always remember when she made an emotional speech at a conference organized in Azores to celebrate my 60th birthday, when she expressed her appreciation in front of all my colleagues during the gala dinner. She is now working as a researcher in Leiden, in the Netherlands, at the Naturalis Biodiversity Center and has a 2 years old child. I'm missing them an awful lot, as you can imagine! My younger daughter has also been very successful in her career, and she is also a young mother, having given birth more recently, in July 2020. I am thus blessed to treasure two grandchildren, a boy and a girl, whom I greatly care about and love to help out!

You have recently received the award "Women in Science" from "Ciência Viva", the Portuguese agency for science. How is it to be a female scientist in Portugal today?

I received this distinction in 2019, and I am extremely honored to have been chosen in my role as an Applied Mathematician to join a group of women scientists who have been selected from among so many distinguished scientists from such diverse fields, who represent approximately 45%

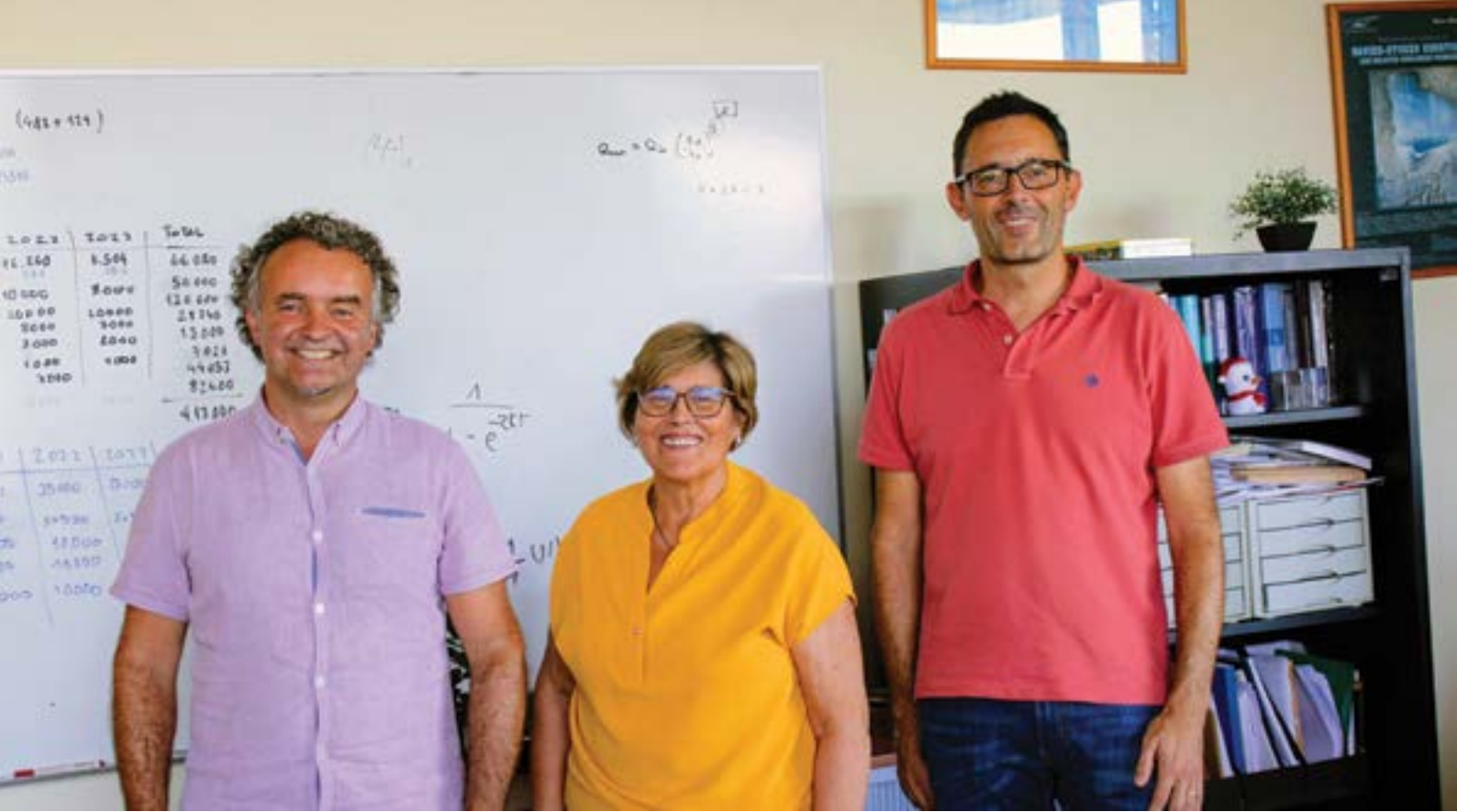
of all researchers in our country. It is not easy to be a female scientist in Portugal, or in any other country for that matter. As I mentioned previously, the fact that one is a woman means that one has to learn how to combine a private and a professional life, which is sometimes quite difficult, especially when small children are involved!

You have supervised an impressive number of PhD and MSc students, as well as postdoc researchers. Looking back, how does it feel to have been such a marking influence in so many researchers, not to mention being a pioneer in a new research field in Portugal?

This was part of my job as a professor. I have always felt that I could somehow help young students and researchers progress in their careers. For several years my research group was quite large, and it was most satisfying for us all to be able to participate in our regular meetings and to realize how scientific debate is an integral source of new ideas and progress for all those involved. Our group was pioneering, and in that sense it was unique in the field of cardiovascular mathematics. Several clinical physicians contacted me to put various questions and proposed groundbreaking important problems to solve, which in turn were immediately shared with the group or delegated to a particular student as a new research subject. I have always found supervisory responsibilities to be very rewarding, from various points of view.

Many students are now preferring to work in industry rather than pursuing an academic career. Well, this is a good sign of the country development; bright students may also have an important role in academia. What would you say to a young student to motivate her, or him, for a research career?

Now, that's a difficult issue. It's quite hard nowadays to convince second cycle students to pursue their studies towards a PhD, as they fail to comprehend the advantage gained from doing so. However, good students are naturally motivated, because they want to learn more and to progress in research in a certain field, without thinking much of anything else for the immediate future. In the cases of students who are hesitant about whether to progress in their studies or getting a job after their Master's, I would recommend to them that it is very important to carry out a PhD thesis and look for opportunities in the future. There is nothing better in life than to work on what you love to do. However, in spite of the expansion of research and academic opportunities, in particular with regards the possibility to combine studying for a PhD with a career in industry, I have to admit that nowadays it is very difficult for a young researcher to pursue a career such as mine, or people of my generation, mainly in our country, essentially because it is not easy to find a stable position. On the other hand, being a researcher has its good and bad moments, with the added necessity of being committed if one is to be able to overcome all these challenges. Either way, working in



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the field of our favorite subject provides us with a unique motivation.

You have recently co-authored with Antonio Fasano a book putting together your research in mathematical modeling of some of the most relevant physiopathologies of the vascular system. Is this the end of a chapter or just the start?

This book was a great challenge for me, or rather for both of us, since it took five years to write, from the moment that we conceived the idea. I remember that it was at an AIMS Conference in Orlando that we met and started thinking about writing the book. Even though it was extremely hard to write, but was also a most agreeable experience, not only from the point of view of our passion for the different topics covered in the book, but also because Antonio is an excellent mathematician and a dear friend. Towards the end, we worked under great pressure, and I am pleased to recount that the book was concluded successfully!

Your personal life and career have seen big changes very recently. You are a grandmother of two. At the same time, you have retired from your teaching duties at Instituto Superior Técnico. All of these during these strange times of pandemic constraints, fortunately now being more relaxed. A new Adélia was born, at the age of 70?... Now

more seriously, what are your personal and academic perspectives for the following times? I know that you have started advising a new PhD student...

“A new Adélia was born” is a good expression! ... for I’m not getting any younger!... Anyway, I like to feel that I’m still full of energy, and I know that I want to pursue my research work for as long as possible. Currently I continue to write papers and evaluate research proposals. Furthermore, I continue to participate as a member of various national and international committees, and have others in the pipeline for the near future. I have also been invited several times to be a keynote speaker at international conferences, and I will be presenting at more very soon. In conjunction with colleagues, I am involved in the organization of the important ENUMATH 2021, conference at IST, which unfortunately had to be postponed until 2023 due to the pandemic. These are just a few aspects of my new life, with basically life going on as before, except for the teaching role and some fairly onerous administrative responsibilities ... Naturally, many other interesting things exist in life, and I now sincerely hope that I will be able to find more time to dedicate to both myself and my family, in particular to my grandchildren.