

Interview

DGS III 2014

CIM thanks the participants **João Almeida** [Instituto Politécnico de Bragança, Portugal], **Carlos Braumann** [Universidade de Évora, Portugal], **Marta Faias** [Universidade Nova de Lisboa, Portugal], **Flávio Ferreira** [Instituto Politécnico do Porto, Portugal], **Penelope Hernandez** [University of Valencia, Spain, Spain], **Onesimo Hernandez-Lerma** [CINVESTAV-IPN, Mexico], **José Martins** [Instituto Politécnico de Leiria, Portugal], **Diana Mendes** [ISCTE, Lisboa, Portugal], **Diogo Pinheiro** [City University of New York, USA], **Edgard Pimentel** [Universidade de Lisboa, Portugal], **Jérôme Renault** [Université de Toulouse, France] of the International Conference and Advanced School Planet Earth, Dynamics, Games and Science III [DGS III], Portugal, February 17-21, 2014, on the occasion of the 50th birthday of Alberto A. Pinto, for sharing with us their ideas and point of views in this interview.

The questions presented here are based in several interviews; in particular, the interviews published in previous CIM bulletins. CIM thanks **Renato Araujo** and **Alberto Pinto** for organizing this interview.

On the meeting DGS III

What is your general impression of the meeting?

João Almeida: The meeting was well organized and the ambient at the conference was warm and friendly. The facilities were very comfortable and well equipped. Both plenary and parallel sessions were most interesting, reaching a wide variety of subjects and with a high scientific level.

Carlos Braumann: I quite enjoyed the meeting, particularly its focus on the usefulness of Mathematics and the nice and cozy environment that favors interaction.

Marta Faias: I personally think that the meeting was very well organized and quite interesting in the sense that there were a lot of topics that were covered.

Flávio Ferreira: The meeting was great!

Onesimo Hernandez-Lerma: I think the meeting was excellent. That is, the selection of topics, the speakers, the venue, and so forth, all were very good.

José Martins: DGSIII follows the second DGS at Calouste Gulbenkian Foundation and the first DGS conference realized in 2008 in Braga. The conference covers a wide range of topics, which is one of its greatest advantages. In my opinion, especially in what is concerned with Applied Mathematics, DGS is one of the most interesting conferences. I hope to attend many more DGS conferences.

Diana Mendes: My general impression of the meeting is quite positive. The meeting had high quality researchers and a very good environment. I really enjoy small/medium size conferences, where the people know each other easier and can exchange ideas. Due of these facts, I think it is very fruitful for our students to participate, to hear good mathematics and learn about respect and friendship. The scientific areas of the meeting are actual and interdisciplinary. There are few conferences /meetings in this area, so, I am quite sure that the impact it is at least reasonable.



Edgard Pimentel: This meeting put together several experts in the field of dynamical systems and its connections with problems in social and life sciences. Game theory was particularly emphasized. For me, as a young scientist, it was an amazing occasion to be in touch with senior scientists working on my field on interest. As the organizer of a special session, I could also bring together specialists whose work is closely related to mine. One of the speakers in that session also submitted an article to the volume edited in occasion of the meeting — it is always good to point out that, to have a volume of such an impact on the community as a byproduct of this meeting is a strong indicator of its scientific relevance.

Diogo Pinheiro: I was very well impressed. In particular, I would like to remark the quality of the communications presented the broad scope of scientific interests represented and the overall organization of the scientific program, allowing plentiful time for fruitful scientific interaction and a stimulating exchange of points of view concerning recent progress. I would also like to point out the wide range of interesting thematic sessions included in the meeting program.

Jérôme Renault: The meeting was nice and interesting, mixing interesting researchers from different fields of mathematics and science. I have had the pleasure to see again old friends like Penelope Hernandez or Frank Riedel, but also to meet new people doing Games and Dynamics, such as Sebastian Van Strien. Moreover, it was my first visit to the beautiful city of Porto, and despite the pretty rainy weather, I appreciated it very much! I believe such meetings are important for cross fertilization of domains and ideas, and for students to meet various active researchers and discover new fields.

Something you would like to highlight?

João Almeida: I would highlight the keynote lectures, where the talks on the selected topics were very deep and in the frontier of their research areas and the coffee break discussions were very fruitful.

Onesimo Hernandez-Lerma: Doing the meeting at the building of the Reitoria da U. Porto was a great idea. This is a beautiful, historical building, with very nice surroundings, and within walking distance to the city center.

José Martins: The quality of the research presented on a wide variety of topics. Something that is hard to find in a more general conference.

Edgard Pimentel: I would like to highlight the volume published in occasion of the conference.

Diogo Pinheiro: I would like to highlight the numerous relevant topics covered during course of the 3rd International Conference on Dynamics, Games and Science, ranging from more theoretical approaches to dynamical systems all the way to relevant applications of dynamics in biology, physics and the social sciences, without neglecting problems connected with game theory and optimization. I would also like to use this opportunity to highlight the presence at the conference of several internationally distinguished researchers.

How important do you think that events like this are for students and researchers?

João Almeida: Events like this are crucial to students and also to researchers. It's an excellent opportunity for students and researchers to meet top researchers in the various fields, to learn about their research and to fruitfully discuss and exchange ideas.

Marta Faias: This kind of event with such different topics is very worthy for the researchers since it is a good opportunity to see the recent research topics from several mathematical areas. For the students it is a good opportunity to become aware of the recent problems that are being handled by researchers and even a good opportunity to be in touch with open problems. In general, the conference environment was very propitious for discussions among young and senior researchers, which is essential for the students and also a good challenge for the senior researchers.

Flávio Ferreira: They are very important.

Onesimo Hernandez-Lerma: The meeting was a unique opportunity for all the participants, students and researchers, to meet professionally interesting people from many different countries and different fields, and interchange ideas. Personally, I learnt a lot of interesting things not only from the lectures but also from talking to other people.

José Martins: Conferences like DGS are an opportunity for students contact with the so many powerful applications of Mathematics and increase their curiosity in some fields of research. Hence, I strongly recommend this conference to students!

Diana Mendes: I really enjoy small/medium size conferences, where the people know each other easier and can exchange ideas. Due of these facts, I think it is very fruitful for our students to participate, to hear good mathematics and learn about respect and friendship. The scientific areas of the meeting are actual and interdisciplinary. There are few conferences /meetings in this area, so, I am quite sure that the impact it is at least reasonable.

Edgard Pimentel: These events are paramount. For they bring together scientists from several countries, working on distinct though related topics; they bolster interactions, potential collaborations and ultimately contribute for the advancement of the field. Also, because our profession reports its new developments through scientific, not rarely technical, papers - which take sometimes too long to appear — these events also play a major role in the dissemination of recent advancements.

Diogo Pinheiro: Attendance and participation at scientific events such as the 3rd International Conference on Dynamics, Games and Science are essential steps in the scientific development of research students, contributing also to an increased maturity and quality of the overall scientific research panorama. To be more detailed, while attending high quality scientific meetings such as the one mentioned above, research students have an opportunity to interact with and learn from distinguished researchers in their fields of activity, being exposed in a very direct way to novel ideas and concepts, while gaining further experience in what concerns presenting and discussing mathematics.

How do you see the impact of this meeting on your field and outside of your field?

João Almeida: The impact is very positive. These events should be made regular.

Flávio Ferreira: It's an excellent opportunity to exchange ideas.

Onesimo Hernandez-Lerma: This is a tricky question, because to answer it we would need, first, to define what "impact" means. And then, assuming we know what impact means, we would need to specify how to measure it. On a personal level, however, I would say that the meeting had a significant, quite positive impact on me because I had the fortune to meet many interesting researchers and hear their ideas, as well as the topics they are working on right now.



On your research:

Did you always want to be a mathematician?

Flávio Ferreira: Yes.

Onesimo Hernandez-Lerma: No. I spent several years in the Mexican Air Force and, probably because of this, I wanted to study Aeronautical Engineering. Nevertheless, when I could attend a university I decided to study Physics instead of Engineering. Finally, after a couple of years of studying Physics, I switched to Mathematics.

Penelope Hernandez: Yes, I loved numbers when I was child, I hated numbers when I was teenager and I loved numbers and structures all the time. It is the way of thinking that I love.

José Martins: Yes. When I went to the college I just want to be a high-school teacher. But now, I can say that I had the happiness of discover the pleasure of research on Mathematics and also the pleasure of being a lecturer in a polytechnic school.

Diana Mendes: Yes, I always want to be a mathematician.

Edgard Pimentel: As a matter of fact, I am an economist. Mathematics became a reality only after

I had graduated from the School of Economics of the University of São Paulo. Somehow bored with the problems studied by the vast majority of the economists - which in turn made then bored with me — I decided to study mathematics and went to IMPA, Rio de Janeiro, for a summer program. The course on real analysis was, for me, like a one-way ticket to a realm of challenging problems. From that summer to the completion of my thesis, it took more or less six years. In December of 2013, I concluded my doctoral studies with the defense of the thesis entitled Time-dependent mean-field games, under the direction of Prof. Diogo Gomes at Instituto Superior Técnico, in Lisbon.

How did you start working in this area? What was the motivation? Could you tell us about your mathematical beginnings, and subsequent career development?

João Almeida: When I was MSc student I met Alberto Pinto. He gave a course on Dynamical Systems and I was impressed by his mathematical insight, particularly into the field of Dynamical Systems. So it was natural for me to work with Alberto and I became his PhD student.

Carlos Braumann: Probability and Statistics was my favorite subject since high school. It is only fitting that, as a PhD student, I have encountered my main area of research by chance, when I met a book about stochastic differential equations (SDE), a subject matter I had never heard about before. I immediately recognized it was just the right tool to model several issues in Biology. Those issues also raised new theoretical interesting problems and that interplay has always been quite fascinating to me.

Diana Mendes: When I was a kid, my purpose was to be a math teacher at my home town high school. At that time, we knew few things about research (no TV and Internet J), but we used to solve problems, prove results and participate at Olympiads, frequently and seriously, at the adequate level. During the last year at the University, my final project supervisor was working on his Dynamical Systems book and asked for my help in some minor questions. This was my first serious contact with dynamical models and applications and it was really precious. Later I leave my country and I became a mathematician and a researcher in a Business School. It was natural what I have to do, to join models with applications in order to try to give some answers to real problems.

Flávio Ferreira: I was motivated by my PhD supervisor Alberto Pinto.

Onesimo Hernandez-Lerma: I used to work on stochastic control problems and two friends (Andrezj S. Nowak from Poland and Mrinal K. Ghosh from India), almost simultaneously, brought to my attention that the techniques that I used in control theory were also applicable to Markov games. That was my motivation to write my first paper on games. Concerning my professional beginnings and subsequent development, my doctoral dissertation, at Brown University, in USA, was on some stability problems for a class of stochastic differential equations. Then I spent a sabbatical year at the University of Texas at Austin where I began working on optimal control problems. A few years later, I did substantial work on infinite-dimensional linear programming. Finally, beginning in about the year 2000 I started working on Markov games, which I do in parallel with control problems. Related to my research work, I have published about 130 papers in peer-reviewed international journals, about 10 or 11 books (at least half of them published by Springer-Verlag), and supervised 19 Ph.D. theses. At present I supervise four Ph.D. students, two of which will complete their dissertations in the following months.

How would you describe the essence of your own research to a young student?

Carlos Braumann: Individuals and biological populations live in randomly fluctuating environments that affect birth, death and growth. The deterministic models commonly used to describe and predict their dynamical behavior are a good basis but are unable to take into account such fluctuations. So, we need stochastic models to quantify, predict and minimize the risks that such fluctuations may cause on life or on the economy in areas like epidemiology, fishing, forestry, pest control, wildlife management, animal farming, agricultural, life insurance and social security.

Marta Faias: To understand the economic behavior of the economic agents and markets, we need to develop models and mechanisms. Mathematics allows us to design these models and mechanisms in a universal language, while also providing the solutions and paving the way to study the properties of these. One main aim of my research is to explain the equilibrium prices and how they arise in several competitive economic settings, for example, in pure exchange economies with an incomplete asset structures and differential information. To undertake such goal we apply game theory. This mathematical tool permits drawing models, finding their solutions and moreover, characterizing such solutions. This research can then be used by the decision makers to help their choices.

Penelope Hernandez: By means of examples and counterexamples to illustrate the bounds of the knowledge of a specific issue.

Diogo Pinheiro: The focus of my research is on dynamical systems and differential equations, its optimal control and applications. I have a very strong interest in Hamiltonian dynamics, renormalization, and perturbation theory. I am also interested in the analysis of stochastic optimal control problems with certain forms of model uncertainty. Finally, I am pursuing applications of stochastic dynamical systems and optimal control techniques to address problems arising from Economics and Finance.

Which would you say are the most interesting/challenging open (or recently solved) problems in your area, and what do you think the future reserves in your area and in your line of research?

Onesimo Hernandez-Lerma: To answer this question requires a lot of thought . . . Nevertheless, the topic



I'm currently working on, namely, dynamic potential games (as opposed to static potential games), is full of interesting, nontrivial, open problems.

José Martins: In Mathematics everything is challenging. A simple problem in real life can be a difficult challenge in Mathematics. The beauty of Mathematics comes from solving problems that appear everywhere and every day. My research is closely related with applications in Biology, more specifically, in epidemiological modeling. The connection between Mathematics and Biology is extremely important and the contributions that Mathematics can give to the well-being of people will never finish. I hope that someday my work can give an important and decisive contribution to the well-being of people.

Jérôme Renault: I believe that exploring the mathematical aspects of strategic interactions is a fascinating and important challenge of our epoch. Games appear everywhere, in particular in social sciences, and it is very challenging (but difficult!) to find general theoretical results with practical and important applications. Regarding dynamic games, I believe that mixed models where time is continuous but agents take decisions at discrete, possibly endogenous, times, have not been considered enough and will play a role in the future.

How do you see your area in terms of its importance in mathematics and in other fields of knowledge, the impact on and from other areas and how do you expect this interplay to develop further?

Carlos Braumann: It is a fascinating area, not only because of the enormous range of current and future applications (with its feedback on new theoretical problems), but also because of the bridges and corresponding cross-fertilization with other areas of Mathematics.

Diana Mendes: I understood that interdisciplinary connections are very important, and that my research area (Nonlinear Dynamics and Nonlinear Time Series Models) has a huge reservoir of applications, involving economics, finance, geography and geomorphology, urbanism, and many others. The meetings allow me to know people, to create connections and to apply to new research projects, sometimes in unexpected problems and topics, which are really provocative and appellative. These challenges are already part of our life, and usually I divulgate them in a friendly way to my students.

Onesimo Hernandez-Lerma: In the area of potential games, the number of papers-per-year has been increasing exponentially because of their nice properties and its applications in engineering, economics, and financial mathematics, among many other fields.

Diogo Pinheiro: Since the development of calculus, differential equations have played a central role in mathematics and other fields of knowledge, with a particular emphasis on physics. Despite the fact that our treatment of differential equations has been changing in nature and expanding in scope with the course of time, mainly through the development of

alternative analytical and geometrical techniques, I believe that, together with other classes of dynamical systems, this topic will play an even deeper role in the development of mathematics and science for the foreseeable future. Let me provide some support for this claim. Start by noticing that, eventually due to the continued rise of computational power observed during the last few decades, most fields of knowledge are becoming increasingly data-driven, placing a stronger emphasis in the development of mathematical models, which very often are introduced to describe some form of evolution. On the other hand, it seems to me that our increasingly technological society may be relying more and more on complex quantitative models, to help with complicated decision-making processes. With these observations I am not claiming that dynamical systems and differential equations will be the main tool to address such needs. Instead, I believe it will be one of multiple tools to address what are, essentially, multidisciplinary problems. This means that not only will the field be of continuous importance to real-world applications, but also that such applications will keep generating problems of theoretical relevance, promoting further technical developments which will ultimately enrich mathematics as a field of knowledge.

Do you have a favorite result, yours and/or from others?

Carlos Braumann: I particular like Girsanov's theorem, which is the key to the martingale theory approach to SDE. Mine, I have two. The first concerns the clarification of the use of Itô or Stratonovich calculus (solving a controversy in the literature). The second obtains qualitative properties for general models of population growth (including populations subjected to fishing), thus generalizing similar results for specific models.

Is it difficult to get funding for doing research in your area?

Carlos Braumann: It is as difficult as in other areas.

On research, more generally:

What would you say are the most important things to keep a research group going?

João Almeida: That's a difficult question. I think there isn't a special formula, but it is important to keep everyone in the group motivated by doing what he or she likes. If someone isn't motivated it is very

important to be able to tell it to the group. Also foster the team spirit is a crucial point. Regular meetings and seminars in the presence of the whole group contribute positively.

Carlos Braumann: Leadership of the principal investigator and a friendly atmosphere.

Marta Faias: I believe that the most important things to keep a research group going are, first, that the members of the group research ought to be equally attracted to the research topics that are being undertaken, and second, they should also be able to talk the same scientific language. A last point that I underline are the complementarities among the researchers, a mix between inventive researchers, researchers that always have an idea to solve the emerging questions and researchers that carefully validate that solutions. These qualities are essential to the maintenance of the group.

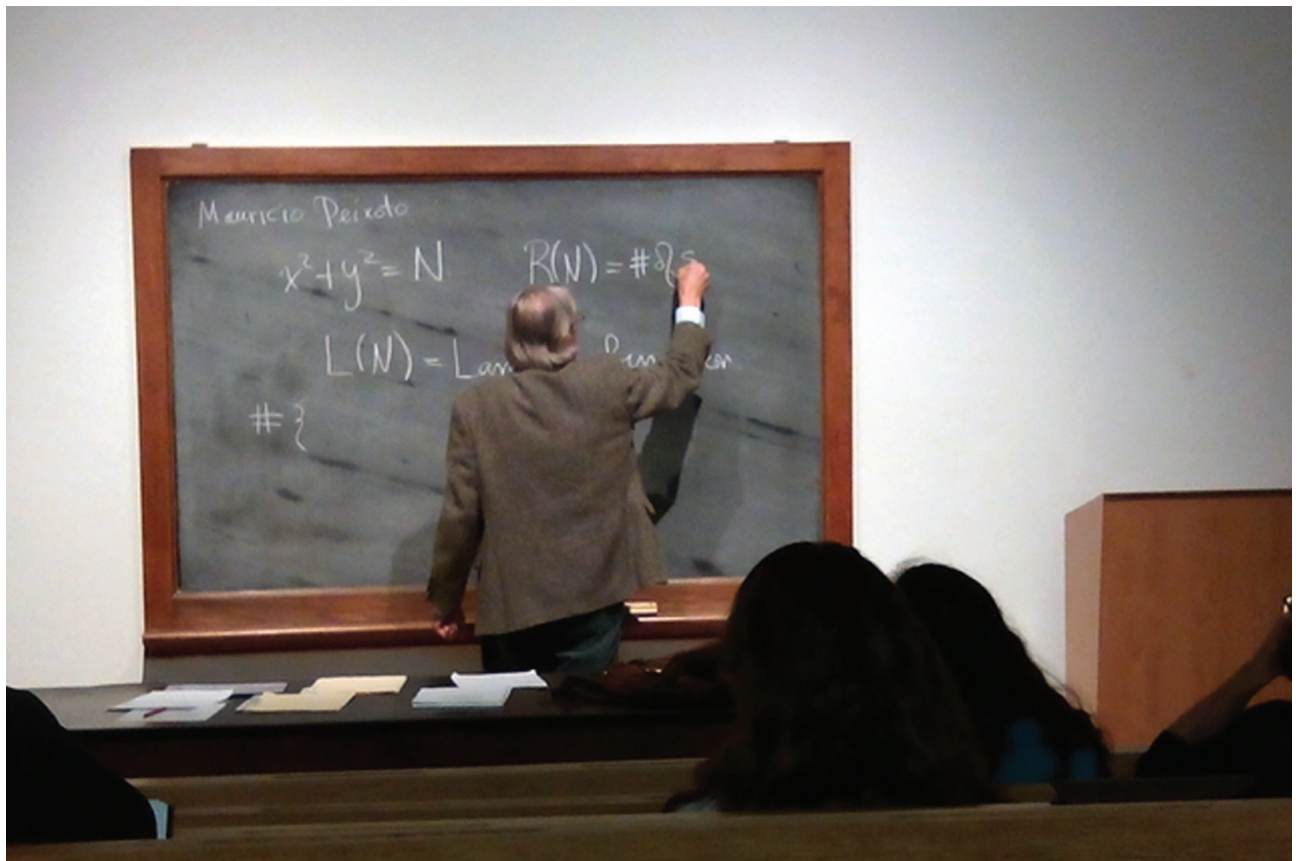
Onesimo Hernandez-Lerma: To keep the group updated on all new research developments, and constant seminars.

Edgard Pimentel: In order to keep a research group going there must be a continuous interaction between its members, in several levels. First, every integrant of the group must interact with its leaders on a regular basis. Then, smaller cells within the group may conduct more independent research activities. It ensures some sort of energy conservation within the group. Also, there must be strategies aiming at the internationalization of the group members and its activities. Mathematics has no nationality, so it is important to take advantage of this fact. Above of all, a research group cannot be motivated by the number of papers or contributions it produces. On the other hand, it should be concerned with the quantum of difficult, genuinely original, problems it has been attacking in an effective manner. It is unnecessary to say that prospecting and obtaining funding and research grants are critical.

How do you see the relation between traveling and research?

João Almeida: Traveling is very important when doing research because you get to know other realities. Also, when traveling one has some extra time available to think about his work and to discuss his research with other experts on his field.

Marta Faias: I think that it is quite difficult to do very good research without travelling. Firstly, a research group should integrate a mix of different



skilled researchers, which is in general only possible if the group is composed by people from different countries. Secondly, the new results should be discussed with experts, those discussions are fundamental to improve and validate the results. Since almost certainly the experts are spread throughout the world, travelling is compulsory.

Onesimo Hernandez-Lerma: I think traveling is neither necessary nor sufficient for doing good research. However, participating each year in a few selected meetings can be quite positive from the viewpoint of professional development.

Penelope Hernandez: The exchange of questions, ideas and techniques used to be easier when a scientific is moving around the world. This is so because when you travel it is easy to disconnect with the normality and to open up your mind and your time for new experiences. The possibility to visit new and good research environment helps to share in a cool ambient the ideas just in front of a black board or just with a coffee. I have travelled a lot in my career and my experience has been positive.

Sometimes it was difficult to talk with people but others I got a lot of insight about my work and the others' results.

Edgard Pimentel: Travel is critical for the advancement of research. Scientists must see their peers and interact with them on a regular basis. Trips to conferences, meetings and schools provide opportunities for us to do so.

On teaching:

What do you think about the relation between teaching and researching?

João Almeida: Researchers should also teach and teachers should do research.

Flávio Ferreira: Teachers should do research.

Onesimo Hernandez-Lerma: Teaching (a reasonable number of hours per week) can be quite positive for research, and the converse is also true.

Penelope Hernandez: A person who knows the last hot topics on research could connect them to the simple and less sophisticated fields that it used to

be taught. This way allows to the students to connect with important features and getting as a challenge the way to study and to understand the world. It is an experience when you realize your students understand why to study the boring matrices. Then they became even useful.

Diana Mendes: Personally I think that it is a quite strong relation between teaching and researching.

Any thoughts on what's crucial for a university teacher and or student?

Onesimo Hernandez-Lerma: Read a lot and work a lot!

Diana Mendes: Researching gives us a different vision about concepts, facilitates the updating of the methods and tools and offers challenging problems and answers for the students. The students are curious and captivated by things that they can understand, visualise (or at least imagine) and apply, instead of simple (or complicated) definitions and theorems. Researching allow us to give all these to our students.

What are your thoughts on the relation between high school and university in terms of education?

João Almeida: I think that, at least in Portugal, university and high school are still far distant from each other, nevertheless some progress have been made to approximate the two levels.

Do you have an advice for students starting their research?

João Almeida: Be persistent because there aren't easy paths along the way.

Onesimo Hernandez-Lerma: Get a good advisor.

Diana Mendes: My advice, for the students starting their research it is the following: be patient but curious, disciplined but audacious, and only do it if you really enjoy it.

Edgard Pimentel: A student starting research in mathematics must be, above of all, brave. Brave in attacking the problem, in checking her solutions, in talk about her progresses or roadblocks. A perhaps more practical advice is to allocate as much time as possible to your research. Then, as soon as something comes up, write things down and talk about them with people (a thesis director is the most suitable person in this case). Avoid focusing on things that — although potentially interesting — are not related to your thesis work: you have a problem to solve

and a thesis to write; everything else falls into the distraction category.

And for the ones who are hesitating between taking a PhD and looking for a different job?

João Almeida: They should try to get a PhD degree without losing a good job opportunity.

Carlos Braumann: I will not advise a student to give away a good job offer in order to take a PhD as a full time student. I would try to convince the employer to keep the job offer and combine it with a PhD thesis of its interest.

Onesimo Hernandez-Lerma: Get a PhD; it never hurts.

Did all your research students become academics?

Carlos Braumann: The answer is yes for all that have a job. Industry and business are not yet hiring PhDs as they should. We need to convince them of the advantages of hiring PhDs and of PhD theses in entrepreneurial context and, in this phase, provide adequate incentives.

Onesimo Hernandez-Lerma: No, a couple of them work at banks or computer companies.

On other issues:

Do you have hobbies?

Flávio Ferreira: Walk and cycling by the sea; watching football; gastronomy.

Onesimo Hernandez-Lerma: Yes, walking and reading.

Diana Mendes: I have some hobbies, painting and cooking, between others.

Do you have a connection to Portugal? How do you see its development?

Onesimo Hernandez-Lerma: My only connection with Portugal is Alberto Pinto!

Penelope Hernandez: I have few connection with Portugal and I think that as in Spain there are a lot of variance in the academic researchers. Fortunately, some of them have the energy to make new and productive issues. This generates the good ambience to continue working and collaborating.