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Anibal Ollero

IEEE RAS Interviews

Q1: So let's begin with some questions about your personal history. If you could tell us your full name and the place where you were born.

Anibal Ollero: I was born in Seville, Spain, South of Spain. And yeah, I studied there. I studied there. Then I left and I went back in the 90s to my city, to Seville, and now professor at the University of Seville, and also scientific director of the Aerospace Technology Center

Q1: Thank you. What first got you interested in robotics? Do you remember your first project or, was there some... a book, a film, a family member who got you interested in the field?

Anibal Ollero: I knew robotics in my department. So because I studied in Seville, I knew the robots there. But then I left. I went to Toulouse, to the last CNRS research institution in France. And then I knew there the more about robotics and about the mobile robots. Then I went to Carnegie Mellon University to the robotic institute in Carnegie Mellon University. And then I learned a lot about aerospace robotic, which is my specialty now. So I started to know there, the unmanned aerial vehicles and the space robotics. That is my main activities later. Then, when I came back to Spain and to Europe, I started to become more and more interested in aerial robotics. So I started the coordination of European projects by the beginning of this century, by 2000. And I started to work on this in the projects, dealing with the unmanned aerial vehicles, the coordination and control. I was coordinating a European consortium of several partners. And yes, this was a joint work with several partners in Europe. I started from them working in other projects that we can also talk about now. Yeah.

Q1: Yes. Yes. So let's talk about some of the key research projects that you have been involved with and are interested in currently.

Anibal Ollero: OK, so after working in unmanned aerial vehicles without pilot and every day more and more intelligence, I am also working on space, on orbit manipulation. I realized that it could be very interesting as a research question to have flying vehicles, but also manipulating how to have aerial manipulators. And then I was interesting to apply my concept of the flying on orbit manipulation to the to the flying in air vehicles. And then I developed aerial manipulation. So I asked for a European project to be able to assembly structure with flying manipulators. And this was an important project because we developed general concepts on aerial manipulation. And then this is still a very active field. But at that time was very new. And then we have this, this project. And then, after the basic concepts we apply. We also apply this project for developing aerial robotic system to perform work at Hays. So that means to perform, for example, inspection and maintenance activities. And this was also very satisfactory because we applied our concept to to solve problems that are of social relevance, right. Because in some countries, you know that work at Hays is the first chaos of casualty INAUDIBLE is working at Hays. So we developed this problem and we received one of the awards of the European

Commission because of this work. Now I'm still working in different challenges relating to these problems that I can explain more.

Q1: Yes. Yes. Before we get there, can you talk a little bit about sources of funding for your research? Has that, what have they in government, military industry? And has that changed over time?

Anibal Ollero: I have to accept to recognize that the main sources in all these activities in the last 20, 25 years was essentially the European Commission. So I participated in about more than 30 projects funded by the European Commission. And I personally coordinated seven projects, which has been very good in terms of consortium interaction with other laboratories in Europe. So we have been working in projects that are more challenging because of this association with other institutions in Europe. Not only research institution, but also companies. So we work with companies, universities and research institution along all Europe, and we solve a number of significant problems. I am very satisfied with this. In addition, we have also a number of contracts with industries to transfer these technologies for practical applications.

Q1: Have there been significant technologies? So, I'm thinking about, on a smaller scale, about things like Connect or kind of conceptual tools like large language models that have come about that have kind of transformed your research?

Anibal Ollero: OK, now my research career has a lot of challenges, right? Still challenges to be solved at the physical level, for example. So I would say that now two big challenges are to have the area robot more safer. So that means safer systems. But also with longer endurance, long flying endurance and also range. And then, this kind of problems means that you have to use models. Essentially, at the beginning, we have two kind of model, physical models. Let's say. Taking data from the nature and so on. So we use the physical models, and then we use kinematic, dynamic, aerodynamic, but also material science models to develop our system. So, for example, we develop birds, robotic birds. These birds do not use the conventional propellers. They just flapping the wings. Flapping the wings means that you don't need propellers. They use the transmission. And then, we have, and this is very important, to combine flapping with gliding in such a way that we can save energy. After that, it is possible to perch, on a branch, for example. We are able to perch on a branch, and then our birds are also able to manipulate. So our birds can use the INAUDIBLE to manipulate us, the birds. So that means that these are some of the challenges that we have now. But also we are developing multirotors, but with a difference, which are they are soft, the body is soft. Even the propellers are soft, so they cannot hurt people. This is safety. So we have a number of challenges that we have to solve. Of course, if we look to the future, we can also learn from the real birds. But this is next step.

Q1: You've mentioned different kinds of challenges, some of which are clearly technical, but also alluded to some of the organizational and funding challenges that come with aerial

technology, as well as regulatory, or political or safety, for example, being unique to your particular kind of research field. As you think about the challenges to your research, are there any that we haven't yet talked about that you have found to be significant?

Anibal Ollero: You mentioned regulatory aspects are very important for the practical applications. So we have to demonstrate that our, for example, UAVs, our unmanned systems, flying systems are safe enough. So we have to demonstrate testing and demonstrating this to the authorities to get the permission. And then I hope that we will be able to use this for example, in urban environments, in the cities. So how to perch in the balcony, how to take samples on how to deliver small, light things. That is possible today. But also at the same time, we can contribute to the bigger systems with some technologies that are, for example, to decrease the noise or to, in general, to make them more safer. So yeah, this is our challenges.

Q1: Given those challenges, are there research problems that you have not yet been able to take on yet? And if so, what are these?

Anibal Ollero: Well, I need another life to solve all these problems. But yes, as I mentioned, in our case, we like to approach more to the real birds to use the wind in the proper way, how to use the wind in the real time in such a way that we can fly better, that we can perch better, how to maintain the equilibria, manipulating like the birds. There is a long list of challenges that we will need to target in the next year from the point of view of basic knowledge. But the second is to apply this. And yes, I am convinced that these aerial robotic technologies can be very useful in two aspects concerning the interaction with the people. The first is to substitute the people working in dangerous conditions at Hays, as I mentioned. But the second is also to help the people working at the Hays, even interacting physically with them. So they are big challenges.

Q1: Just out of curiosity, do you understand enough about birds yet to model them in your robotics system?

Anibal Ollero: No. We work with people that know about the birds, and we have discussion, many discussion with them. But we always need to know more and we, of course, need to learn more about the behavior of the bird to improve the behavior of our robotic birds.

Q1: Yeah, what an interesting set of challenges. As you think about your career, can you tell us a little bit about what you see your most significant contributions to the field as being?

Anibal Ollero: I would say aerial robotics. And if you want to be more precise, aerial robotics manipulation.

Q1: I'll say a different way of asking that question. Is there something in your career that you are most proud of?

Anibal Ollero: Well, yeah, essentially related with this activity, but also not only about my personal work, but also the work of my students. So I like pretty much the work of my students, and then I think that this will be part of the future of the aerial robotics and particularly aerial robotics manipulation that in my lab, is particularly relevant.

Q1: And speaking of students, as you think about the diversity of your own projects and the range of skills that a student would need to be successful in robotics as it kind of exists now, what do you think those skills or strategies would be for someone coming into the field?

Anibal Ollero: Can you repeat the question?

Q1: So yes, I'm sorry. So you've described a set of projects that are very complex, both again, technically and in relation to social and political factors. I can imagine that takes a team with many different skills. As you think about your students coming into the field today, as it exists today, what do you think are the most critical skills or what advice would you have for students coming into the field?

Anibal Ollero: Okay, let me say first from the background and from what are the main characteristics we would like to have in our students. So we would like to have creativity. We would like to have also solid scientific background. And also the third is engineering expertise. So I would say the three creativity, science, and engineering, not only technology, the use of the science, but the engineering capabilities. And this is for the students. Also, there are very important characteristics. We have, we need in our projects, not small teams. We need a significant number of people working together with different specializations and different characteristics. And in my opinion, to be able to interact with other people and with other students and other professors is extremely important.

Q1: Interesting. As think about the field itself, as you've experienced it, over the past several decades, what, how do you think the field has changed over that time period?

Anibal Ollero: Well, if you asked me 30 years ago about the, a man-aerial vehicle, oaky, I, at that time, I didn't realize that we were at the beginning of this evolution. Now they are very, very popular. So the drones are very popular in the media, for example. I mean, if you told me 30 years ago about that, for me now it's very surprising. The evolution of the technology in this

field. So I have to say, and this is because, okay, I expect significant progress still in this technology, but I have to say that please do not believe that we can have just direct application of ChatGPT to our flying robot. That is pretty complex.

Q1: Yeah. Well, that was going to be my next question. Do you, do you see any applications of generative AI to your particular research areas or you're—you seem skeptical. Do you see any useful applications?

Anibal Ollero: Well, from the scientific point of view, I have to be skeptical, and then we have to analyze the conditions. But yeah, if you want to, I am more optimistic in terms of, for example, recognition of the INAUDIBLE and being able to select significant information from this INAUDIBLE. But if we are moving to physical interaction of my aerial robots, with the people and the objects in the environment, this is more difficult and will require more time.

Q1: I asked you earlier about new technologies that have, that then become available. I should have maybe asked you specifically about inexpensive commercial unmanned vehicles. Has that dramatically changed the kind or the extent of the research that people—?

Anibal Ollero: Okay. I have mixed feeling. For one side, I agree that this is a very good interest, that this is the popularization of this area of robots, that you can try to put some intelligent functions at low cost and so on. However, if we want to have applications in a number of sectors, that means safety. That means reliability. That means testing. That means certification. And that means, then, higher cost. So we have to find the compromise.

Q1: I asked you about changes that you witnessed in the field over your life. What do you imagine are the changes that are coming in the next decade or two?

Anibal Ollero: Well, being able to have, for example, in our city, INAUDIBLE environments, this aerial system raised a number of questions. I mentioned safety, but also a number of questions related to privacy, for example. Then we have to deal with all these social aspects of the research and the application of our research that we have to analyze and we have to demonstrate. This is the social aspect of the application of robotics that needs also significant attention. So, we have to pay attention, not only to the noise that I mentioned before. We do not want to have noise around, but we also want to have everything that people raise concerns about these applications.

Q1: You mentioned earlier the size and diversity of the teams that have to be involved in solving these very complicated problems. When you think about, specifically, the social and the ethical and the political side, do you think the kind of institutions that we have from your university to the IEEE to government have the right tools for that, or is that something that could use INAUDIBLE improvement?

Anibal Ollero: Okay. I think that colleagues working in other applications, like say medical applications, for example, and all these kinds of things are being involved in this problem that we have now for many years. So they are more advanced that has analyzing the ethical aspects and so on. Typically in our case, we have to deal with these ethical aspects that are, let's say, obvious. So we do not have very particular ethical aspect in addition of safety and privacy and so on. But yes, there are always some concerns about that. So I have to repeat many times that the robotics is not only to substitute workers, but it's to help workers. And we have to repeat many times. So this is not the matter of substituting if we want to substitute only in dangerous activities. So the concerns about the substitution of people by robots in our case is not something that we have to take into account at the level, at the same level, that in other industrial application of robotics, for example. So in our case, aerial robots are to help people.

Q1: So I had asked you earlier about, mostly your work with aerospace and aerial robotics, but there are some aspects of your research, health, this kind of questions of work and worker augmentation that we haven't yet talked about. Do you want to say a little bit about what those projects will look like for you?

Anibal Ollero: No, but I think that, I mean, helping people is not only for one particular kind of robotic, it's for every kind of robotic application. You can realize many applications, even guiding, for example. Guiding people, guiding people, handicapped people, guiding in the INAUDIBLE environments, or guiding indoor applications. You can think indoor application of aerial robotics. Why not? In many cases, there are a lot of difficulties to move a robot around on the ground. However, it is more easy to fly. So why not asking the aerial robot flying indoor to guide you to some places in this building and so on? So this is new.

Q1: It sounds to me, I think you've answered this question, but is there anything about your collaborations with industry that you haven't talked about? You talked about various commercial firms that you've worked with, but are there other aspects of that? And has that changed over time?

Anibal Ollero: I have many contracts with industry, so I am collaborating with industry. And this is not only because it is sources of funding, it's because I think that they provide us problems that we want to solve in research. So they provide that what are some kind of challenges,

industrial challenges. So I will be continuously collaborating with the industry to, at least they can pose these challenges to guide your research.

Q1: Yes. As we approach the end of our time together, are there some topics that we haven't yet talked about that you would like to?

Anibal Ollero: Well, I think that I have tried to summarize what are my main topics now. But let's say considering, for example, my field, you can see in the skies not only one bird flying, you can see flocks of birds. So I would like to understand first, better, how these flocks behave, that there are a number of significant work, not only in my field, in robotics, how the birds behave, how the flock of birds behave. But also, ideally, we would like to interact with this kind of flock of birds, because I think that this contribute also to understand their nature, and then to use these concepts in our robot.

Q1: I know just a little about flocking and swarming behavior. And I may not be asking this question in quite the right way but, to you, does it matter whether you understand the kind of biology of that or simply the empirical behavior? Does it matter to your research to what degree we understand why birds and fish swarm and flock?

Anibal Ollero: It is a very complex problem. It is not something that you can easily do. So that means that the combination of the observation of the nature, but also to deal with complex system equations and so on, it should be in some way, the way. So, in my opinion, we cannot separate, okay, this is the data-based approach coming from the nature. Take a lot of data, take a lot of videos and then try to understand. Okay, this is very important, but also we have equations and we have interactions and so on. So the idea is to identify the parameters of this model from the observation of the nature. This was, by the way, a classical approach. So we have model, even if we have model, we postulate that this model will work, but then we need to INAUDIBLE the parameter of this model. And this can be done, of course, from the observation of the nature. And finally, from learning. So we are converging these two approaches that are essentially our physical models and our database models.

Q1: Thank you. That was very, very interesting. I appreciate that. I think we are at the end of our time, Darryl, did you get what you need? Thank you very much.

Anibal Ollero: It's OK. I try to be not too abstract, but I don't know.

Q1: No, that was great. And one of the ways in which we are going to use this material is both as interviews, but also addressing particular questions and kind of breaking these interviews up to

address particular questions in the field, like social implications of the field, or thinking about the relationship between robots and nature in a particular way. And you gave us lots of really great material. Thank you.

Anibal Ollero: Thank you. Thank you very much.