

# University Management and Microwaves: the Art of Matching

**Alejandro Díaz-Morcillo**

Electromagnetics and Matter Group

Department of Information Technologies and Communications

Polytechnic University of Cartagena, Spain

Contact E-mail: [alejandro.diaz@upct.es](mailto:alejandro.diaz@upct.es)

Sometimes in a lifetime the boundary conditions open a window of opportunity to completely change your work and even your social life. In my case, after almost 20 years devoted to teaching and microwave engineering, it was for serving my university, the Polytechnic University of Cartagena (UPCT), in the position of Rector. The advisory committee of the AMPERE's Newsletter kindly invited me to write down a few lines about this experience and my return to teaching and researching tasks. So, here is the story.

## The chance

After a brief period as Vice-Rector on Research and Innovation, I had the chance in 2016 to present my candidature for the election of Rector.

In all public universities in Spain the university community elects the rector every four years through a weighted vote. In the case of UPCT, full-time PhD faculties are weighted with 51%, part-time and non-PhD lecturers/researchers with 15%, administrative staff with 9% and students with 25%. It was a hard campaign of ten days between two candidates. Indeed, the most exhausting days I remember of my whole life. In the end I won with 54% versus 46% and on April 26<sup>th</sup> I took office.

## The term

What is there in common with university management at a political level and microwaves? I could summarize it in a short sentence: The art of matching, by which I mean, matching the internal and external waves. Inner waves are commanded mainly by the heads of departments (15) and the heads of schools (in Cartagena we have Industrial, Telecommunication, Civil, Naval and Agronomic Engineering, Architecture and Business schools, plus a Defense center, which belongs to the Spanish Air Force). The outer waves, that is, the social forces,

are represented by the Spanish Research and University Ministry, the Regional Government, the City Council, companies, entrepreneur associations and a long etcetera. Between these two factions the Rector acts as a "matching network", trying to get the best results from the university for society, and trying to get for his community the best working conditions for both teaching and researching.

I had the greatest of luck in that my mandate coincided with my colleague and friend Juan Monzó (former Secretary of AMPERE) in charge of the General Direction of Universities and Research, that is, the department in the Regional Government responsible for control and funding of public universities. His knowledge of the University and his experience in research helped inform the understanding required between public powers and politicians.

During my mandate, I had four main goals:

- Improving the quality of teaching tasks.
- Increasing the knowledge transfer to companies, especially through the creation of university/company chairs. At the end of my mandate, we had 50 of these chairs, where companies and the university worked together, with room within the university campus, for a long-term strategy for achieving technological goals and/or searching for talent amongst our students and alumni for the company.
- Increasing the internationalization of UPCT, attracting foreign students from Europe, Latin-America, North-Africa, China (see Fig 1) and India. At the end of my mandate, I had the great fortune of creating the European University of Technology (EUt+), within the Erasmus+ European Universities program, a European consortium of 8 universities from 8 countries (Germany, Latvia, Ireland, Bulgaria, Cyprus, France, Romania and Spain) to transform them, in

the medium term, in a unique university with 8 different campuses (see Fig. 2).

- Dissemination of science and technology among the youngsters and children in order to increase STEM vocations, especially for girls. I would point out in this respect, the project for the STEM promotion among girls “Quiero Ser Ingeniera” (I Want to Be an Engineer) (see Fig. 3)



Figure 1. Signing of a MoU for exchange of students and lecturers with the University of Jilin, China



Figure 2. Signing of the EUT+ bylaws at Cluj – Napoca, Romania



Figure 3. Meeting with more than 3000 girls within the project “I Want to Be an Engineer”

## Extra-time

After almost four years, I felt I had neither the energy nor the enthusiasm for four more years. Therefore, at the end of December 2019 I announced to the Senate of my University my decision not to present my candidature for the re-election in March 2020.

My plans were to have a sabbatical after these four years of practical disconnection from research, basically for two reasons: first, I could do it, since I was hardly involved in research projects that tied me to my University; second, I had to do it, since an intensive update was necessary after such long period away from technical papers, conferences and projects. Unfortunately, the pandemic spoilt this opportunity. The elections, which had been called in February, were suspended. In a giant effort by our lecturers, classes were transformed from in-person to video-conference format in just two days: the weekend of 14–15 March, when the lockdown was set in Spain. In the next weeks many of internal norms and regulations were modified in order to fit the new remote conditions for master classes, laboratory sessions and examinations. A temporary COVID committee was created on 13 March for an agile management of critical matters: teaching, access to researching facilities, situation of incoming and outgoing Erasmus students, students’ residence, loan of equipment to students in order to allow internet connection for classes, and so on.

Finally, after finishing the 2019-20 course and having prepared the university for 2020/21, the elections took place in July by means of electronic vote and on the 28th I finished my term. I can summarize it, despite there being neither calm days nor resting weekends or holidays, as a very rewarding period, where I grew as I couldn’t have imagined as a person.

## Coming back to research activities

From the Fall of 2020 I returned first to my research on microwave engineering, and later to lectures (I teach currently Analysis and Design of Electrical Circuits). I was so eager to return to research that I am now working on different technological readiness levels, different and distant frequency regions and different power levels. Let me try to explain it. I could say that I am nowadays in the three stages of knowledge generation and its valorization, i.e.,



research–innovation–entrepreneurship. In other words, I am both trying to transform the money in knowledge and vice versa.

First, I am involved in a very fundamental research subject (which hopefully could find its application in ten or twenty years, but it is key for the understanding of our universe), which consist of the analysis and design of resonant cavities for the detection of the axion, a hypothetical particle which could compound the dark matter [1]. At this moment, we are looking for the axion at three different regions of the electromagnetic spectrum: the lower UHF band (300–500 MHz), the X band (8–12 GHz) and the W band (75–110 GHz). The challenge is tremendous, since it is necessary to detect powers around  $10^{-24}$  W within an 8 T magnet and at a temperature between 10 mK and 4K.

Second, I am collaborating in the innovation step, among other projects, through the development of new microwave-assisted processes for devulcanizing of rubber [2], in a European project led by my colleague and friend José Fayos (former Secretary of AMPERE, too). Finally, I am involved in the creation of a spin-off company for the production of microwave drying machines of clothes for the home market. In these two last applications I feel more comfortable, working at 2.45 GHz and with powers in the order of kilowatts.

### A tribute

Some weeks ago, my portrait joined those of the former Rectors in the Rectorate Hall (see Figures 4 and 5). I included in the painting two books which have greatly influenced my research career. One of them is *Foundations of Electroheat: A Unified Approach*, authored by our colleague and past Honorary/President of AMPERE and an example to us all, Ricky Metaxas. It's a little tribute for a research life devoted to fostering the high-power microwave and radio frequency technologies and its community.



Figure 4. Rectorate building at UPCT

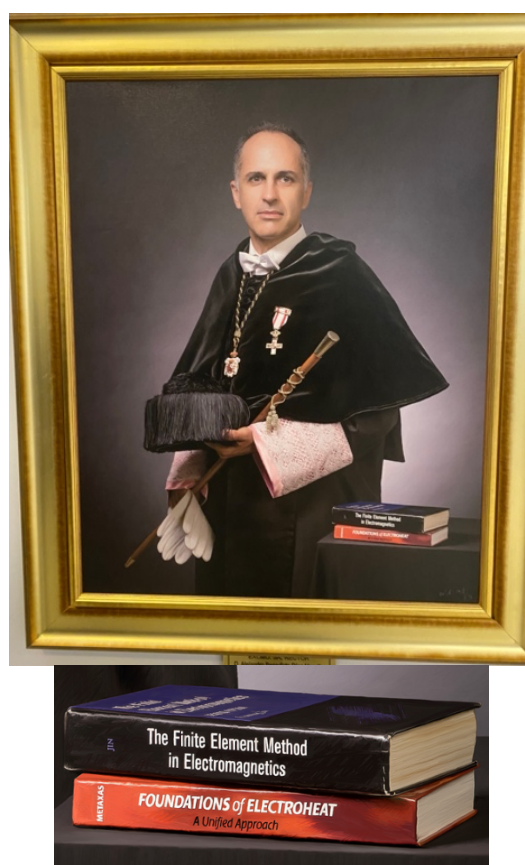


Figure 5. Portrait in the rectoral hall, with zoom of the books in the painting.

### References

1. Alejandro Díaz-Morcillo et al., Design of New Resonant Haloscopes in the Search for the Dark Matter Axion: A Review of the First Steps in the RADES Collaboration, *Universe* 2022 8 (5), January 2022. arXiv:2111.14510 [physics.ins-det].
2. Rafael Pérez Campos et al., Improved control on the microwave devulcanizing of ground tire rubber by means of sulphur gas sensors, *18th International Conference on Microwave and High Frequency Applications. AMPERE 2021*, Goteborg, Sweden, 13th September 2021.

**About the author**

Communications at UPV, and in 1999, he joined the

**Alejandro Díaz-Morcillo** received the M.S. Eng. and Ph.D. degrees in telecommunication engineering, both from the Valencia Polytechnic University (UPV), Valencia, Spain, in 1995 and 2000, respectively. From 1996 to 1999, he was a Research Assistant in the Department of

Department of Information Technologies and Communications, Technical University of Cartagena (UPCT), Spain, as a Teaching Assistant, where he is currently Professor since 2011. He leads the “Electromagnetics and Matter” Research Group at UPCT and his main research interests include numerical methods in electromagnetics, microwave engineering (communications and IMS applications) and dielectric characterization. He has been Vice-Chancellor for Research and Innovation at UPCT and President of UPCT (2016-2020).

## ***Microwave Research at the School of Engineering University of Aberdeen***

**Claudia Fernandez-Martin**

University of Aberdeen, School of Engineering, Fraser Noble Building, Room 356, King's College, Aberdeen, AB24 3UE

Contact E-mail: [cfmartin@abdn.ac.uk](mailto:cfmartin@abdn.ac.uk)

The University of Aberdeen (UK) has a growing and established research group working on microwave-assisted carbon capture technologies at the school of Engineering. Led by AMPERE's Secretary elect, Dr Claudia Fernandez-Martin (CFM), this active research group is investigating how the energy penalty associated with regeneration in any carbon capture process can be mitigated with the use of microwaves.

Their recent research outputs in which microwave technology is investigated include a PhD thesis, in which an in-depth systematic investigation on microwave-assisted post-combustion carbon capture and its comparison with the analogous conventional process is conducted ('Feasibility study of microwave-assisted swing adsorption for post-combustion carbon capture'. Mohamud Mohamed Abdi Yassin, 2021. Main Supervisor: CFM. Part of the project titled: Intensification of post-combustion capture by using advanced regeneration technologies).

The University of Aberdeen's microwave research group has well-established collaborations with several universities in Europe working in microwave technology, such as The University of Nottingham and Valencia Polytechnic University (UPV).

CFM's research group is currently working in collaboration with Professor Catala's group from the UPV on the design, and commission of a unique apparatus to carry out further investigation on the application of microwave irradiation on chemical processes, mainly hydrogen production and carbon capture. Some of CFM research group's recent publications on the use of microwaves for carbon capture applications can be found in the following “for further reading” section.

### **For further reading**

1. M.M. Yassin, J.A. Anderson, G.A. Dimitrakis, C.F. Martín\* (2021). Effects of the heating source on the regeneration performance of different adsorbents under post-combustion carbon capture cyclic operations. A comparative analysis. Separation and Purification Technology, vol 276 Impact Factor: 7.312. Quartile: Q1
2. M. M. Yassin, S. Biti, W. Afzal, C. F. Martín\* (2021). A systematic analysis of the dynamics of microwave- and conventionally-assisted swing adsorption on zeolite 13X and an activated carbon under post-combustion carbon capture conditions. Journal of Environmental Chemical Engineering. Vol 9 (6), 106835. Impact Factor: 5.909. Quartile: Q1
3. <https://www.abdn.ac.uk/engineering/people/profiles/cfmartin#publications>