Conference Report

The IEEE MTT-S International Conference on Numerical Electromagnetic and Multiphysics Modeling and Optimization 2022

■ **Stéphane Bila** and **Dominique Baillargeat**

After an interruption in 2021 due to COVID-19, the IEEE MTT-S International Conference on Numerical Electromagnetic and Multiphysics Modeling and Optimization (NEMO) 2022 was held from 6 to 8 July in Limoges, France. IEEE NEMO is an annual event, founded by the IEEE Microwave Theory and Technology Society (MTT-S), on electromagnetic- and multiphysics-based computer-aided design (EM-CAD), rotating among Europe, North America, and Asia. It aims to stimulate a broad exploration of "disruptive" technologies of EM-CAD as well as traditional topics.

The meeting brought together experts and practitioners of electromagnetic- and multiphysics-based modeling; simulation; and optimization for RF, microwave, terahertz, and other applications for three days of activities, discussion, and networking. The conference

Stéphane Bila (stephane.bila@xlim.fr) and Dominique Baillargeat (dominique.baillargeat@xlim.fr) are with the Université de Limoges, CNRS, XLIM, UMR 7252, F-87000 Limoges, France.

was an ideal forum for the sharing of new ideas on techniques for electromagnetic and multiphysics modeling; proposals for efficient design algorithms and tools; and the anticipation of modeling/analysis needs for future technologies and applications.

The event was held at the University of Limoges. NEMO2022 was organized with the support of the XLIM Research Institute. The organizing committee and the conference were chaired by Prof. Dominique Baillargeat.

NEMO2022 was financially sponsored by the MTT-S and technically cosponsored by the University of Limoges; IEEE France Section; the Nouvelle Aquitaine region; and the city of Limoges. All financial and registration matters were managed by Julien Lintignat, Patricia Leroy, and the administrative staff of the University of Limoges. Elise Guyot managed communications for the conference, keeping attendees informed and ensuring an enjoyable conference.

IMAGE LICENSED BY INGRAM PUBLISHING

The conference featured an exciting technical program, with invited talks given by internationally recognized experts in electromagnetic and multiphysics modeling; simulation; and optimization. All of the papers submitted to the conference were thoroughly reviewed by the NEMO Technical Program Committee (TPC), which was chaired and cochaired by Stéphane Bila and Cédric Quendo, respectively. The TPC was composed of a diverse international group from academia and industry. Despite the effects of the pandemic, 83 papers from 30 countries were submitted, and 73 were accepted. There were 121 attendees (Figures 1 and 2).

Five half-day sessions were proposed by the organizing committee, comprising technical and special sessions; keynote speeches; and one focused session. There were 16 technical sessions.

There were 10 special sessions.

Figure 1. *A group photo of the NEMO2022 attendees.*

Figure 2. *(a) The opening ceremony with the President of the University of Limoges; the Mayor of Limoges City; Dr. Stéphane Bila; and Prof. Dominique Baillargeat. (b) Participants at a session. (c) A coffee break. (d) Participants at a session. (e) Information panel for the day's sessions. (f) Participants at a session. (g) A group photo of volunteer Ph.D. students from XLIM. (h) A lunch among attendees.*

- Machine Learning, AI and Uncertainties (WE1—5 papers)
- Recent Advances in Metasurface Technologies (WE2—5 papers)
- Modeling and Design of Passive Circuits (WE5—4 papers)
- Electromagnetic and Multiphysics Multiscale Modelling and Characterization for Advanced and Efficient Materials—Part 2 (WE9—4 papers)
- Modeling and Design of Antenna and Networks (TH2—5 papers)
- Advanced on TLM Method for Microwave Applications (TH3—5 papers)
- Advanced on the FDTD Method for EMC and Microwave Structures Modelling (FR2—4 papers)
- AI-Deep Learning for RF Component Design (FR3— 4 papers).

There were also six regular sessions.

- Modeling, Simulation, and Design of RF, mm-Wave, and THz Devices and Circuits Part 1 (WE4—4 papers)
- Computational Electromagnetics, Algorithms, and Applications—Part 1 (WE6—4 papers)
- Multiphysics Modeling and Design of Microwave Circuits and Components (WE7—5 papers)
- Modeling of Inverse Electromagnetic Problems and Design of Metasurfaces (WE8—5 papers)
- Computational Electromagnetics Algorithms and Applications—Part 2 (TH1—5 papers)
- Modeling, Simulation and Design of RF, mm-wave and THz Devices and Circuits—Part 2 (FR—4 papers).

With the help of Raphaël Sommet, Christophe Guiffaut and Thomas Fromentèze organized six keynote speeches by distinguished researchers with a high level of expertise. The talks were delivered by:

- Jacques Sombrin: "From Fractal Materials to Fractional Power Function Nonlinear Models for Passive Intermodulation Distortions"
- Prof. Francisco Chinesta: "Advanced Technologies Embracing Physics-Based and Data-Driven Models to Empower EM Simulations"
- Prof. Okan Yurduseven: "Holographic Metasurfaces: From Antennas to Beyond"
- Prof. Dirk de Villiers: "Design of Modern Radio Telescope Antennas Using Surrogate Modeling"
- Prof. Peter Fritzson: "The Open-Modelica Environment and Its Use for Development of Digital Twins"
- Dr. Wissam Saabe: "Improving System Simulation Accuracy With Measurement-Based Behavioral Model."

Focus sessions were dedicated to industry and organized by Sébastien Mons and Cyrille Menudier. The featured talks were by:

- Dr. Tom De Muer, from Keysight Technologies: "Analyzing and Optimizing the Local Oscillator Output of an Ultrawideband Signal Analyzer"
- Dr. Hassan Chreim, from Dassault Systèmes SE: "Model-Based Radome Design Engineering"
- Gerald Albertini, from Math-Works: "RF System Modeling With MATLAB."

All accepted papers were published in a proceedings and were made available to the participants via the conference website, which was managed by Olivier Tantot and Arnaud Beaumont. The accepted papers were also made available for archiving on IEEE *Xplore*. To conclude NEMO2022, the authors were invited to submit extended articles to a special mini-issue of *IEEE Transactions on Microwave Theory and Techniques*.

A good conference incorporates multiple opportunities to network and meet informally over refreshments. Two social events stand out, both of which were organized by Laure Huitéma and Audrey Martin.

The mayor of Limoges invited all participants to a welcome reception at City Hall. He gave a speech that expressed

(a)

(b)

Figure 3. *(a) The welcome reception at Limoges City Hall. (b) Dr. Stéphane Bila (at microphone) with the Mayor of Limoges City (left) and Prof. Dominique Baillargeat.*

his pride in hosting an international conference like NEMO in Limoges. He also presented some historical moments of the city of Limoges (Figure 3). At the welcome reception, we had the pleasure of having Prof. Rashaunda Henderson, the 2022 MTT-S president, for a short visit. We deeply thank her for coming to Limoges under difficult travel conditions. It was a pleasure to take her to dinner and to share a very pleasant moment with her (Figure 4).

The second special social event, held at the Pôle de Lanaud, allowed attendees to discover the countryside surrounding Limoges and the culinary specialties of the Limousin region during the very pleasant conference banquet (Figure 5). This event was the occasion for Dr. Qi-Jun Zhang, as the chair of the NEMO ExCom, to present the organizer certificate to Prof. Dominique Baillargeat, as the chair of NEMO2022 (Figure 6). All attendees were delighted by these two events.

A student paper competition was organized by Nicolas Delhote with a jury of experts. They challenged Ph.D. students technically and in terms of their presentation skills. The prize for the Best Student Paper of NEMO2022 was awarded to Nastaran Soleimani with her cosupervisors, Riccardo Trinchero and Flavio Canavero of Politecnico di Torino, Italy, for the paper titled "Vector-Valued Kernel Ridge Regression for the Modeling of High-Speed Links." A sum of €1,000 was associated with the prize, which rewarded a research work of high scientific quality highlighted by a very good oral presentation (Figure 7).

According to the feedback from attendees, everyone was glad to have the opportunity to participate in NEMO2022 and to be in person after a long absence. On behalf of the organizing committee and all the sponsors,

Figure 4. *From left: Prof. Dominique Baillargeat (NEMO2022 chair); Dr. Stéphane Bila (NEMO2022 TPC chair); Prof. Rashaunda Henderson (2022 MTT-S president); and Dr. Qi-Jun Zhang (NEMO ExCom chair) at City Hall of Limoges for the welcome reception.*

Figure 6. *Qi-Jun Zhang (left) presents the organizer certificate to Prof. Dominique Baillargeat.*

(a)

(b)

Figure 5. *(a) and (b) The conference banquet at the Pôle de Lanaud.*

To project (18) onto a graphic, we introduce such an angle θ as to meet

$$kQ = \tan 2\theta. \qquad (19)$$

Employing this angle, (18) becomes amazingly elegant as

$$\eta_{max} = \tan^2\theta. \qquad (20)$$

That is to say, kQ and η_{max} are correlated by way of θ. In this sense, $\tan\theta$ should be called the *efficiency tangent* by analogy with so-called loss tangent. The square on $\tan\theta$ implies a quantity measurable on a power scale rather than an amplitude scale.

Thanks to (19) and (20), we can visualize the relation (18) as shown in Figure 8(c). In this figure, a triangle is drawn exactly by the same procedure as that in Figure 5, but it represents a different physical meaning. When kQ is given as the prime triangle's height,

the smaller triangle becomes $\tan\theta$ tall, and, thus, the square's area results in η_{max}. Looking at these graphics, students realize a basic law of WPT: η_{max} ranges from zero to unity when kQ ranges from zero to infinity.

Conclusion

We have explored plane geometry and found eight figures that explain wave engineering essentials. The leading figures are all in elementary shapes, such as a square, rectangle, and triangle, so they are genuinely friendly even to undergraduates. Employing these graphics in classes, students will be richly inspired and, thus, become interested in our wave engineering world. To seek further stimulating discovery about the impedance plane, Smith chart, and other related geometry, students are encouraged to proceed to the three articles in the "References" section.

References

[1] T. Ohira, "What in the world is Q? [Distinguished Microwave Lecture]," *IEEE Microw. Mag.,* vol. 17, no. 6, pp. 42–49, Jun. 2016, doi: 10.1109/MMM.2016.2538512.

[2] T. Ohira, "A radio engineer's voyage to double-century-old plane geometry [Educator's Corner]," *IEEE Microw. Mag.,* vol. 21, no. 11, pp. 60–67, Nov. 2020, doi: 10.1109/MMM.2020.3015136.

[3] T. Ohira, "Power transfer theory on linear passive two-port systems," *IEICE Trans. Electron.,* vol. E101.C, no. 10, pp. 719–726, Oct. 2018, doi: 10.1587/transele.E101.C.719.

Conference Report

Figure 7. *The Best Paper Award ceremony. From left: Dr. Stéphane Bila; Nastaran Soleimani (the awarded Ph.D. student); Dr. Nicolas Delhote (the president of the jury of experts); and Prof. Dominique Baillargeat.*

we wish to thank the attendees and those who have made NEMO2022 a huge success. We do not forget our team of volunteer Ph.D. students from XLIM, who have always been of great help to the participants. At last, we especially thank Dr. Qi-Jun Zhang (NEMO ExCom chair) and Lukrecija LeLong (IEEE senior manager, Event Management Services) for their help and advice in setting up the conference.

NEMO will be back in June 2023 and will be held from 28 to 30 June in Winnipeg, Canada, with Prof. Vladimir Okhmatovski as general chair. The conference will be held in a hybrid format. The deadline to submit conference papers for technical review is 15 February 2023 at https://nemo-ieee.org/.

We hope to see you at NEMO2023!