remote sensing

*Editorial*

# Microwave and Radar Week (MRW 2020): Selected Papers

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## 1. Microwave and Radar Week (MRW 2020)

The 9th Microwave and Radar Week (MRW 2020) was held in Warsaw the capital of Poland, on 5–7 October 2020. Initially, MRW 2020 was to be held in Lithuania, Vilnius, on 18–21 May 2020, but due to the COVID19 pandemic, it was decided to move it to Warsaw, Poland and shift dates to October (Figure 1). Due to the pandemic, for the first time in its history, MRW2020 was organised in a hybrid way—a part of the guests, mainly from Poland, were participating physically, while the majority of foreign guests were taking part virtually via electronic communication means. All presentations, including posters, were available on-line during MRW 2020 and a few weeks after the conference.


**Figure 1.** A photo of Warsaw city (MRW 2020 venue) center, from MRW 2020 Call for Papers [1].

The 9th Microwave and Radar Week (MRW 2020) was a continuation of the very successful series of scientific events held previously in Warsaw (2004), Krakow (2006), Wroclaw (2008), Vilnius (2010), Warsaw (2012), Gdansk (2014), Krakow (2016) and Poznan (2018). This time MRW 2020 consisted of four conferences: the 23rd International Microwave and Radar Conference (MIKON 2020), the 21st International Radar Symposium (IRS 2020), the Baltic URSI Symposium (Baltic URSI 2020) and the Signal Processing Workshop (SPW 2020). MRW 2020 was an opportunity to present the latest research results and exchange the newest scientific and engineering ideas related to radio, microwave and terahertz frequency devices, systems and techniques, radars, communications, electromagnetics, signal processing, as well as remote sensing.

The total number of MRW 2020 participants was 317 (118 on-site and 199 on-line), representing over 30 countries around the world. A total of 261 papers were presented during 48 topical oral sessions, two plenary sessions, five tutorial/workshop sessions and two poster sessions. The sessions concerned, among others, such aspects as antennas and antenna arrays, millimeter-wave technologies, electromagnetic microwave measurements, passive and active RF and microwave components, terahertz technologies, devices and systems, field theory methods, textile-integrated microwave components, microwave components for particle accelerators, passive radars, noise radars, automotive radars, artificial intelligence in radar, compressed sensing in radar, tracking, synthetic aperture radars, radio astronomical observations, wireless communication and systems, electronic and photonic microsystems, electromagnetic compatibility, soil measurements, as well as biomedical and acoustic signal processing.

## 2. Overview of the Papers Published in the Special Issue

The authors of the papers presented at MRW 2020 were requested to send the new extended versions of their papers to the Special Issue of MDPI Remote Sensing, and 12 contributions were submitted. These works went through an additional review process according to the high-standard rules of MDPI Remote Sensing. Finally, six of those papers were found suitable for publication in this Special Issue. The papers published in the Special Issue cover a broad range of advances in the microwave and radar technologies and their applications.

The first paper "The Analysis of Experimental Deployment of IGLUNA 2019 Trans-Ice Longwave System" [2] by T.A. Miś and J. Modelski focuses on the experimental results of a longwave transmitting system, as the contribution to the IGLUNA project [3]. A direct communication system between an ice-cave-hidden lunar habitat and the surface was proposed and validated through experimental measurement. In fact, the proposed system, operating on longwave of 270 kHz with possible sub-carriers (in the broadcasting part of the spectrum with magnetic quarter-wavelength loop antennas on a high altitude), was set up and operated in June 2019 on the Klein Matterhorn glacier in Switzerland. The paper reports both the measured and computed parameters of the antenna system, showing the possibility of a radio communication on large distances, as well as the possibility of the remote longwave sensing of the nearby rock and ice layers.

The second paper "A Tunable and Electrically Small Antenna for Compact GNSS Receivers" [4] by Y. Yashchyshyn, D. Vynnyk, V. Haiduchok, I. Solskii, C. Wu, G. Bogdan and J. Modelski presents the design and experimental validation of a tunable electrically small antenna (ESA) to be employed in receivers conceived for the global navigation satellite systems (GNSSs). These systems are operating at low frequency (L-band), which is equivalent to a wavelength of approximately 24 cm. Even adopting an efficient half-wavelength antenna, the resulting dimensions are still too large for compact devices. In the paper, the authors propose an innovative approach to miniaturize the antenna size up to 3 cm, by using a proper loading through a dielectric block and utilizing a ground plane. The operational principle and analysis of the radiation characteristic of the proposed idea are discussed and validated through experimental results, presenting a suitable candidate for an adaptive antenna dedicated to compact GNSS receivers.

The next paper "Towards Cooperative Global Mapping of the Ionosphere: Fusion Feasibility for IGS and IRI with Global Climate VTEC Maps" [5] by A. Froń, I. Galkin, A. Krankowski, D. Bilitza, M. Hernández-Pajares, B. Reinisch, Z. Li, K. Kotulak, I. Zakharenkova, I. Cherniak, D. Roma Dollase, N. Wang, P. Flisek and A. García-Rigo, is the result of a research cooperation between worldwide Research Institute, with the aim of establishing data sources and fusion methodologies for mapping the ionosphere. The proposed approach integrates three interesting ionospheric products of the GAMBIT (Global Assimilative Model of Bottom side Ionosphere Timeline) database, which are potentially useful in providing ionospheric weather–climate specifications in the future.

The next two papers concern the applications of the radio-telescopes being a part of the international network called LOFAR (LOw-Frequency ARray for radio astronomy). The first of them "Type III Radio Bursts Observations on 20 August 2017 and 9 September

2017 with LOFAR Bałdy Telescope" [6] by B. Dabrowski, P. Flisek, K. Mikuła, A. Froń, C. Vocks, J. Magdalenić, A. Krankowski, P. Zhang, P. Zucca and G. Mann, reports the analysis of two solar radio events of type III burst [7], observed at the LOFAR station in the observatory in Bałdy (Poland), occurred in 2017. The study is performed by using several instrumentations (LOFAR, IRIS, SDO) and it is detailed in a clear way, and can be understood even by non-expert readers in the solar physics, thus becoming very useful for students and young radio researchers..

The second paper related to the LOFAR system "Beamforming of LOFAR Radio-Telescope for Passive Radiolocation Purposes" [8] by A. Droszcz, K. Jędrzejewski, J. Kłos, K. Kulpa and M. Pożoga presents the results of the original research on the possibility of the usage of the LOFAR radio-telescope as a receiver in the passive coherent location (PCL) system for aerial and space object detection and tracking. Such a PCL system seems to be a cost-effective solution, since the necessary infrastructure, i.e., a big LOFAR antenna array with the appropriate electronic circuitry, as well as commercial transmitters (e.g., digital radio DAB+ transmitters, as in the paper) serving as illuminators of opportunity, which can be employed in the passive radiolocation, already exist. The authors focused on the issues related to the beamforming of the LOFAR radio-telescope elements in the context of its usage for passive radiolocation purposes. The analytical considerations are illustrated by the results of field trials obtained by means of the LOFAR radio-telescope located in Borówiec, Poland. It should be pointed out that the original concept presented in the paper can inspire other scientists to use radio-telescopes (particularly LOFAR radio-telescopes) as receivers in passive radiolocation systems.

The next paper "Errors in Broadband Permittivity Determination due to Liquid Surface Distortions in Semi-Open Test Cell" [9] by M. Kalisiak and W. Wiatr is devoted to the problem of the microwave measurement of the permittivity of liquids, and the reduction of the errors caused by the meniscus and a tilt of a semi-open coaxial test cell. The authors concern two the classic Nicolson-Ross-Weir technique and the method called the meniscus removal proposed by the authors. The techniques allow the determination of the permittivity on the basis of the measurement of the S-parameters of a sample in the test fixture. The results of analyses presented in the paper indicate that the meniscus removal technique provides smaller errors than the Nicolson-Ross-Weir technique. The authors pay attention to the originality of the research on the effect of the cell tilt on the measurement of the permittivity of liquids, which was not analyzed in the literature.

## 3. Conclusions

Summarizing, the articles published in this special issue show interesting and inspiring results of contemporary research in the areas, fully or partly related to remote sensing, which were represented during MRW 2020. We hope that the next conference 10th Microwave and Radar Week, which is planned for 16–19 May 2022 in Gdańsk, Poland, will take place in the traditional in-person form, and will probably end with the same or greater success as MRW 2020.

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## Abbreviations

The following abbreviations are used in this manuscript:

| | |
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| DPD | Digital Pre-Distortion |
| ESA | Electrically Small Antenna |
| GAMBIT | Global Assimilative Model of Bottomside Ionosphere Timeline |
| GNSS | Global Navigation Satellite System |
| IRIS | Interface Region Imaging Spectrograph |
| IRS | International Radar Symposium |

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|---|---|
| LOFAR | Low-Frequency Array for Radio Astronomy |
| MIKON | International Microwave and Radar Conference |
| MRW | Microwave and Radar Week |
| PCL | Passive Coherent Location |
| SDO | Solar Dynamics Observatory |
| SPW | Signal Processing Workshop |
| URSI | International Union of Radio Science |

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