

## **Millimeter Wave Passive Waveguide Arrays for Planetary Exploration and Communication Beyond 5G**

Makoto ANDO

Professor Emeritus, Past Executive Vice President  
Tokyo Institute of Technology  
Japan

For realizing the sustainable development goals (SDGs), the role of radio science is increasing both as the sensors and the communication, which connects the Cyber and Physical Systems (CPS). This talk starts with the 100 years of history of URSI and radio science together with their role in the future. In 5G and beyond, millimeter and even terahertz frequency will be utilized in wireless systems. The arrays are promising for enhanced wireless systems in these bands.

Then this talk reviews high gain and high efficiency waveguide arrays developed by the authors. Proof of Concept demonstration of compact range communication has been conducted using diffusion bonding thin plates waveguide arrays in Millimeter-wave "Tokyo Tech Wireless Fiber Project". In addition, another application is the radial line slot antenna (RLSA) in 32GHz on board of JAXA Asteroid explorer "Hayabusa 2" which came back to earth on 6 December 2020. Ultra lightweight millimeter wave RLSAs were successfully operating. These are promising and typical application of planar waveguide passive arrays for future millimeter wave systems.

For 5G and beyond, both achievements will contribute to the design of the heterogeneous networking utilizing millimeter wave; these passive arrays would be enhanced active functions such as beam scanning, power combining and signal processing capability, for compensating the difficulties of higher frequencies in communication networks.



**Makoto Ando** received his doctorate of engineering in electrical engineering from Tokyo Institute of Technology in 1979. He subsequently joined NTT and was engaged in the development of antennas for satellite communication. He moved to Tokyo Institute of Technology in 1982 and served as a Professor and 2015-2018 Executive Vice President for Research. In 2018, he moved to National Institute of Technology (KOSEN) and served as the senior executive director where he is now the adviser.

His main interests have been field and waves in radio science, especially high frequency diffraction theory, the design of waveguide planar arrays, and millimeter-wave antennas for future wireless communication. He plays a leading role in the promotion of a wide range of applications of millimeter-wave wireless communications in Japan. He is the Program Director of Strategic Information and Communications R&D Promotion Programme (SCOPE) of Ministry of Internal Affairs and Communications, Japan (MIC).

His international activities have included service as 2009 president of the IEEE Antennas and Propagation Society, 2018-2019 President of The Institute of Electronics, Information and Communication Engineers (IEICE), Japan and 2017-2021 president of the International Union of Radio Science (URSI),

Professor Ando is a fellow of IEEE, URSI and an honorary member of IEICE.

Recognized by the IEICE with the Distinguished Achievement and Contributions Award, he has also received the Inoue Prize for Science, both the Meritorious Award on Radio and the Meritorious Award on Contributions to the Promotion of Computerization from the Minister of Internal Affairs and Communications (MIC) and the 2016 Culture Award from the Japan Broadcasting Corporation (NHK).