LOW ELECTROMAGNETIC FIELD EXPOSURE WIRELESS DEVICES

FUNDAMENTALS AND RECENT ADVANCES

EDITED BY
MASOOD UR REHMAN
MUHAMMAD ALI JAMSHED

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Edited by

Masood Ur Rehman
University of Glasgow, Glasgow, UK

Muhammad Ali Jamshed
University of Glasgow, Glasgow, UK

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I dedicate this effort to my parents, Khalil Ur Rehman and Ilfaz Begum;
my siblings, Habib, Waheed, Tahera;
my wife, Faiza;
and my son, Musaab.

Masood Ur Rehman

I dedicate this effort to my parents, Jamshed Iqbal and Nuzhut Jamshed;
my siblings, Laiba, Maliha, Mariam;
and my wife, Aqsa Tariq.

Muhammad Ali Jamshed

Editor Biography

Masood Ur Rehman received a B.Sc. degree in electronics and telecommunication engineering from the University of Engineering and Technology, Lahore, Pakistan, in 2004 and a M.Sc. and Ph.D. degrees in electronic engineering from Queen Mary University of London, London, UK, in 2006 and 2010, respectively. He worked at Queen Mary University of London as a Postdoctoral Research Assistant until 2012 before joining the Centre for Wireless Research at the University of Bedfordshire as a Lecturer. He served briefly at the University of Essex, UK and then moved to the James Watt School of Engineering at the University of Glasgow, UK in the capacity of an Assistant Professor. His research interests include compact antenna design, radiowave propagation and channel characterization, satellite navigation system antennas in cluttered environment, electromagnetic wave interaction with human body, body-centric wireless networks and sensors, remote health care technology, mmWave and nano-communications for body-centric networks, and D2D/H2H communications. He has worked on a number of projects supported by industrial partners and research councils. He has contributed to a patent and authored/co-authored 4 books, 7 book chapters, and more than 120 technical articles in leading journals and peer reviewed conferences. Dr. Ur Rehman is a fellow of the Higher Education Academy, UK, a member of the IET and part of the technical program committees and organizing committees of several international conferences, workshops, and special sessions. He is acting as an Associate Editor of the IEEE Access and IET Electronics Letters and Lead Guest Editor of numerous special issues of renowned journals. He also serves as a reviewer for book publishers, IEEE conferences, and leading journals.

Muhammad Ali Jamshed received a Ph.D. degree from the University of Surrey, Guildford, UK, in 2021. He is endorsed by Royal Academy of Engineering under exceptional talent category. He was nominated for Departmental Prize for Excellence in Research in 2019 at the University of Surrey. He served briefly as Wireless Research Engineer at BriteYellow Ltd., UK, and then moved to James Watt School of Engineering, University of Glasgow, as a Post-Doctoral Research Assistant. He has authored/co-authored 2 book chapters and more than 37 technical articles in leading journals and peer reviewed conferences. His main research interests include EMF exposure reduction, low SAR antennas for mobile handsets, machine learning for wireless communication, Backscatter communication, and wireless sensor networks. He served as a Reviewer, TPC, and the Session Chair, at many well-known conferences, i.e. ICC, WCNC, VTC, GlobeCom etc., and other scientific workshops.

List of Contributors

Yasir Alfadhl

School of Electronic Engineering and Computer Science

Queen Mary University of London

London

UK

Tim W.C. Brown

Institute of Communication Systems (ICS)

Home of 5G and 6G Innovation Centre, University of Surrey

Guildford

UK

Xiaodong Chen

School of Electronic Engineering and Computer Science

Queen Mary University of London

London

UK

Fabien Héliot

Institute of Communication Systems (ICS)

Home of 5G and 6G Innovation Centre, University of Surrey

Guildford

UK

Muhammad Ali Imran

James Watt School of Engineering

University of Glasgow

Glasgow

UK

Muhammad Ali Jamshed

James Watt School of Engineering

University of Glasgow

Glasgow

UK

Wali Ullah Khan

Interdisciplinary Center for Security Reliability and Trust (SnT)

University of Luxembourg

Luxembourg City

Luxembourg

Sung Won Kim

Department of Information and Communication Engineering

Yeungnam University

Gyeongsan-si

South Korea

Ali Nauman

Department of Information and Communication Engineering

Yeungnam University

Gyeongsan-si

South Korea

Haris Pervaiz

School of Computing and Communications

Lancaster University

Lancaster

UK

Muhammad Rafaqat Ali Qureshi

School of Electronic Engineering and Computer Science

Queen Mary University of London

London

UK

Masood Ur Rehman
James Watt School of Engineering
University of Glasgow
Glasgow
UK

Preface

The past decade has seen a huge upsurge in the demand of wireless devices that are expected to cross the 29.4 billion mark by 2030. This increase is fueled by the advances in wearables, portables, flexible electronics, and other wireless technologies facilitating communication, transportation, and navigation needs of billions of users around the world in the wake of Internet of Things and 5G/6G. These rising numbers, along with ever-growing data requirements, necessitate a growth in the capacity of wireless communication networks by almost 1000 times. Part of this capacity enhancement will be made possible by increasing the number of access points (APs). These developments are ultimately resulting in added electromagnetic field (EMF) exposure sources in the environment.

EMF exposure has been deemed prone to inflict adverse health and safety effects on the users. The World Health Organization (WHO) has classified these EMF radiations as possibly carcinogenic to humans and has an ongoing project to assess potential health effects of exposure to EMF in the general and working population. The Federal Communications Commission (FCC) and the International Commission on Non-Ionizing Radiation Protection (ICNIRP) have, therefore, imposed strict safety standards for device operation. Consequently, EMF exposure characterization warranting strict adherence to these safety regulations is a vital design parameter for wireless devices to ensure the safety of the users.

The current developments and expected future growth of the wireless systems are also mounting concerns regarding users' safety and possible health consequences of EMF

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