## IEEE SIGNAL PROCESSING SOCIETY

The Signal Processing Society is an organization, within the framework of the IEEE, of members with principal professional interest in the technology of transmission, recording, reproduction, processing, and measurement of speech and other signals by digital electronic, electrical, acoustic, mechanical, and optical means, the components and systems to accomplish these and related aims, and the environmental, psychological, and physiological factors concerned therewith. All members of the IEEE are eligible for membership in the Society and will receive this TRANSACTIONS upon payment of the annual Society membership fee of \$20.00 plus an annual subscription fee of \$129.00. For information on joining, write to the IEEE at the address below. Member copies of Transactions/Journals are for personal use only.

#### **T-ASLP Editorial Board** EDITOR-in-CHIEF

LI DENG Microsoft Research Redmond, WA 98052 deng@microsoft.com

#### TRANSACTIONS ASSOCIATE EDITORS

THUSHARA D. ABHAYAPALA College of Eng. & Comput. Sci. The Australian National Univ. Canberra ACT 0200, Australia

GEOFFREY CHAN Dept. of Electrical & Computer Queen's Univ. Kingston, ON K7L 3N6, Canada

MADS GRÆSBØLL CHRISTENSEN Aalborg Univ. Audio Analysis Lab, AD:MT DK-9200 Aalborg SV, Denmark

MARCELLO FEDERICO, Senior Area Editor FBK-Fondazione Bruno Kessler 38100 Trento, Italy

WOON-SENG GAN Information Engineering Nanyang Technological Univ. Singapore 639798

SHARON GANNOT, Senior Area Editor School of Electrical Engineering

Bar-Ilan Univ. Ramat-Gan 52900, Israel

JIM GLASS

MIT Computer Science and Artificial Intelligence Lab. Cambridge, MA 02139

RODRIGO CAPOBIANCO GUIDO São Paulo State Univ. Institute of Physics at Sao Carlos 13566-590 Sao Carlos, Brazil

SOREN HOLDT JENSEN Dept. of Electronic Systems Aalborg Univ Aalborg DK9220, Denmark

BRIAN KINGSBURY IBM T. J. Watson Research Center Yorktown Heights, NY 10598

BOZENA KOSTEK Gdansk Univ. of Technology Gdansk, Poland 80-952

HAIZHOU LI, Senior Area Editor Institute for Infocomm Research Singapore 138632

XIAO LI Facebook Inc. Cupertino, CA 95014

ZHEN-HUA LING

Univ. of Sci. and Technol. of China Hefei, Anhui, 230027, China

The Univ. of Texas at Dallas Richardson, TX 75080

KAREN LIVESCU

Toyota Technological Inst. at Chicago Chicago, IL 60637

Manwai Mak

The Hong Kong Polytechnic Univ. Clear Water Bay, 619-0237, Hong Kong, SAR of China

HERMANN NEY, Senior Area Editor Dept. of Computer Sci. RWTH Aachen, Univ Aachen, Germany D-52074

NOBUTAKA ONO

Principles of Informatics Rsch. Div. National Inst. of Informatics Tokyo, 101-8430, Japan

BOAZ RAFAELY Dept. of Elect. & Comp. Eng. Ben-Gurion Univ. of Negev Beer-Sheva 84105, Israel

STEVE RENALS, Senior Area Editor Univ. of Edinburgh Edinburgh, U.K.

MURAT SARACLAR Dept. of Electrical and Electronic Engineering Bogazici Univ.

34342 Bebek Istanbul, Turkey

ROBERTO TOGNERI

Dept. Elect. Electron. & Computing The Univ. of Western Australia Crawley WA 6009, Australia

GEORGE TZANETAKIS, Senior Area Editor Computer Science Dept. Univ. of Victoria

Victoria, British Columbia V8W

3P6 Canada

VINCENT VANHOUCHKE Google Research Mountain View, CA 94043 DELIANG WANG Dept. of Comp. Sci. and Eng.

The Ohio State Univ. Columbus, OH 43210-1277

SHINII WATANANBE

Mitsubishi Electronic Research Labs. Cambridge, MA 02139

CHUNG-HSIEN WU

Dept. of Comp. Sci. and Inf. Eng. National Cheng Kung Univ. Tainan, Taiwan ROC

JUNICHI YAMAGISHI

Ctr. for Speech Technology Research

Univ. of Edinburgh Edinburgh, EH8 9AB, UK

Microsoft Speech Research Group, Redmond

Bothell, WA 98011

RONGSHAN YU

Dept. of Signal Processing Inst. for Infocomm Research (i2R)

Singapore 643268

YUNXIN ZHAO

Dept. Comput. Sci. Univ. of Missouri

Columbia, MO 65211

THOMAS FANG ZHENG Tsinghua Univ Beijing 100084, China

BOWEN ZHOU

IBM T. J. Watson Research Yorktown Heights, NY 10598

# **IEEE Officers**

ROBERTO DE MARCA, President HOWARD E. MICHEL, President-Elect MARKO DELIMAR, Secretary JOHN T. BARR, Treasurer PETER W. STAECKER, Past President

SAURABH SINHA, Vice President, Educational Activities GIANLUCA SETTI, Vice President, Publication Services and Products RALPH M. FORD, Vice President, Member and Geographic Activities KAREN BARTLESON, President, Standards Association JACEK M. ZURADA, Vice President, Technical Activities GARY L. BLANK, President, IEEE-USA

MARINA RUGGIERI, Director, Division IX-Signals and Applications

### **IEEE Executive Staff**

DR. E. JAMES PRENDERGAST, Executive Director & Chief Operating Officer

THOMAS SIEGERT, Business Administration ELENA GERSTMANN, Corporate Activities
DOUGLAS GORHAM, Educational Activities EILEEN LACH, General Counsel & Corporate Compliance

SHANNON JOHNSTON, Human Resources CHRIS BRANTLEY, IEEE-USA

DONNA HOURICAN, Information Technology (acting) PATRICK MAHONEY, Marketing CECELIA JANKOWSKI, Member and Geographic Activities ANTHONY DURNIAK, Publications KONSTANTINOS KARACHALIOS, Standards Activities MARY WARD-CALLAN, Technical Activities

### **IEEE Periodicals** Transactions/Journals Department

Senior Director: FRAN ZAPPULLA

Editorial Director: DAWN MELLEY Production Director: PETER M. TUOHY Managing Editor: MARTIN J. MORAHAN Associate Editor: ANDREW SWARTZ