

# IEEE Signal Processing

MAGAZINE

[VOLUME 31 NUMBER 2 MARCH 2014]

## DSP AND CODING FOR MULTI-Tb/s OPTICAL TRANSPORT *RECENT ADVANCES*

MELODY EXTRACTION FROM  
POLYPHONIC MUSIC SIGNALS

ON THE RECURSIVE SOLUTION  
TO THE NORMAL EQUATIONS

HAPTICS AND SIGNAL PROCESSING

THE HOPPING DISCRETE  
FOURIER TRANSFORM

## SPECIAL SECTION—DSP AND CODING FOR MULTI-Tb/s OPTICAL TRANSPORT

### 15 FROM THE GUEST EDITORS

Ivan B. Djordjevic, William Shieh, Xiang Liu, and Moshe Nazarathy

### 16 DIGITAL SIGNAL PROCESSING TECHNIQUES ENABLING MULTI-Tb/s SUPERCHANNEL TRANSMISSION

Xiang Liu, S. Chandrasekhar, and Peter J. Winzer

### 25 MIMO SIGNAL PROCESSING FOR MODE-DIVISION MULTIPLEXING

Sercan Ö. Arık, Joseph M. Kahn, and Keang-Po Ho

### 35 EFFICIENT CLOCK AND CARRIER RECOVERY ALGORITHMS FOR SINGLE-CARRIER COHERENT OPTICAL SYSTEMS

Xiang Zhou

### 46 DIGITAL FIBER NONLINEARITY COMPENSATION

Liang B. Du, Danish Rafique, Antonio Napoli, Bernhard Spinnler, Andrew D. Ellis, Maxim Kuschnerov, and Arthur J. Lowery

### 57 CYCLE SLIP COMPENSATION WITH POLARIZATION BLOCK CODING FOR COHERENT OPTICAL TRANSMISSION

Tsuyoshi Yoshida, Takashi Sugihara, Kazuyuki Ishida, and Takashi Mizuocho

### 70 SUBBANDED DSP ARCHITECTURES BASED ON UNDERDECIMATED FILTER BANKS FOR COHERENT OFDM RECEIVERS

Moshe Nazarathy and Alex Tolmachev

### 82 ADVANCED DSP TECHNIQUES ENABLING HIGH SPECTRAL EFFICIENCY AND FLEXIBLE TRANSMISSIONS

Alan Pak Tao Lau, Yuliang Gao, Qi Sui, Dawei Wang, Qunbi Zhuge, Mohamed H. Morsy-Osman, Mathieu Chagnon, Xian Xu, Chao Lu, and David V. Plant

### 93 CODED MODULATION FOR FIBER-OPTIC NETWORKS

Lotfollah Beygi, Erik Agrell, Joseph M. Kahn, and Magnus Karlsson

### 104 MULTIDIMENSIONAL SIGNALING AND CODING ENABLING MULTI-Tb/s OPTICAL TRANSPORT AND NETWORKING

Ivan B. Djordjevic, Milorad Cvijetic, and Changyu Lin

## FEATURE

### 118 MELODY EXTRACTION FROM POLYPHONIC MUSIC SIGNALS

Justin Salamon, Emilia Gómez, Daniel P.W. Ellis, and Gaël Richard

## COLUMNS

### 4 FROM THE EDITOR

Peer Reviews: What Would Be the Best Model?  
Abdelhak Zoubir

### 6 PRESIDENT'S MESSAGE

The Only Constant Is Change  
Alex Acero

### 11 SPECIAL REPORTS

Touching Research: Haptics and Signal Processing  
John Edwards

### 135 SP TIPS & TRICKS

The Hopping Discrete Fourier Transform  
Chun-Su Park and Sung-Jea Ko

### 140 LECTURE NOTES

On the Recursive Solution to the Normal Equations: Some Other Results  
Manuel D. Ortigueira

## DEPARTMENTS

### 8 SOCIETY NEWS

SPS Fellows and Award Winners Recognized

### 143 DATES AHEAD