

# IEEE TRANSACTIONS ON PATTERN ANALYSIS AND MACHINE INTELLIGENCE

*A publication of the IEEE Computer Society*

JANUARY 2021

VOLUME 43

NUMBER 1

ITPIDJ

(ISSN 0162-8828)

## REGULAR PAPERS

<i>3D Rigid Motion Segmentation with Mixed and Unknown Number of Models</i> X. Xu, L.-F. Cheong, and Z. Li .....	1
<i>A Framework of Composite Functional Gradient Methods for Generative Adversarial Models</i> R. Johnson and T. Zhang .....	17
<i>A General Decoupled Learning Framework for Parameterized Image Operators</i> Q. Fan, D. Chen, L. Yuan, G. Hua, N. Yu, and B. Chen .....	33
<i>A Microfacet-Based Model for Photometric Stereo with General Isotropic Reflectance</i> L. Chen, Y. Zheng, B. Shi, A. Subpa-asa, and I. Sato .....	48
<i>Bayesian Low-Tubal-Rank Robust Tensor Factorization with Multi-Rank Determination</i> Y. Zhou and Y.-M. Cheung .....	62
<i>Blind Deblurring of Barcodes via Kullback-Leibler Divergence</i> G. Rioux, C. Scarvelis, R. Choksi, T. Hoheisel, and P. Maréchal .....	77
<i>Community Detection Using Restrained Random-Walk Similarity</i> M. Okuda, S. Satoh, Y. Sato, and Y. Kidawara .....	89
<i>Deep Affinity Network for Multiple Object Tracking</i> S. Sun, N. Akhtar, H. Song, A. Mian, and M. Shah .....	104
<i>Distributed Variational Representation Learning</i> I.E. Aguerri and A. Zaidi .....	120
<i>Multiset Feature Learning for Highly Imbalanced Data Classification</i> X.-Y. Jing, X. Zhang, X. Zhu, F. Wu, X. You, Y. Gao, S. Shan, and J.-Y. Yang .....	139
<i>On Learning 3D Face Morphable Model from In-the-Wild Images</i> L. Tran and X. Liu .....	157
<i>OpenPose: Realtime Multi-Person 2D Pose Estimation Using Part Affinity Fields</i> Z. Cao, G. Hidalgo, T. Simon, S.-E. Wei, and Y. Sheikh .....	172
<i>Recipe1M+: A Dataset for Learning Cross-Modal Embeddings for Cooking Recipes and Food Images</i> J. Marín, A. Biswas, F. Ofli, N. Hynes, A. Salvador, Y. Aytaç, I. Weber, and A. Torralba .....	187
<i>Relative Saliency and Ranking: Models, Metrics, Data and Benchmarks</i> M. Kalash, M.A. Islam, and N.D.B. Bruce .....	204

*(Contents continued on back cover)*

Published in cooperation with: **Aerospace & Electronic Systems Society, Control Systems Society, Engineering in Medicine & Biology Society, Information Theory Society, Systems, Man & Cybernetics Society, Ultrasonics, Ferroelectrics, & Frequency Control Society**

Indexed in MEDLINE®/PubMed®  
and indexed in ISI



www.computer.org  
tpami@computer.org

<i>Revisiting Video Saliency Prediction in the Deep Learning Era</i> W. Wang, J. Shen, J. Xie, M.-M. Cheng, H. Ling, and A. Borji.....	220
<i>Robust Low-Rank Tensor Recovery with Rectification and Alignment</i> X. Zhang, D. Wang, Z. Zhou, and Y. Ma.....	238
<i>Rotation Averaging with the Chordal Distance: Global Minimizers and Strong Duality</i> A. Eriksson, C. Olsson, F. Kahl, and T.-J. Chin.....	256
<i>RotationNet for Joint Object Categorization and Unsupervised Pose Estimation from Multi-View Images</i> A. Kanezaki, Y. Matsushita, and Y. Nishida.....	269
<i>Simultaneous Fidelity and Regularization Learning for Image Restoration</i> D. Ren, W. Zuo, D. Zhang, L. Zhang, and M.-H. Yang.....	284
<i>Stereo Matching Using Multi-Level Cost Volume and Multi-Scale Feature Constancy</i> Z. Liang, Y. Guo, Y. Feng, W. Chen, L. Qiao, L. Zhou, J. Zhang, and H. Liu.....	300
<i>The Perils and Pitfalls of Block Design for EEG Classification Experiments</i> R. Li, J.S. Johansen, H. Ahmed, T.V. Ilyevsky, R.B. Wilbur, H.M. Bharadwaj, and J.M. Siskind.....	316
<i>Towards Safe Weakly Supervised Learning</i> Y.-F. Li, L.-Z. Guo, and Z.-H. Zhou.....	334
<i>Variational Context: Exploiting Visual and Textual Context for Grounding Referring Expressions</i> Y. Niu, H. Zhang, Z. Lu, and S.-F. Chang.....	347
<i>Visual Tracking via Dynamic Memory Networks</i> T. Yang, and A.B. Chan.....	360



**PURPOSE:** The IEEE Computer Society is the world's largest association of computing professionals and is the leading provider of technical information in the field.

**MEMBERSHIP:** Members receive the monthly magazine *Computer*, discounts, and opportunities to serve (all activities are led by volunteer members). Membership is open to all IEEE members, affiliate society members, and others interested in the computer field. **OMBUDSMAN:** Email [ombudsman@computer.org](mailto:ombudsman@computer.org)  
**COMPUTER SOCIETY WEBSITE:** [www.computer.org](http://www.computer.org)

#### **EXECUTIVE COMMITTEE**

**President:** Leila De Floriani; **President-Elect:** Forrest Shull; **Past President:** Cecilia Metra; **First VP:** Riccardo Mariani; **Second VP:** Sy-Yen Kuo; **Secretary:** Dimitrios Serpanos; **Treasurer:** David Lomet; **VP, Membership & Geographic Activities:** Yervant Zorian; **VP, Professional & Educational Activities:** Sy-Yen Kuo; **VP, Publications:** Fabrizio Lombardi; **VP, Standards Activities:** Riccardo Mariani; **VP, Technical & Conference Activities:** William D. Gropp; **2019-2020 IEEE Division VIII Director:** Elizabeth L. Burd; **2020-2021 IEEE Division V Director:** Thomas M. Conte; **2020 IEEE Division VIII Director-Elect:** Christina M. Schober

#### **BOARD OF GOVERNORS**

**Term Expiring 2020:** Andy T. Chen, John D. Johnson, Sy-Yen Kuo, David Lomet, Dimitrios Serpanos, Forrest Shull, Hayato Yamana  
**Term Expiring 2021:** M. Brian Blake, Fred Douglass, Carlos E. Jimenez-Gomez, Ramalatha Marimuthu, Erik Jan Marinissen, Kunio Uchiyama  
**Term Expiring 2022:** Nils Aschenbruck, Ernesto Cuadros-Vargas, David S. Ebert, William Gropp, Grace Lewis, Stefano Zanero

#### **BOARD OF GOVERNORS MEETING**

**16 – 18 December 2020, virtual**

#### **EXECUTIVE STAFF**

**Executive Director:** Melissa A. Russell; **Director, Governance & Associate Executive Director:** Anne Marie Kelly; **Director, Finance & Accounting:** Sunny Hwang; **Director, Information Technology & Services:** Sumit Kacker; **Director, Marketing & Sales:** Michelle Tubb; **Director, Membership Development:** Eric Berkowitz

#### **COMPUTER SOCIETY OFFICES**

**Washington, D.C.:** 2001 L St., Ste. 700, Washington, D.C. 20036-4928; **Phone:** +1 202 371 0101; **Fax:** +1 202 728 9614; **Email:** [help@computer.org](mailto:help@computer.org)

**Los Alamitos:** 10662 Los Vaqueros Cir., Los Alamitos, CA 90720; **Phone:** +1 714 821 8380; **Email:** [help@computer.org](mailto:help@computer.org)

**MEMBERSHIP & PUBLICATION ORDERS:** **Phone:** +1 800 678 4333; **Fax:** +1 714 821 4641; **Email:** [help@computer.org](mailto:help@computer.org)

#### **IEEE BOARD OF DIRECTORS**

**President & CEO:** Toshio Fukuda  
**President-Elect:** Susan K. "Kathy" Land  
**Past President:** José M.F. Moura  
**Secretary:** Kathleen A. Kramer  
**Treasurer:** Joseph V. Lillie  
**Director & President, IEEE-USA:** Jim Conrad; **Director & President, Standards Association:** Robert S. Fish; **Director & VP, Educational Activities:** Stephen Phillips; **Director & VP, Membership and Geographic Activities:** Kukjin Chun; **Director & VP, Publication Services & Products:** Tapan Sarkar; **Director & VP, Technical Activities:** Kazuhiro Kosuge

