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PROCEEDINGS

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Electronic Imaging

SCIENCE AND TECHNOLOGY

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Media Watermarking, Security, and Forensics 2017

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Media Watermarking, Security, and Forensics 2019

Conference overview

The ease of capturing, manipulating, distributing, and consuming digital media (e.g., images, audio, video, graphics, and text) has enabled new applications and brought a number of important security challenges to the forefront. These challenges have prompted significant research and development in the areas of digital watermarking, steganography, data hiding, forensics, media identification, biometrics, and encryption to protect owners' rights, establish provenance and veracity of content, and to preserve privacy. Research results in these areas has been translated into new paradigms and applications for monetizing media while maintaining ownership rights, new biometric and forensic identification techniques for novel methods for ensuring privacy.

The Media Watermarking, Security, and Forensics conference is a premier destination for disseminating high-quality, cutting-edge research in these areas. The conference provides an excellent venue for researchers and practitioners to present their innovative work as well as to keep abreast of the latest developments in watermarking, security, and forensics. Early results and fresh ideas are particularly encouraged and supported by the conference review format: only a structures abstract describing the work in progress and preliminary results is initially required and the full paper is requested just before the conference. A strong focus on how research results are applied in practice by industry also gives the conference its unique flavor.

MEDIA WATERMARKING, SECURITY, AND FORENSICS 2019

Monday January 14, 2019

Capture to Publication: Authenticating Digital Imagery

Session Chair: Nasir Memon, New York University (United States)

9:00 – 10:00 am
Cypress C

MWSF-525

KEYNOTE: From capture to publication: Authenticating digital imagery, its context, and its chain of custody, *Matt Robben and Daniel DeMattia, Truepic (United States)*

Matt Robben is the VP of engineering for Truepic, responsible for leading new technology development across the Truepic authenticity platform and building a world-class pool of engineering talent. Prior to Truepic, Robben has helped technology groups and teams at One Medical, Dropbox, Sold. (acq. by Dropbox), and Microsoft deliver mission-critical software products to market across a variety of verticals. Robben holds a BS in computer engineering from Northwestern University.

Daniel DeMattia is the VP of security for Truepic. He is responsible for ensuring the security and integrity of Truepic, its systems, technology and data. He brings with him more than 20 years of security experience in high risk environments that he applies to every aspect of Truepic operations. Prior to Truepic, DeMattia was head of security at SpaceX as well as Virgin Orbit, where he helped build mission critical security and communication systems that operate both on the ground and in space. In his early days, he acted as an independent penetration tester and advised on vulnerability assessment and incident response.

10:10 – 10:30 am Coffee Break

Watermark & Biometric

Session Chair: Husrev Taha Sencar, TOBB University (Turkey)

10:30 am – 12:10 pm
Cypress C

10:30 MWSF-526
Printed image watermarking with synchronization using direct binary search, *Yujian Xu and Jan Allebach, Purdue University (United States)*

10:55 MWSF-527
Hiding in plain sight: Enabling the vision of signal rich art, *Ajith Kamath[1] and Harish Palani[1,2]; [1]Digimarc and [2]UC Berkeley (United States)*

11:20 MWSF-528
How re-training process affect the performance of no-reference image quality metric for face images, *Xinwei Liu[1,2], Christophe Charrier[3], Marius Pedersen[2], and Patrick Bours[2]; [1]University of Caen (France), [2]Norwegian University of Science and Technology (Norway), and [3]Normandie University (France)*

11:45 MWSF-529
Forensic reconstruction of severely degraded license plates, *Benedikt Lorch[1], Shruti Agarwal[2], and Hany Farid[2]; [1]Friedrich-Alexander-University (Germany) and [2]Dartmouth College (United States)*

12:30 – 2:00 pm Lunch

Monday Plenary

2:00 – 3:00 pm
Grand Peninsula Ballroom D

Autonomous Driving Technology and the OrCam MyEye, *Amnon Shashua, President and CEO, Mobileye, an Intel Company, and senior vice president, Intel Corporation (United States)*

The field of transportation is undergoing a seismic change with the coming introduction of autonomous driving. The technologies required to enable computer driven cars involves the latest cutting edge artificial intelligence algorithms along three major thrusts: Sensing, Planning and Mapping. Shashua will describe the challenges and the kind of computer vision and machine learning algorithms involved, but will do that through the perspective of Mobileye's activity in this domain. He will then describe how OrCam leverages computer vision, situation awareness and language processing to enable blind and visually impaired to interact with the world through a miniature wearable device.

Prof. Amnon Shashua holds the Sachs chair in computer science at the Hebrew University of Jerusalem. His field of expertise is computer vision and machine learning. Shashua has founded three startups in the computer vision and machine learning fields. In 1995 he founded CogniTens that specializes in the area of industrial metrology and is today a division of the Swedish Corporation Hexagon. In 1999 he cofounded Mobileye with his partner Ziv Aviram. Mobileye develops system-on-chips and computer vision algorithms for driving assistance systems and is developing a platform for autonomous driving to be launched in 2021. Today, approximately 32 million cars rely on Mobileye technology to make their vehicles safer to drive. In August 2014, Mobileye claimed the title for largest Israeli IPO ever, by raising $1B at a market cap of $5.3B. In August 2017, Mobileye became an Intel company in the largest Israeli acquisition deal ever of $15.3B. Today, Shashua is the president and CEO of Mobileye and a senior vice president of Intel Corporation. In 2010 Shashua co-founded OrCam which harnesses computer vision and artificial intelligence to assist people who are visually impaired or blind.

3:00 – 3:30 pm Coffee Break

Image Forgery Detection

Session Chair: Robert Ulichney, HP Labs, HP Inc. (United States)

3:30 – 4:45 pm
Cypress C

3:30 MWSF-530
Deep learning methods for event verification and image repurposing detection, *Arjuna Flenner[1], Michael Goebel[2], Lakshmanan Nataraj[2], and B.S. Manjunath[2]; [1]NAVAIR and [2]Mayachitra Inc. (United States)*

3:55 MWSF-531
Dictionary learning and sparse coding for digital image forgery detection, *Mohammed Aloraini, Lingdao Sha, Mehdi Sharifzadeh, and Dan Schonfeld, University of Illinois at Chicago (United States)*

4:20 MWSF-532
Detecting GAN generated Fake Images using co-occurrence matrices, *Lakshmanan Nataraj[1], Tajuddin Manhar Mohammed[1], B.S. Manjunath[1], Shivkumar Chandrasekaran[1], Arjuna Flenner[2], Jawadul Bappy[3], and Amit Roy-Chowdhury[4]; [1]Mayachitra, Inc., [2]NAVAIR, [3]JD.com, and [4]University of California, Riverside (United States)*

5:00 – 6:00 pm All-Conference Welcome Reception

Tuesday January 15, 2019

7:15 – 8:45 am Women in Electronic Imaging Breakfast

Production and Deployment I

Blockchain to Transform Industries

9:00 – 10:00 am
Cypress C

MWSF-533
KEYNOTE: Blockchain and smart contract to transform industries – Challenges and opportunities, *Sachiko Yoshihama, IBM Research (Japan)*

Dr. Sachiko Yoshihama is a senior technical staff member and senior manager at IBM Research - Tokyo. She leads a team that focuses on financial and blockchain solutions. Her research interest is to bring advanced concepts and technologies to practice and address real-world problems to transform industries. She served as a technical leader and advisor in a number of blockchain projects with clients in Japan and Asia. She joined IBM T.J. Watson Research Center in 2001, and then moved to IBM Research – Tokyo in 2003 and worked on research in information security technologies, including trusted computing, information flow control, and Web security. She served as a technology innovation leader at IBM Research Global Labs HQ in Shanghai in 2012, where she helped define research strategies for developing countries. She received her PhD from Yokohama National University (2010). She is a member of ACM, a senior member of Information Processing Society of Japan, and a member of IBM Academy of Technology.

10:00 am – 7:00 pm Industry Exhibition

10:10 – 10:30 am Coffee Break

Steganalysis

Session Chair: Jessica Fridrich, Binghamton University (United States)

10:30 am – 12:10 pm
Cypress C

10:30 MWSF-534
Detection of diversified stego sources with CNNs, *Jan Butora and Jessica Fridrich, Binghamton University (United States)*

10:55 MWSF-535
Algorithm mismatch in spatial steganalysis, *Stephanie Reinders[1], Jennifer Newman[1], Li Lin[1], Yong Guan[1], and Min Wu[2]; [1]Iowa State University and [2]University of Maryland (United States)*

11:20 MWSF-536
StegoAppDB: A steganography apps forensics image database, *Jennifer Newman[1], Li Lin[1], Wenhao Chen[1], Stephanie Reinders[1], Yangxiao Wang[1], Yong Guan[1], and Min Wu[2]; [1]Iowa State University and [2]University of Maryland, College Park (United States)*

11:45 MWSF-537
Are we there yet?, *Mehdi Boroumand[1], Remi Cogranne[2], and Jessica Fridrich[1]; [1]Binghamton University (United States) and [2]Troyes University of Technology (France)*

12:30 – 2:00 pm Lunch

Tuesday Plenary

2:00 – 3:00 pm
Grand Peninsula Ballroom D

The Quest for Vision Comfort: Head-Mounted Light Field Displays for Virtual and Augmented Reality, *Hong Hua, professor of optical sciences, University of Arizona (United States)*

Hong Hua will discuss the high promises and the tremendous progress made recently toward the development of head-mounted displays (HMD) for both virtual and augmented reality displays, developing HMDs that offer uncompromised optical pathways to both digital and physical worlds without encumbrance and discomfort confronts many grand challenges, both from technological perspectives and human factors. She will particularly focus on the recent progress, challenges and opportunities for developing head-mounted light field displays (LF-HMD), which are capable of rendering true 3D synthetic scenes with proper focus cues to stimulate natural eye accommodation responses and address the well-known vergence-accommodation conflict in conventional stereoscopic displays.

Dr. Hong Hua is a professor of optical sciences at the University of Arizona. With more than 25 years of experience, Hua is widely recognized through academia and industry as an expert in wearable display technologies and optical imaging and engineering in general. Hua's current research focuses on optical technologies enabling advanced 3D displays, especially head-mounted display technologies for virtual reality and augmented reality applications, and microscopic and endoscopic imaging systems for medicine. Hua has published more than 200 technical papers and filed a total of 23 patent applications in her specialty fields, and delivered numerous keynote addresses and invited talks at major conferences and events worldwide. She is an SPIE Fellow and OSA senior member. She was a recipient of NSF Career Award in 2006 and honored as UA Researchers @ Lead Edge in 2010. Hua and her students shared a total of 8 "Best Paper" awards in various IEEE, SPIE and SID conferences. Hua received her PhD in optical engineering from the Beijing Institute of Technology in China (1999). Prior to joining the UA faculty in 2003, Hua was an assistant professor with the University of Hawaii at Manoa in 2003, was a Beckman Research Fellow at the Beckman Institute of University of Illinois at Urbana-Champaign between 1999 and 2002, and was a post-doc at the University of Central Florida in 1999.

3:00 – 3:30 pm Coffee Break

Taking Blockchain Beyond Crypto-currency

3:30 – 5:00 pm
Cypress C

Panel Moderator: Gaurav Sharma, University of Rochester (United States)
Panelists:
Nasir Memon, New York University (United States)
Marc Mercuri, Microsoft Corporation (United States)
Hilarie Orman, Cryptic Labs (United States)
Sachiko Yoshihama, IBM Research (Japan)

Marc Mercuri is a director in Microsoft's Applied Innovation team where he focuses on scaling emerging business and technology scenarios for Microsoft. His current focus areas include Blockchain and Smart Buildings. Mercuri's career has included architecture, consulting, engineering, evangelism, and strategy leadership roles at startups, enterprises, ISVs and CSVs. He has worked in Europe, Latin America, Asia, and the United States and his work has been featured in a number of mainstream media outlets including ABC, Advertising Age, AdWeek, TechCrunch, Ars Technica, the BBC, CNET, the Telegraph, FastCompany, Mashable, Wired, and ZDNet. He has 12 issued patents and 15 patents pending in the areas of cloud, mobile, and social. Mercuri is the author of four books on services and identity. He is also the technical editor of a book on Microservices with Docker on Microsoft Azure.

Hilaire Orman's expertise centers on the design, development, and analysis of software and systems that protect data and communications; applied cryptography is principal technology for those protections. She has designed well-regarded protocols and cryptographic documents for the IETF. Orman's educational software for demonstrating malware and how to respond to it is part of the educational archive at USC's Information Sciences Institute. She is one of the founders and co-organizers to the GREPSEC workshop for under-represented groups in computer security research. Orman is the "Practical Security" columnist for IEEE Internet Computing Magazine. *Recent articles have covered online voting, the secrets of email headers, and the Internet of Things. She is the archivist for the IACR and a constant advocate for open source publishing. Orman has a BS in mathematics from the Massachusetts Institute of Technology. She's a former chair of the IEEE Computer Society's Technical Committee on Security and Privacy. She has a strong interest in Blockchain, particularly in the area of smart contracts.*

Dr. Sachiko Yoshihama is a senior technical staff member and senior manager at IBM Research - Tokyo. She leads a team that focuses on financial and blockchain solutions. Her research interest is to bring advanced concepts and technologies to practice and address real-world problems to transform industries. She served as a technical leader and advisor in a number of blockchain projects with clients in Japan and Asia. She joined IBM T.J. Watson Research Center in 2001, and then moved to IBM Research – Tokyo in 2003 and worked on research in information security technologies, including trusted computing, information flow control, and Web security. She served as a technology innovation leader at IBM Research Global Labs HQ in Shanghai in 2012, where she helped define research strategies for developing countries. She received PhD from Yokohama National University (2010). She is a member of ACM, a senior member of Information Processing Society of Japan, and a member of IBM Academy of Technology.

Nasir Memon is a professor in the department of computer science and engineering at NYU Polytechnic School of Engineering and director of the Information Systems and Internet Security (ISIS) laboratory. He is one of the founding members of the Center for Interdisciplinary Studies in Security and Privacy (CRISSP), a collaborative initiative of multiple schools within NYU including NYU-Steinhardt, NYU-Wagner, NYU-Stern and NYU-Courant. His research interests include digital forensics, biometrics, data compression, network security and security and human behavior. Memon earned a Bachelor of Engineering in chemical engineering and a Master of Science in mathematics from Birla Institute of Technology and Science (BITS) in Pilani, India. He received a Master of Science in computer science and a PhD in computer science from the University of Nebraska. Memon has published more than 250 articles in journals and conference proceedings and holds a dozen patents in image compression and security. He has won several awards including the Jacobs Excellence in Education award and several best paper awards. He has been on the editorial boards of several journals and was the editor-in-chief of Transactions on Information Security and Forensics. *He is an IEEE Fellow and a distinguished lecturer of the IEEE Signal Processing Society. Memon is the co-founder of Digital Assembly and Vivic Networks, two early-stage start-ups in NYU-Poly's business incubators.*

5:30 – 7:00 pm Symposium Demonstration Session

Wednesday January 16, 2019

Solutions to Foreign Propaganda

Session Chair: Nasir Memon, New York University (United States)

9:00 – 10:00 am
Cypress C

MWSF-538

KEYNOTE: Technology in context: Solutions to foreign propaganda and disinformation, *Justin Maddox and Patricia Watts, Global Engagement Center, US State Department (United States)*

Justin Maddox is an adjunct professor in the department of information sciences and technology at George Mason University. Maddox is a counterterrorism expert with specialization in emerging technology applications. He is the CEO of Inventive Insights LLC, a research and analysis consultancy. He recently served as the deputy coordinator of the interagency Global Engagement Center, where he implemented cutting-edge technologies to counter terrorist propaganda. He has led counterterrorism activities at the CIA, the State Department, DHS, and NNSA, and has been a special operations team leader in the US Army. Since 2011, Maddox has taught National Security Challenges, a graduate-level course, requiring students to devise realistic solutions to key strategic threats. Maddox holds an MA from Georgetown University's National Security Studies Program and a BA in liberal arts from St. John's College, the "great books" school. He has lived and worked in Iraq, India, and Germany, and can order a drink in Russian, Urdu and German.

Patricia Watts is currently acting chief, Science and Technology/ Cyber, in the US State Department. Watts is a skilled senior intelligence professional with extensive research experience, and brings a solid understanding of foriegn operations, weaponry, and worldwide terrorism. Over a diverse career, Watts has managed the Joint Intelligence Directorate, supervising and overseeing operations of personnel in Afghanistan supporting the Global War on Terrorism; supervised combat maneuver training operations; aided and assisted the tactical training of more than 40,000 maneuver brigade soldiers at the US Army National Training Center; and supplied multi-national support to British, French and US forces in an Allied Command in Berlin, Germany.

10:00 am – 3:30 pm Industry Exhibition

10:10 – 10:30 am Coffee Break

Steganography

Session Chair: Marc Chaumont, LIRMM Montpellier France (France)

10:30 am – 12:10 pm
Cypress C

10:30 MWSF-539

New graph-theoretic approach to social steganography, *Hanzhou Wu, Wei Wang, and Jing Dong, Chinese Academy of Sciences (China)*

10:55 MWSF-540

Reducing coding loss with irregular syndrome trellis codes, *Christy Kin-Cleaves and Andrew Ker, University of Oxford (United Kingdom)*

11:20 MWSF-541

Nondestructive ciphertext injection in document files, *Scott Craver[1], Jugal Shah[2], and Enshirah Altarawneh[1]; [1]Binghamton University (United States) and [2]Nirma University (India)*

11:45 MWSF-542

A natural steganography embedding scheme dedicated to color sensors in the JPEG domain, *Patrick Bas[1], Théo Taburet[1], Wadih Sawaya[2], and Jessica Fridrich[3]; [1]CNRS (France), [2]IMT Lille-Douais (France), and [3]Binghamton University (United States)*

12:30 – 2:00 pm Lunch

Wednesday Plenary

2:00 – 3:00 pm
Grand Peninsula Ballroom D

Light Fields and Light Stages for Photoreal Movies, Games, and Virtual Reality, *Paul Debevec, senior scientist, Google (United States)*

Paul Debevec will discuss the technology and production processes behind "Welcome to Light Fields", the first downloadable virtual reality experience based on light field capture techniques which allow the visual appearance of an explorable volume of space to be recorded and reprojected photorealistically in VR enabling full 6DOF head movement. The lightfields technique differs from conventional approaches such as 3D modelling and photogrammetry. Debevec will discuss the theory and application of the technique. Debevec will also discuss the Light Stage computational illumination and facial scanning systems which use geodesic spheres of inward-pointing LED lights as have been used to create digital actor effects in movies such as Avatar, Benjamin Button, and Gravity, and have recently been used to create photoreal digital actors based on real people in movies such as Furious 7, Blade Runner: 2049, and Ready Player One. The lighting reproduction process of light stages allows omnidirectional lighting environments captured from the real world to be accurately reproduced in a studio, and has recently be extended with multispectral capabilities to enable LED lighting to accurately mimic the color rendition properties of daylight, incandescent, and mixed lighting environments. They have also recently used their full-body light stage in conjunction with natural language processing and automultiscopic video projection to record and project interactive conversations with survivors of the World War II Holocaust.

Paul Debevec is a senior scientist at Google VR, a member of Google VR's Daydream team, and adjunct research professor of computer science in the Viterbi School of Engineering at the University of Southern California, working within the Vision and Graphics Laboratory at the USC Institute for Creative Technologies. Debevec's computer graphics research has been recognized with ACM SIGGRAPH's first Significant New Researcher Award (2001) for "Creative and Innovative Work in the Field of Image-Based Modeling and Rendering", a Scientific and Engineering Academy Award (2010) for "the design and engineering of the Light Stage capture devices and the image-based facial rendering system developed for character relighting in motion pictures" with Tim Hawkins, John Monos, and Mark Sagar, and the SMPTE Progress Medal (2017) in recognition of his achievements and ongoing work in pioneering techniques for illuminating computer-generated objects based on measurement of real-world illumination and their effective commercial application in numerous Hollywood films. In 2014, he was profiled in The New Yorker *magazine's "Pixel Perfect: The Scientist Behind the Digital Cloning of Actors" article by Margaret Talbot.*

3:00 – 3:30 pm Coffee Break

Forensics

Session Chair: Scott Craver, Binghamton University (United States)

3:30 – 4:50 pm
Cypress C

3:30 MWSF-543
Statistical sequential analysis for object-based video forgery detection, *Mohammed Aloraini, Mehdi Sharifzadeh, Chirag Agarwal, and Dan Schonfeld, University of Illinois at Chicago (United States)*

3:55 MWSF-544
Explaining and improving a machine learning based printer identification system, *Karthick Shankar, Alexander Gokan, Zhi Li, and Jan Allebach, Purdue University (United States)*

4:20 MWSF-545
Tackling in-camera downsizing for reliable camera ID verification, *Erkam Tandogan, Enes Altinisik, Salim Sarimurat, and Husrev Taha Sencar, TOBB University of Economics and Technology (Turkey)*

4:45
Conference Closing Remarks

Media Watermarking, Security, and Forensics 2019 Interactive Posters Session

5:30 – 7:00 pm
The Grove

The following work will be presented at the EI 2019 Symposium Interactive Papers Session.

MWSF-546
Hybrid G-PRNU: A novel scale-invariant approach for asymmetric PRNU matching, associating videos to source smartphones, *Reepjyoti Deka, Chiara Galdi, and Jean-Luc Dugelay, Eurecom (France)*

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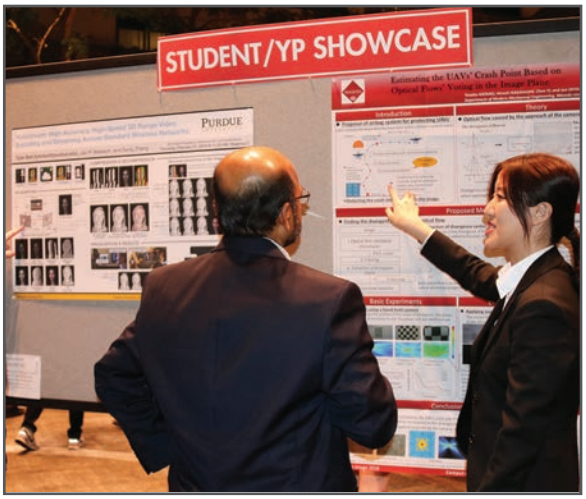

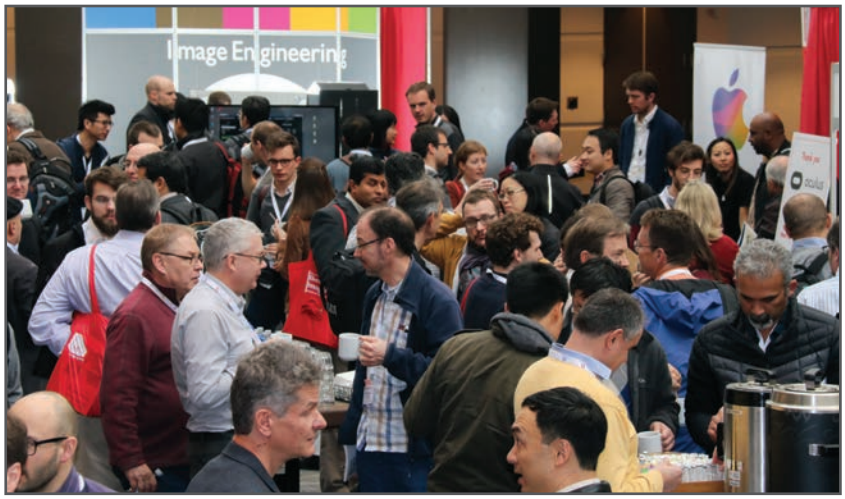

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