Reverse Engineering of Electronic Devices: An Information Forensic Paradigm

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Abstract
Information forensics is an emerging new interdisciplinary field concerning about framework, algorithms, and methodology for traitor tracing, content protection, tampering detection, component analysis for intellectual rights protection/infringement, and behavior modeling and analysis for multimedia social networks.

Information forensics is to reconstruct what have happened to the content and to answer who has done what, when and how. To perform forensic analysis, there got to be some traces of evidences. There are invisible traces of evidences left on the content when going through some operations and devices. These "intrinsic fingerprints" can provide powerful forensic evidences regarding the history and provenance of digital content.

In this talk, we will present state-of-the-art advances to identify components inside a electronic device solely from its output by inferring what algorithms/processing are employed and estimating their parameter settings. We will, as an example, discuss a new methodology for forensic analysis of digital camera images based on the observation that color interpolation leaves distinct intrinsic traces on digital images, and these *intrinsic fingerprints* can then be identified and employed to verify the authenticity of digital data. Using a detailed imaging model and applying component analysis techniques, we can determine which interpolation algorithm is being used, estimate the parameter settings, and thus determine the brand and model of the camera that take this picture.

It can be used for tampering detection as well. Any change or inconsistencies among the estimated in-camera fingerprints, or the presence of new postcamera fingerprints suggests that the image has undergone some kind of processing after the initial capture, such as tampering or steganographic embedding. Building upon such component forensics knowledge, we can extend such a "non-intrusive" forensic methodology to address a number of larger forensic issues in discovering technology infringement and protecting intellectual property rights (*infringement forensics*), identifying the type and model of acquisition device (*acquisition forensics*), detecting a variety of content tampering and verifying integrity (*tampering forensics*), and building universal detector capable of detecting unseen and challenging steganography schemes (*steganography forensics*), just to name a few.

Biography

Dr. Liu is Distinguished Scholar-Teacher of University of Maryland, College Park. Dr. Liu is Director of Communications and Signal Processing Laboratories and leads the Maryland Signals and Information Group (SIG) with research contributions that encompass broad aspects of wireless communications and networking; multimedia communications and signal processing; information forensics and security; biomedical imaging and bioinformatics; and signal processing algorithms and architectures, in which he has published over 450 refereed papers, books, and book chapters.

Dr. Liu is the recipient of numerous honors and awards including the National Science Foundation 1994 National Young Investigator (NYI) Award, the IEEE Signal Processing Society Best Paper Award in 1993 and 2005, EURASIP Best Paper Award in 2004, IEEE 50th Vehicular Technology Conference Best Paper Award in 1999, IEEE Signal Processing Society 2004 Distinguished Lecturer, and EURASIP 2004 Meritorious Service Award. Dr. Liu is a Fellow of the IEEE. He also received various research and teaching recognitions from the University of Maryland, including Poole and Kent Senior Faculty Teaching Award and Outstanding Faculty Research Award, both from A. James Clark School of Engineering; 2004 Invention of the Year Award from Office of Technology Commercialization.

Dr. Liu is Vice President - Publications and on the Board of Governor of IEEE Signal Processing Society. He was the Editor-in-Chief of IEEE Signal Processing Magazine, the founding Editor-in-Chief of EURASIP Journal on Applied Signal Processing, and the prime architect and proposer of IEEE Trans. on Information Forensics and Security and IEEE Journal on Selected Topics of Signal Processing. He has served as the General Chair of IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP), Hawaii, 2007.

His recent books include *Cooperative Communications and Networking*, Cambridge University Press, 2008; *Resource Allocation for Wireless Networks: Basics, Techniques, and Applications*, Cambridge University Press, 2008; *Ultra-Wideband Communication Systems: The Multiband OFDM Approach*, Wiley, 2007; *Network-Aware Security for Group Communications*, Springer, 2007; *Multimedia Fingerprinting Forensics for Traitor Tracing*, EURASIP Book Series on Signal Processing and Communication (Hindawi), 2005; *Design of Digital Video Coding Systems: A Complete Compressed Domain Approach*, Marcel Dekker, 2001; and a co-editor of Handbook on Array Processing and Sensor Networks, IEEE-Wiley, 2009.