Lecture Notes in Electrical Engineering 354

James J. (Jong Hyuk) Park
Han-Chieh Chao
Hamid Arabnia
Neil Y. Yen
Editors

Advanced Multimedia and Ubiquitous Engineering

Future Information Technology Volume 2

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Advanced Multimedia and Ubiquitous Engineering

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Editors
James J. (Jong Hyuk) Park
Seoul National University of Science and Technology
Seoul
Korea, Republic of (South Korea)

Han-Chieh Chao
National Ilan University
Yilan City
Taiwan

Hamid Arabnia
The University of Georgia
Athens, GA
USA

Neil Y. Yen
The University of Aizu
Aizuwakamatsu
Japan

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Message from the FutureTech 2015 General Chairs

FutureTech 2015 is the 10th event of the series of international scientific conference. This conference takes place on May 18–20, 2015, in Hanoi, Vietnam. The aim of the FutureTech 2015 is to provide an international forum for scientific research in the technologies and application of information technology. FutureTech 2015 is the next edition of FutureTech 2014 (Zhangjiajie, China), FutureTech 2013 (Gwangju, Korea), FutureTech 2012 (Vancouver, Canada), FutureTech 2011 (Loutraki, Greece), and FutureTech 2010 (Busan, Korea, May 2010) which was the next event in a series of highly successful the International Symposium on Ubiquitous Applications and Security Services (UASS-09, USA, January 2009), previously held as UASS-08 (Okinawa, Japan, March 2008), UASS-07 (Kuala Lumpur, Malaysia, August 2007), and UASS-06 (Glasgow, Scotland, UK, May 2006).

The conference papers included in the proceedings cover the following topics: Hybrid Information Technology High-Performance Computing, Cloud and Cluster Computing, Ubiquitous Networks and Wireless Communications Digital Convergence, Multimedia Convergence, Intelligent and Pervasive Applications, Security and Trust Computing, IT Management and Service Bioinformatics and Bio-Inspired Computing, Database and Data Mining, Knowledge System and Intelligent Agent, Game and Graphics Human-centric Computing and Social Networks, Advanced Mechanical Engineering, Computer-Aided Machine Design, Control and Automations, and Simulation. Accepted and presented papers highlight new trends and challenges of future information technologies. We hope readers will find these results useful and inspiring for their future research.

We would like to express our sincere thanks to Steering Chair: James J. Park (SeoulTech, Korea) and Hamid R. Arabnia (The University of Georgia, USA). Our special thanks go to the Program Chairs: Joon-Min Gil (Catholic University of Daegu, Korea), Neil Y. Yen (The University of Aizu, Japan), and Muhammad Khurram Khan (King Saud University, Saudi Arabia); all program committee members; and all reviewers for their valuable efforts in the review process that helped us to guarantee the highest quality of the selected papers for the conference.

We cordially thank all the authors for their valuable contributions and the other participants of this conference. The conference would not have been possible without their support. Thanks are also due to the many experts who contributed to making the event a success.

C.S. Raghavendra, University of Southern California, USA
Jason C. Hung, Oversea Chinese University, Taiwan
Doo-soon Park, SoonChunHyang University, Korea
Jianhua Ma, Hosei University, Japan
FutureTech 2015 General Chairs

Message from the FutureTech 2015 Program Chairs

Welcome to the 10th International Conference on Future Information Technology (FutureTech 2015), which will be held in Hanoi, Vietnam, on May 18–20, 2015. FutureTech 2015 will the most comprehensive conference focused on the various aspects of information technologies. It will provide an opportunity for academic and industry professionals to discuss recent progress in the area of future information technologies. In addition, the conference will publish high-quality papers which are closely related to the various theories and practical applications in multimedia and ubiquitous engineering. Furthermore, we expect that the conference and its publications will be a trigger for further related research and technology improvements in these important subjects.

For FutureTech 2015, we received many paper submissions, and after a rigorous peer review process, we accepted only articles with high quality for the FutureTech 2015 proceedings, published by the Springer. All submitted papers have undergone blind reviews by at least two reviewers from the technical program committee, which consists of leading researchers around the globe. Without their hard work, achieving such a high-quality proceeding would not have been possible. We take this opportunity to thank them for their great support and cooperation. We would like to sincerely thank the following invited speakers who kindly accepted our invitations and, in this way, helped to meet the objectives of the conference: Prof. Han-Chieh Chao, National Ilan University, Taiwan, and Prof. Timothy K. Shih, National Central University, Taiwan. Finally, we would like to thank all of you for your participation in our conference and also thank all the authors, reviewers, and organizing committee members. Thank you and enjoy the conference!

Joon-Min Gil, Catholic University of Daegu, Korea
Neil Y. Yen, The University of Aizu, Japan
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Message from the MUE 2015 General Chairs

MUE 2015 is the 9th event of the series of international scientific conference. This conference takes place on May 18–20, 2015, in Hanoi, Vietnam. The aim of the MUE 2015 is to provide an international forum for scientific research in the technologies and application of multimedia and ubiquitous engineering. Ever since its inception, International Conference on Multimedia and Ubiquitous Engineering has been successfully held as MUE-14 (Zhangjiajie, China, May 2014), MUE-13 (Seoul, Korea, May 2013), MUE-12 (Madrid, Spain, July 2012), MUE-11 (Loutraki, Greece, June 2011), MUE-10 (Cebu, Philippines, August 2010), MUE-09 (Qingdao, China, June 2009), MUE-08 (Busan, Korea, April 2008), and MUE-07 (Seoul, Korea, April 2007).

The conference papers included in the proceedings cover the following topics: Multimedia Modeling and Processing, Ubiquitous and Pervasive Computing, Ubiquitous Networks and Mobile Communications, Intelligent Computing, Multimedia and Ubiquitous Computing Security, Multimedia and Ubiquitous Services, Multimedia Entertainment, and IT and Multimedia Applications. Accepted and presented papers highlight new trends and challenges of multimedia and ubiquitous engineering. We hope readers will find these results useful and inspiring for their future research.

We would like to express our sincere thanks to Steering Chair: James J. (Jong Hyuk) Park (SeoulTech, Korea). Our special thanks go to the Program Chairs: Gangman Yi (Gangneung-Wonju National University, Korea) and Chengcui Zhang (The University of Alabama at Birmingham, USA); all program committee members; and all reviewers for their valuable efforts in the review process that helped us to guarantee the highest quality of the selected papers for the conference.

Shu-Ching Chen, Florida International University, USA
Young-Sik Jeong, Dongguk University, Korea
Han-Chieh,Chao National Ilan University, Taiwan
MUE 2015 General Chairs

Message from the MUE 2015 Program Chairs

Welcome to the 9th International Conference on Multimedia and Ubiquitous Engineering (MUE 2015), which will be held in Hanoi, Vietnam, on May 18–20, 2015. MUE 2015 will be the most comprehensive conference focused on the various aspects of multimedia and ubiquitous engineering. It will provide an opportunity for academic and industry professionals to discuss recent progress in the area of multimedia and ubiquitous environment. In addition, the conference will publish high-quality papers which are closely related to the various theories and practical applications in multimedia and ubiquitous engineering. Furthermore, we expect that the conference and its publications will be a trigger for further related research and technology improvements in these important subjects.

For MUE 2015, we received many paper submissions, and after a rigorous peer review process, we accepted only articles with high quality for the MUE 2015 proceedings, published by the Springer. All submitted papers have undergone blind reviews by at least two reviewers from the technical program committee, which consists of leading researchers around the globe. Without their hard work, achieving such a high-quality proceeding would not have been possible. We take this opportunity to thank them for their great support and cooperation. Finally, we would like to thank all of you for your participation in our conference and also thank all the authors, reviewers, and organizing committee members. Thank you and enjoy the conference!

Gangman Yi, Gangneung-Wonju National University, Korea
Chengcui Zhang, University of Alabama at Birmingham, USA
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The Study on the Detection of the Damaged File Using the Graph of the Information Entropy for File Trust Management

Chae Ho Cho, Sungsuk Kim, Seonmi Han and Kwang Sik Chung

Abstract Information entropy refers to the complexity of information included in set of data in a mathematical way. Entropy is now usually used for the classification of files or detection and analysis of malicious code. Information entropy graph shows the probability of occurrence of each information included in set of data using information entropy. Each Well Known File has different entropy and each file can be sorted using this. When it comes to binary file, however, different files can have the same entropy values so there is error possibility. Thus, the identification of files for the least errors can be possible when using entropy and graph patters. In the forensic analysis process, detections of hidden and tampered files are handled. With existing forensic method, the extensions of header and footer of tampered files are not automatically detected. When the other functions such as calculation and comparison of graphs are added, accuracy of experiment is increased in the forensic process. In this study, we proved that different files but have the same entropy values are assorted with the information entropy graphs. The information entropy graphs of Well Known Files showed the meaningful patterns for analysis and detection. When it comes to the damaged file header, footer, and even body, they sustained the same graph patterns even though they showed different entropy values.

C.H. Cho
Korea Cyber Forensics Professional Association, Seoul, Republic of Korea
e-mail: greatopen@gmail.com

S. Kim
Department of Computer Science, Seokyeong University, Seoul, Republic of Korea
e-mail: sskim03@skuniv.ac.kr

S. Han
Department of Nano Convergence Engineering, Seokyeong University, Seoul, Republic of Korea
e-mail: gkstjsal83@gmail.com

K.S. Chung (✉)
Department of Computer Science, Korea National Open University, Seoul, Republic of Korea
e-mail: kchung0825@knou.ac.kr

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Keywords Forensic · Information entropy · Information entropy graph · Augmented reality · File steganography · Forgery of files

1 Introduction

Entropy refers to the physical concept that indicates the measure of disorder in certain system in thermodynamics. Claude E. Shannon, the mathematician first suggested Information Entropy which means the amount of information or signals related to the events using entropy [1]. Given situation, information entropy is characterized that the more different information mixed with, the higher entropy it has while the more same information mixed with, the lower entropy it has. That is, the characteristics of information can be measured by entropy value and as uncertain and disordered information is increased, entropy is also increased. Forensic method using information entropy is broadly used for the malicious code detection or analysis of compressed file.

Damaged files in Meta area has to be recovered with using self-information of the files not using the information of file system. One of the carving technologies using the characteristics of file itself is the way to use information entropy. The files which have various extensions have different header and footer information for each and then store the information through certain forms of files. According to each kind of file, information entropy value varies and even if header or footer is damaged, information entropy value is rarely changed. Although the file is deleted and Meta information area is damaged, deleted or hidden files can be restored with information entropy value in data area. When the entropy values of different forms of files are similar, however, those files can be recognized as the same file.

In this study, beyond the existing research which only uses the information entropy value, detection method of damaged files using the information entropy graph is suggested. The detection of files utilizing the information entropy graph can be indicated that different files with similar entropy values can have different entropy graphs. Especially, when the different files have the same entropy values because of damaged header or footer information of files, the information entropy graph shows their differences for sure.

In Chapter "Enhancing Dataset Processing in Hadoop YARN Performance for Big Data Applications", we will discuss the concept of the information entropy suggested by Claude E. Shannon and header and footer information of Well Known files. Also, existing study for file detection and restoration using information entropy will be dealt with. In Chapter "A Multimetric Approach for Discriminating Distributed Denial of Service Attacks from Flash Crowds", the method for damaged file detection with information entropy and entropy graphs will be suggested. It proved that the files are not able to detected with existing forensic technology can be identified as files before damaged with the information entropy and entropy graphs. In Chapter "A Supporting Tool for Spiral Model of Cryptographic Protocol Design with Reasoning-Based Formal Analysis", the further development and study for the forensic technology using the information entropy and graphs will be addressed.

2 Related Research

The information entropy H(X) that Claude E. Shannon suggested can be digitized as following formula [1].

$$\begin{aligned} H(X) &= \sum_{i=1}^{n} p(x_i) I(x_i) \\ &= \sum_{i=1}^{n} p(x_i) \log_b \frac{1}{p(x_i)} \\ &= -\sum_{i=1}^{n} p(x_i) \log_b p(x_i) \end{aligned}$$

The information entropy is the total value of information probability that each information can have in a group. In the information entropy H, the certain information refers to xi and its probability is p(xi). Also its amount of information refers to I(xi). Shannon used log to get I(xi). The entropy of the xi would be gotten through logarithmic calculations with multiplying pi, all possible probability value by its reciprocal. The base number of log 'b' is generally 2 and Euler's constant 'e' or 10 would be used either. The higher the entropy is, the more the amount of information is and vice versa.

The various Well Know Files have their own header and footer information. In general computer system, even if operating system, possessor or the size of files are changed, its header and footer information never change. In cyber forensic filed, changed or corrupted files are identified with these characteristics of files.

In Study [2], the information entropy of Well Know File was measured and verified that the entropy values of execution file or compressed execution file are higher than general text or image files. After measuring the entropy of each file, even though the different files have the same extensions caused by malicious changes, with the entropy values for each, they can be sorted. In Study [3], the malicious code having the form of compressed execution file showed higher entropy than other general execution files. Using the properties that show different information entropies according to the tools used for compressing the execution files, tools used in the process of malicious code can be detected and analyzed.

In Study [4], the way to use the information entropy for the restoration of broken files was suggested. The information entropy was used for the restoration of broken files in more than 300 hard drives. JPEG files, Microsoft OLE files, and compressed file format ZIP files were selected and then, each entropy value of each defragmented cluster was measured. After measuring the entropies of adjacent cluster, clusters having similar entropies were gathered together then, reconstructed.

Except that, there is another way to compare the patterns of files by using the restoration technology that data area is interpreted with stream units. This method, however, has high probability of error when it has the similar patterns and takes long time for the restoration. The Carving technology using Slack Space is RAM Slack. When the files saved with cluster units don't use the sound cluster, the final sector area would be filled with 0×00. If each cluster of sector detects the sector filled with 0×00, header and footer of file can be automatically detected [4]. In the case of text file, there are two ways; calculating the frequency that character string composed of ASCII Code appears and the confirmation of line feed character. Line feed character is generally composed of '\n' which means line feed and '\r' which means carriage return. This method, however, has restriction for use because it is confined to text file and has different values of line feed characters in Windows or UNIX operation system.

The existing forensic tools don't have functions for the automatic detection of files which have been tampered because of the change of the extensions or signatures. In this case, suspicious files should be opened respectively and then be analyzed the structures with manual sorting. With this reason, the camouflaged files having changed names, extensions, headers and footers should be evaluated only by the forensic analyst. Even the way to use the script function offered by forensic tool has the probability of error so new detection method would be inevitable.

3 File Detection Using the Information Entropy Graph

In this study, the information entropy graph is suggested for the detection of damaged file. During the forensic analysis process, the information entropy graph can help the accuracy of damaged or hidden file's detection increase.

This study suggests the information entropy values and its graphs as a method for the detection of damaged files. In this study, the problem has been solved that the existing forensic tools are not able to verify which file is fake or not because header or footer of file has been damaged. It has an advantage that files don't need to be executed or read to verity that the files are modulated or not in forensic process, but only need patterns of graphs to identify the types of files. The information entropy values and its graphs of Well Known File are compared in this. The files used in this experiment have different resolutions and were selected randomly.

3.1 doc File

doc file is the file extension of MS-Word developed by MS-Office, Microsoft. After comparing the information entropy graphs, confirmed that p(x0) is higher than other p(xi). The graphs are in Table 1.

Table 1 Comparison of the information entropy in docx file

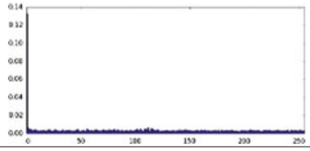
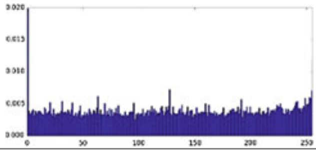
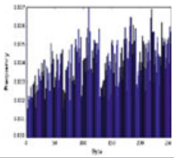
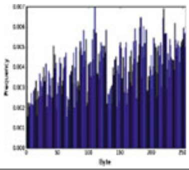
File	Information entropy	Information entropy graph	Note
1.docx	7.91		Original file
2.docx	7.94		Change in header, footer and extensions

Table 2 Comparison of the information entropy in the damaged jpg file

File	Information entropy	Information entropy graph	Note
1.jpg	7.76		Original file
2.jpg	7.76		Change in header, footer and extensions

3.2 *Damaged jpg File*

The detection and analysis of the damaged file is an important element in whole forensic process. In this test, the differences between when the header or footer and extensions were changed and when the part of body information was changed were compared. As a result, when the header, footer, and extension were changed, the information entropy value showed the same and there was no visible change in the information entropy graph. Also, when the part of body information was changed, the information entropy value showed meaningful changes but only minimal change of patter was found in the graph. The entropy graph of damaged files is seen in Table 2.

	A	B	C	D	E	F
1	freqList[i]	Original File	20% Damaged File	30% Damaged File	Standard Deviation of 20% Damaged File	Standard Deviation of 30% Damaged File
2	0	0.024384781	0.035997715	0.039489602	0.476236965	0.619436432
3	1	0.004747106	0.006412434	0.006992432	0.350809209	0.472988375
4	2	0.004407331	0.006117025	0.007015156	0.387920452	0.591701449
5	3	0.003643379	0.005845422	0.007020566	0.604395604	0.926937927
6	4	0.003866289	0.006148406	0.00739605	0.590260285	0.912958298
7	5	0.004610763	0.006471949	0.007214259	0.403661112	0.564656184
8	6	0.002985472	0.00530438	0.006549859	0.7767307	1.193910837
9	7	0.003846811	0.005842176	0.006882059	0.518706048	0.789029536
10	8	0.003237598	0.004893187	0.005793482	0.511363636	0.789438503
11	9	0.003853304	0.005690684	0.006741388	0.47683235	0.749508565
12	10	0.004347817	0.006120272	0.00694482	0.407665505	0.597312096
13	11	0.003672596	0.004973262	0.005660386	0.35415439	0.541249263
14	12	0.003852222	0.00530979	0.005943892	0.378370787	0.542977528
15	13	0.0033945	0.00457289	0.005243783	0.347146956	0.544788014
16	14	0.00308286	0.004326175	0.005074978	0.403299403	0.646191646
17	15	0.004555577	0.005570572	0.006042361	0.22280285	0.326365796
18	16	0.00352435	0.004604271	0.00521132	0.306416948	0.478661345
19	17	0.003499462	0.004029684	0.004548002	0.151515152	0.299628942
20	18	0.003871699	0.004715726	0.005175612	0.217998882	0.336780324
21	19	0.003428045	0.004274235	0.004727628	0.246843434	0.379103535

Fig. 1 Dynamic rage of the entropy value for each unit

3.3 Graph Changes in Information Entropy

The information entropy graphs of Well Known Files stayed the same pattern regardless of the degree of damage. In this study, to measure the rate of change of the entropy graphs with pre-damaged and post-damaged files, standard deviation was used. Pre-damaged file p(xi)·I(xi) and post-damaged file p(xi)·I(xi) were compared each other and their range of fluctuation was examined. Almost no variation when calculating the entropies of neighboring units (Fig. 1).

4 Conclusion

In recent Cyber infringement accidents, deleting or damaging the critical evidences has been increasing. The tampered files can be detected when only using the information of header and footer or extensions of files in existing forensic tools. It has certain limitations to detect and verify files when both extension and header or footer are tampered in forensic process. In this study, the new way to verify the damaged files using the information entropy values and their graphs of 'well-Known Files' were suggested. The same kinds of files have the similar patterns of entropy graphs, which can help identify the characteristics of files. Although the entropy values were changed according to the degree of damage, their graphs maintained the same patters. To sum up, if the entropy graphs is utilized to verify the damaged files, the possibility of errors in forensic analysis process can be decreased.

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Enhancing Dataset Processing in Hadoop YARN Performance for Big Data Applications

Ahmed Abdulhakim Al-Absi, Dae-Ki Kang and Myong-Jong Kim

Abstract In Hadoop MapReduce distributed file system, as the input dataset files get loaded and split to every worker, workers start to do the required computation according to user logic. This process is done in parallel using all nodes in the cluster and computes output results. However, the contention of resources between the map and reduce stages cause significant delays in execution time, especially due to the memory IO overheads. This is undesired because the task execution in the Hadoop MapReduce induces an overhead in considering redundant data in case of imprecise applications which increases the execution time. Thus, in this paper we present our approach to optimize local worker memory management mechanism to reduce the presence of null schedule slots. Efficient utilization of slots leads to reduce execution times. The local memory management mechanism adopted enables efficient parallel execution and reduced memory overheads. The approach effectively reduced the MapReduce computation time which minimizes the budget for application execution in the cloud.

Keywords Dataset · Hadoop YARN · MapReduce · Big data · Cloud computing

A.A. Al-Absi (✉) · D.-K. Kang
Division of Computer and Information Engineering, Dongseo University, Busan, Korea
e-mail: absiahmed@gmail.com; ahmed_absi2005@yahoo.com

D.-K. Kang
e-mail: dkkang@dongseo.ac.kr

M.-J. Kim
School of Business, Pusan National University, 63 Beon-gil 2, Busandaehag-ro, Geumjeong-gu, 609-735 Busan, Korea
e-mail: mjongkim@pusan.ac.kr

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