Using Deep Learning Methods for Forensic Image and Video Investigation

Geradts, Z.J.; Ruifrok, A.C.

Publication date
2016

Document Version
Final published version

Published in
Proceedings of the American Academy of Forensic Sciences

Citation for published version (APA):
AMERICAN ACADEMY OF FORENSIC SCIENCES
410 North 21st Street
Colorado Springs, CO 80904
Phone: (719) 636-1100
Fax: (719) 636-1993
E-mail: membership@aafs.org
Website: www.aafs.org

PROCEEDINGS
of the American Academy of Forensic Sciences 68th Annual Scientific Meeting

The Proceedings of the American Academy of Forensic Sciences is an official publication of the American Academy of Forensic Sciences (AAFS). It is devoted to the publication of the abstracts of technical oral papers and posters presented at the AAFS annual scientific meeting. These include various branches of the forensic sciences such as pathology, toxicology, anthropology, psychiatry, immunology, odontology, jurisprudence, criminalistics, questioned documents, digital evidence, and engineering. Similar submissions dealing with forensic oriented aspects of the social sciences are also included.

Please note that some of the abstracts included in the Proceedings deal with topics, results, and/or conclusions which are controversial. The publication of abstracts does not imply that the AAFS, its sections, or the individual section program chairs/committee members have verified or agree with the studies, results, and/or conclusions of each abstract. During the process of planning a scientific program, it is impossible to “peer-review” each abstract and presentation to the degree that is accomplished during manuscript review. Abstracts and presentations are accepted, in part, so that they can be critiqued and reviewed by other scientists. Thus, a forum is created to discuss controversial issues.

The views expressed in this publication are not those of the AAFS. The data and opinions appearing in the published material were prepared by and are the responsibility of the contributor(s), not of AAFS nor its respective employees, employers, officers, and agents. The AAFS does not supply copies of meeting papers. Please write directly to individual authors to obtain copies of specific papers. Presentation of some abstracts may have been scheduled or canceled after the publication of this document.

English is the official language of the AAFS and its meetings; neither oral nor written translations will be provided.

Copyright 2016 by the AAFS. Unless stated otherwise, noncommercial photocopying of editorial material published in this periodical is permitted by AAFS. Permission to reprint, publish, or otherwise reproduce such material in any form other than photocopying must be obtained from AAFS.
C2 Using Deep Learning Methods for Forensic Image and Video Investigation

Zeno J. Geradts, PhD*, Netherlands Forensic Institute, Laan van Ypenburg 6, Den Haag, SH 2497 GB, NETHERLANDS; and Arnout C. Ruifrok, PhD, Laan van Ypenburg 6, Den Haag 2497 GB, NETHERLANDS

After attending this presentation, attendees will understand how to search through images based on deep learning methods. This presentation will impact the forensic science community by illustrating how newly developed algorithms become available for use in forensic science and how they can be applied in casework. The possibilities and limitations will be discussed.

The amount of stored digital images and video material is growing very rapidly since the number of cameras are rapidly increasing, ranging from cameras of Closed-Circuit Television (CCTV) systems to smartphones, computers, and drones in combination with social networks. In complex crime cases or terrorist attacks, the number of images and videos that require processing are often too much to handle in a short period of time. Searching for a certain suspect or tracking persons in video images is often a challenge. To make the pre-processing for further forensic investigation more efficient, there are several approaches for assisting investigators with this process.

Deep learning techniques are now commonly used for searching through many images and videos. In this presentation, an overview is given of methods that are state of the art and which can help the forensic investigation with man-machine interaction. Due to increasing processing power, the deep learning techniques are more feasible to use, and searching in videos and images is easier; however, real-world images are often from different angles, have poor lighting, and other conditions are present that may make the retrieval more complicated.

In this presentation, several examples of deep learning are presented. Several computer vision techniques in combination are presented and the results for a database are also discussed.

More research in deep learning techniques is needed for optimizing the methods that can be used for searching quickly through many hours of video material and classifying the material by user-defined classes. One such example is the search of images of feet or hands that may be useful in child pornography cases in which suspects are only partially visible. Another interesting area is the example of an investigator searching for the brand and model of a camera based on images, where the images of known cameras and models are used as training materials. Another briefly discussed comparison is that of facial comparison.

Additionally, the presentation of retrieval results is a challenge, since most people can only actively search through image material for less than 30 minutes before they become tired and make too many mistakes in the retrieval process. More time is needed for forensic comparison, since it often requires a 1:1 comparison, which takes longer. A good pre-selection is important, and perhaps in the future, the results of deep learning methods can help in finding a likelihood ratio of a certain shape of a feature. Validation of these methods for use in forensic science is important; however, the current research is focused on how deep learning can assist forensic image and video investigation.

Deep Learning, Multimedia, Searching

*Presenting Author