Proposal for Master 2 Internship / Final Project Assignment (PFE): Heatmap fusion for accurate image forgery localization

Keywords: Digital image, image analysis, information fusion, deep learning, image statistics.

Context and objective

Digital image has become an efficient and natural communication medium. Historically, the authenticity of visual data has been very reliable. However, nowadays, the existence of a large number of image editing software tools makes it extremely easy to modify digital images so that the possibility of tampering with and falsifying visual content is no longer restricted to experts. Faithful detection and accurate localization of image forgeries have become popular and important research topics [1]. Many image forensic detectors have been proposed which aim to expose different traces left by image tampering operations. However, the forgery localization result of individual detectors is often noisy and could be further improved (see the so-called *heatmaps* shown in Figure 1), and research efforts should also be devoted to the effective fusion of heatmaps of multiple detectors in order to achieve more accurate localization. The **objective** of the proposed internship is to design and implement technical solutions to the above two problems.

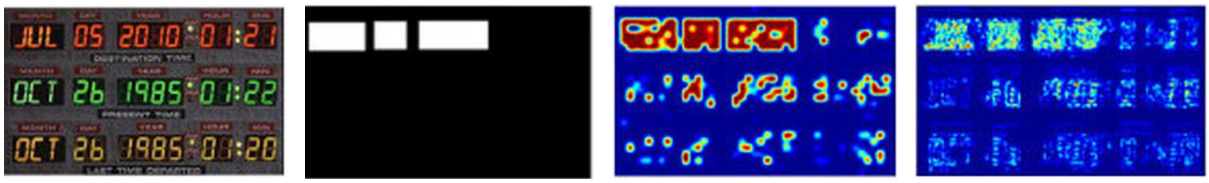

Figure 1. From left to right: a falsified image, ground-truth forgery mask where white color means tampered regions, output heatmap (hotter color means higher probability of falsification) of the forensic detector proposed in [2], and heatmap of another forensic detector proposed in [3]. The images are extracted from [4].

Tasks

The internship student is expected to accomplish the following tasks, in chronological order.

1. Carry out a brief literature review, mainly on image forgery localization and heatmap fusion (around 5 scientific papers).
2. Understand the implementations (already available) of a number of typical forgery localization methods.
3. Improve the output heatmaps (such as those shown in Figure 1) of individual methods. This can be done in collaboration with another internship student who works on copy-move forgery localization. Possible solutions would be based either on images statistical models or deep learning methods.
4. Propose an effective heatmap fusion method, probably utilizing an appropriate deep learning model, to obtain a more accurate localization map that is closer to the ground-truth mask.

Working environment and application

The proposed internship will take place in the Department of Images and Signals of GIPSA-lab (Grenoble Images Parole Signal Automatique, http://www.gipsa-lab.grenoble-inp.fr/). The internship student will work with Dr. François Cayre, Dr. Kai Wang and their Ph.D. students Ludovic Darmet and Ivan Castillo Camacho. A monthly stipend of about 560 € will be provided. Working language can be either French or English. It would be possible to continue and extend this work to a Ph.D. thesis.

We seek excellent candidate with strong background in Mathematics and Image Processing, highly motivated by the proposed research problem, and proficient in Python programming.

For applying, please send **your CV, a motivation letter, and M1 and M2 grade transcripts** to francois.cayre@gipsa-lab.grenoble-inp.fr and kai.wang@gipsa-lab.grenoble-inp.fr

Expected starting date of the internship is 1st February 2019.

References:

[1] A. Piva, ‘‘An overview on image forensics,’’ ISRN Signal Processing, vol. 2013, article ID 496701, pp. 1-22, 2013.

[2] Z. Lin, J. He, X. Tang, and CK Tang, ‘‘Fast, automatic and fine-grained tampered JPEG image detection via DCT coefficient analysis,’’ Pattern Recognition, vol. 42, no. 11, pp. 2492-2501, 2009.

[3] P. Ferrara, T. Bianchi, A. De Rosa, and A. Piva, ‘‘Image forgery localization via fine-grained analysis of CFA artifacts,’’ IEEE Transactions on Information Forensics and Security, vol. 7, no. 5, pp. 1566-1577, 2012.

[4] M. Zampoglou, S. Papadopoulos, and Y. Kompatsiaris, ‘‘Large-scale evaluation of splicing localization algorithms for web images,’’ Multimedia Tools and Applications, vol. 76, no. 4, pp. 4801-4834, 2017.