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Internship proposal for 2015
Proposal ref:
DPL_2015_SP_VP_019

Title of internship (web): **DPL_2015_SP_VP_019** Signal Processing for Multimedia Security

Summary of the internship (web)

Piracy has been significantly facilitated by the commercial deployment of software to manipulate digital multimedia content, and the development of rapid and efficient distribution networks. To tackle this issue, content protection is mainly ensured by cryptography during the distribution, but at the rendering time only forensics techniques can prevent from piracy. Such forensics solutions mostly rely on (i) digital watermarking to provide a tracing mechanism to be able to pinpoint the source of a leak when it occurs, and (ii) passive forensics techniques to characterize pirate samples. Depending on the profile of the applicant, the internship will focus either on research or development. Technicolor topics of interest in video forensics include (but are not limited to): assessing HEVC watermarking system, improving HTTP Adaptive Streaming contents watermarking, refining fidelity models to ensure invisibility of the watermarks on either single or stereo contents, proposing new features for video re-alignment in the particular case of short sequences, defining the piracy path and some passive video forensics statistics of the screencasting attack.

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Proposal ref:
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Title of internship: Signal Processing for Multimedia Security

Internship period & duration: 6 months e.g. March-August 2015 (can be adjusted)

Working environment: The selected candidate will join a team of 6 researchers and engineers working on signal processing for multimedia security. The members of the team are located in Rennes (France) in the new facilities of Technicolor R&D France, the largest Research Centre of the group.

Context: The rapid transition from analog to digital media over the last decades puts the Entertainment industry under increased pressure to protect their high-valued assets. Piracy has indeed been significantly facilitated with the commercial deployment of software to manipulate digital content, and the development of rapid and efficient distribution networks. To tackle this issue, content protection is mainly ensured by cryptography during the distribution, but at the rendering time only forensics techniques can prevent from piracy. Such forensics solutions mostly rely on (i) digital watermarking to provide a tracing mechanism to be able to pinpoint the source of a leak when it occurs, and (ii) passive forensics techniques to characterize pirate samples.

Objective: The intern will contribute to Technicolor's effort to propose innovative solutions in video forensics. Depending on the profile of the applicant, the internship will focus either on research or development. Topics of interest include (but are not limited to):

HEVC watermarking. Technicolor's video watermarking technology originally tied to the H.264/AVC video codec has recently been exported to the HEVC coding format to enlarge the scope of Technicolor's offer. So far, fidelity models which aim at checking the invisibility of the watermarks as well as the modulation strategy designed for H.264 have been reused for HEVC. The intern will be in charge to assess the relevance of existing fidelity criteria and to propose new improved one(s). He will also modify the watermarking modulation strategy to cope with the new features of HEVC. This topic is particularly timely in view of a recent specification released by MovieLabs that mandates the used of forensic watermarking for 4K content.

HAS watermarking. HTTP Adaptive Streaming (HAS) essentially consists in switching between different qualities of a video in order to account for the ever changing bandwidth of the network and is routinely used for video consumption on mobile devices. However, these regular switches have been reported in prior work to potentially disrupt the watermark modulation strategy of our 2-step watermarking systems. The intern will explore various techniques to harmonize the payload embedding pace and/or new watermark detection paradigms.

Fidelity models. Digital watermarks inserted into multimedia content should be unnoticeable by an average viewer. To guarantee such imperceptibility, it is common practice to rely on perceptual models. However, common models such as PSNR and SSIM are tailored for compression and may not be readily usable in watermarking. The intern will study how to measure perceived distortion either when only a few blocks are modified in a video or when noise is added to stereo video content.

Watermark detection on short sequences. In some applications such as content protection along the movie creation chain, short sequences (like dailies) need to be watermarked. However, watermark detection on short sequences poses numerous challenges. First of all, realigning the pirate video with the corresponding master, which is necessary prior to watermark detection, is more difficult. Actually, realignment relies on content-dependent salient features such as key-frames, whose detection and extraction is more difficult on short sequences. Secondly, the amount of watermark embedded on a short sequence may be too small to reliably decode the watermark after severe degradation. The intern will explore new key frames extraction strategies as well as new temporal consistency constraints to improve the accuracy of Technicolor's resynchronization framework. He will also design new detection strategies to improve decoding on short sequences.

Piracy path. Screencasting, aka. recording what is displayed on a PC screen, is currently replacing camcording as a piracy threat. Both video watermarking and fingerprinting are expected to be robust against the display-and-record pipeline, but this is hardly validated in practice due to the required tedious benchmarking campaigns. The intern will analyze all the mechanisms occurring along a specific piracy path to (i) model the distortions experienced by the content and/or (ii) design an efficient mimicry piracy simulator. When relevant, the intern will also explore whether such statistical evidence could be used to tell-tale which devices or piece of software took part in the production of the analysed pirate sample.

Candidates, who have a general interest in multimedia security but do not find an appealing internship in the list above, are encouraged to contact Gwenaël Doërr directly by email (gwenael.doerr@technicolor.com) to discuss potential internship topics and assess whether they are in line with Technicolor's research roadmap.

Profile of the applicant: 3rd year engineer or master, specialized in signal processing.

Prerequisites:

- Signal processing fundamentals e.g. filtering, denoising, estimation, segmentation, indexing, compression, etc;
- [opt.] Multimedia security e.g. DRM, watermarking, fingerprinting, forensics, biometrics, steganography;
- [opt.] Machine learning, statistics, optics, communications, human perception;
- Linux/windows environment;
- C/C++ programming, Matlab;
- Fluent in English.

Apply at: stage.rennes@technicolor.com