

Internship proposal

Generative AI methods to model Printing-and-Digitalization process

Keywords: Generative learning, image processing, printed documents

Context of the study

Due to development and broad availability of high-quality printing and scanning devices, the number of forged or counterfeited products and documents is dramatically increasing. Therefore, there is continuous research of new solutions to protect the documents and valuable products. One of the promising and accessible solution is the use of security printing. When an electronic document is printed and scanned one/several times, a slightly different image of the document - due to the optical characteristics of the capture devices - is obtained each time. We can use this information loss principle to identify the devices used for production of the document hardcopy.

In this case, the authentication/identification systems take a full advantage of Printing-and-Digitalization (PD) process. In current stage, we need to print a big quantity of samples to learn the authentication detectors or forgery detectors. Nevertheless, the dataset construction process is very expensive and time-consuming. Additionally, the data collection process requires dedicated personnel and very strict procedures. Therefore, we are looking for solutions that can help to learn a surrogate model of PD process and create a big public dataset of printed documents.

This internship is a part of ANR project *TRUSTIT: Theoretical and practical study of physical object security in real world use cases* that aims to explore the potential offered by deep learning methods in the context of secure printing from the verifier's point of view.

Description of the subject

The generative neural networks (GANs) and probabilistic latent diffusion models recently have showed their efficiency in data generation and style transfer [1,2]. The main tasks of this internship are:

- 1) To learn a surrogate representation of one pair printer-scanner using existing large dataset of L3iTTextCopies [3].
- 2) To experiment with different architectures of GANs and probabilistic diffusion approaches to identify the best method for our task.
- 3) To compare the pseudo-synthetic samples with real printed documents using some commonly used metrics as Pearson correlation, Mean square error (MSE) distance and Fréchet Inception Distance (FID) between the datasets [4].
- 4) To evaluate the possibility of fine-tuning the proposed models for unseen pairs of printer and scanner.
- 5) To create a public synthetic dataset of printed documents and if possible, to publish the results in the international conference or scientific journal.

Required profile

- The candidate must currently be enrolled in a Master 1 or Master 2 program or in the final year of engineering school (that corresponds to Bac+5 in France) in Computer Science.
- Programming languages: Python.
- Libraries for image analysis and processing: OpenCV, scikit-image (Python).
- Machine learning frameworks: scikit-learn, PyTorch.
- Scientific knowledge: signal processing, image analysis, machine learning and deep learning.
- Knowledge on multimedia security will be considered a plus.
- Languages: French or English.

Place and allowance of internship

The internship will be held in LIRIS (Laboratoire d'Informatique en Image et Systèmes d'information) laboratory, campus of Université Lumière Lyon 2, Bron. Internship allowance is 4.5 euros per hour.

Contact information

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Please provide your CV, the motivation letter, and the transcripts with your marks for the last two years of studies.

References

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- [4] Y. Belousov, B. Pulfer, R. Chaban, J. Tutt, O. Taran, T. Holotyak, S. Voloshynovskiy, “Digital twins of physical printing-imaging channel”, IEEE WIFS 2022.