



Geometric & Visual Computing

## Video Style transfer in a railway setting

We are seeking a full-time post-doctoral research fellow to join IRT System X and Ecole Polytechnique to work in the DOS team on video style transfer from May 2021 for 1 year.

**Summary:** The primary goal of this post-doc is to develop methods that transfer realistic weather and luminosity conditions (e.g. rain, daylight) on railway video sequences. The secondary goal is to develop evaluation techniques with video-realistic metrics (e.g. perception) and reliability or safety metrics (e.g. weather-related modifications are correctly detected as part of the video instead of external objects or anomalies).

### Advisors:

The research fellow will be co-supervised by Sarah Lannes and Raphael Braud from the DATA/AI team and Claire Corral-Colliere (SNCF Innovation) at [IRT System X](#) and [Vicky Kalogeiton](#), [Damien Rohmer](#), and [Marie-Paule Cani](#) from the [GeoViC](#) team at [LIX](#), [Ecole Polytechnique](#).

### Profile of the candidate:

- PhD in Computer Vision, Computer Graphics, Image Processing, or Machine Learning (or expected to defend before the end of 2021)
- Experienced in Python or C++ programming
- Hands-on experience with deep learning frameworks (PyTorch/Tensorflow)
- A record of scholarly work, such as work in top-tier peer-reviewed conferences/journals in either Computer Vision (CVPR, ICCV, etc.) or Computer Graphics (SIGGRAPH, Eurographics, etc.)
- Good oral and written communication skills in both spoken and written English
- Experience with GANs is a plus
- Background on Computer Graphics & Augmented Reality, big data is a plus

### Project Description:

This post-doctoral position is proposed by [project DOS](#) (Détection d'Obstacles et lecture de Signalisation latérale) which is a cooperative project with SNCF, Alstom, Systra and IRT System X. This project's mission is to design innovative solutions to develop a system for automatic obstacles detection on tracks as well as reading railway traffic signals for further integration in an autonomous freight train. During the course of this project, hundreds of hours of videos have been recorded aboard a testing train through variegated weather conditions. This data was acquired for the reading of traffic signals but was also used as a basis in which obstacles were incrustated for obstacles or anomaly detection. The coverage and representativeness of this dataset is a key issue for using AI techniques in real-life situations, a particularly sensitive issue in a domain where safety issues are paramount.

Style transfer methods seem particularly appropriate to augment such dataset in a controlled manner, with or without incrustations, e.g. [2]. However, most style transfer techniques typically focus on artistic styles and art-related applications. Therefore, we anticipate challenges in trying to transfer a realistic style onto a real image/video-frame where artefacts and deformations of the original image may be problematic, potentially rendering the data unusable for our problem. These difficulties are all the more important as the style transfer needs to be performed on video sequences rather than still images.

Depending on the candidate/s expertise, we are open to other solutions, such as graphics or augmented reality techniques. One possible avenue to be discussed during the project, according to the expertise of the candidate, is the integration of 3D virtual models of, possibly animated obstacles within the video footage, following an augmented reality methodology that can be used in VFX for instance [16]. A computer vision approach allowing to detect the main elements along the train trajectory as well as their depth, will be used to handle occlusion and the change of view angle. Finally the rendering of the 3D model will need to be made consistent with the environment following the mentioned style transfer methodology, or in adapting the rendering parameters.

### **Position requirements:**

The successful candidate will be expected to:

- Investigate state-of-the-art methods to identify those that might pertain to our problem and gather datasets that could be of use.
- Implement and test out these methods, and generate new sequences from our data; offer improvements to these methods.
- Measure the side effects of these techniques and present metrics to evaluate the relevance of these approaches in our demanding context.
- If applicable, publish the findings in international journals/conferences.

### **About:**

The project will take place at IRT System X and GeoViC team at Ecole Polytechnique. IRT System X is a research institute devoted to bringing innovative solutions to the industry in the field of digital technologies and nurturing research collaborations between industries and academics. The post-doctorate will join the team DATA/AI at the IRT SystemX. Ecole Polytechnique is one of the most prestigious and selective universities in France. The GeoViC team is the vision and graphics team of Ecole Polytechnique. Both institutes are located in Palaiseau, France at the center of the premier research campus in France.

### **We offer:**

- Exciting and challenging work making a difference to society with real-life applications.
- Two highly-technical and international teams composed of students, researchers, IT support, engineers.
- A creative, dedicated and friendly working environment.
- Full-time 12-months contract starting from March/May 2021.
- A large degree of freedom, flexible working hours with the possibility for part-time remote work.

### **How to apply:**

To apply, please contact Sarah Lannes and Raphael Braud at [sarah@irt-systemx.fr](mailto:sarah@irt-systemx.fr) and [raphael@irt-systemx.fr](mailto:raphael@irt-systemx.fr), and Vicky Kalogeiton at [vicky@polytechnique.edu](mailto:vicky@polytechnique.edu) with “[Video Style transfer post-doc]” in the subject line and please provide a (1) CV, (2) a short statement of research interest and (3) the contact of two references. We particularly encourage applications from women, and from underrepresented groups in academia.

## References:

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