Université de Rennes

Appel à projets - Année 2025

Contrats doctoraux «Ordinaires»

Direction de la Recherche et de l'Innovation

ECOLE DOCTORALE : MATISSE **POLE DE RECHERCHE : INFORMATIQUE**

Unité de recherche d'accueil

Unité de Recherche : IRISA UMR CNRS 6074

Equipe : VIRTUS

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HDR : □ oui X non (en cours) **Nb de thèses en cours** : 2 en co-encadrement

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Sujet

Titre : LIGHTING ESTIMATION FROM IMAGES FOR SEAMLESS INTEGRATION OF VIRTUAL OBJECTS INTO REAL SCENES

Mots clés : Virtual Production, Image-Based Rendering, Computer Graphics, Real-Time Visual Effects

Cotutelle internationale (oui/non) : non **Si oui, préciser l'établissement et le pays de rattachement** :

Descriptif (15-30 lignes) :
Contexte socioéconomique et scientifique ; Les hypothèses et questions posées ; Les grandes étapes de la thèse et démarche ; Approches méthodologiques et techniques envisagées

The objective of this thesis is to work on new techniques for estimating the position, orientation and intensity of light sources from videos, to seamlessly integrate virtual objects into real scenes.
Past year, a preliminary work has been achieved using single images as input. It allowed us to estimate the global illumination of a real scene. The first step computed an HDR panorama from a single image [2], whilst an approximation of the 3D model of the scene was obtained using AnyDepth. By reprojecting the estimated HDR panorama onto the 3D model, we generate a first approximation of the global illumination and thus insert virtual objects into real scenes in a photorealistic and visually plausible way, using Unreal Engine.

We propose here to build on this work by first improving the current limitations and then generalizing the approach. The first step is to be able to work from videos where the lighting is dynamic. The key challenge lays in the ability to generate temporally stable light estimations over the sequence. A second step is to design a validation framework to assess the preciseness of the light reconstruction and the quality of the generated results, typically by using the ground truth generated by a game engine such as Unreal Engine (UE). Additional extensions would include the possibility to have a multi-pass rendering approach where the synthetic objects illumination also impacts the real scenes (consider for example the color bleeding of a virtual red sphere over a real white wall).

In addition to the previous research directions, to improve the generalization capacity the thesis will also focus on exploring techniques using radiance scene representations such as 3D Gaussian Splatting to model more precise light behaviors than emissive meshes and also explore how diffusion-based techniques could be adapted to handle light sources estimation, in the way ray diffusion is used to perform camera pose estimation. The application of the results to real scenes will be then investigated, either from single images or 360 videos provided by VFX companies and movie productions.

➢ **Ce document est à renvoyer par la direction de l'unité de Recherche aux animateurs du Pole Recherche et à l'école Doctorale pour le 13 février 2025 au plus tard**