A propos du centre ou de la direction fonctionnelle

The Inria Sophia Antipolis - Méditerranée center counts 34 research teams as well as 7 support departments. The center's staff (about 500 people including 320 Inria employees) is made up of scientists of different nationalities (250 foreigners of 50 nationalities), engineers, technicians and administrative staff. 1/3 of the staff are civil servants, the others are contractual agents. The majority of the center's research teams are located in Sophia Antipolis and Nice in the Alpes-Maritimes. Four teams are based in Montpellier and two teams are hosted in Bologna in Italy and Athens. The Center is a founding member of Université Côte d'Azur and partner of the I-site MUSE supported by the University of Montpellier.

Contexte et atouts du poste

The internship will take place at Inria Sophia Antipolis in the GRAPHDECO group (http://team.inria.fr/graphdeco). Inria will provide a monthly stipend of around 1100 euros for EU citizen in their final year of master, and 400 euros for other candidates. The internship will be at least partly on site if possible at the time.

Please also see here: https://team.inria.fr/graphdeco/files/2021/10/PointBasedNeuralRendering.pdf

Mission confiée

Context and goal

Recently, neural rendering [4] has seen an explosion in novel research results [5,6,8,9], many of which are centered around volumetric approaches where a Multi-layer Perceptron (MLP) is used to encode the radiance field in a scene, aka NeRF [3] (Fig. 1a). These representations have many advantages, notably the fact that they are naturally differentiable, simplifying training to reconstruct 3D geometry from photos. They can also handle (semi-)transparent objects, deal relatively well with reflections and moving highlights. However, in most scenes where these methods have been demonstrated, the content is almost entirely opaque surfaces. Consequently, the expensive volumetric ray-marching approach used for view synthesis seems conceptually wasteful.

In our recent work, we have shown that point-based representations [1,2] can actually perform better in some cases based on visual quality, while maintaining some, but not all of the advantages of volumetric NeRFs (Fig. 1b). An important benefit of point-based representations is that they are naturally suited to the display of opaque objects (as opposed to volumetric ray-marching), and amenable to fast rendering, completely compatible with the traditional graphics pipeline.

In this internship, we will develop novel solutions that exploit the advantages of both representations, leading to an algorithm that will on the one hand maintain the power and flexibility of NeRF to capture high-quality geometry and appearance representations of real objects during training, but will create a rendering-efficient, graphics-compatible point-based representation for rendering. The intern will work in collaboration with G. Kopanas, Ph.D. student in the group and first author of [1].

Principales activités

Approach

The internship will start with an analysis of the training process of NeRF, and in particular NeRF++, for the kind of real-world outdoors scenes we wish to treat (see [7] and Fig. 1). The group has already performed extensive experiments for other projects, and we have identified parts of the process that can be completely redesigned to avoid the costly step of volumetric ray-marching, replacing a significant part of the training process by operations on points. These points will be enhanced with features, in a manner analogous to [1]. We envisage a progressive algorithm that starts in a manner similar to standard NeRF to maintain all the advantages in terms of high-quality geometry reconstruction in difficult cases such as thin structures etc., and progressively transition the representation to a point-based solution that only maintains volumetric components when necessary.

The development of this algorithm faces many challenges. The first important challenge is to define the theoretical framework that will allow the algorithm to transition from volumetric to point-based without loss of rendering quality. Finally, the development of a mixed rendering algorithm that will seamlessly and efficiently support volumetric and point-based rendering is a major challenge.

References

Compétences

Candidates should have strong programming and mathematical skills as well as knowledge in computer graphics, geometry processing and machine learning, with experience in C++, OpenGL and GLSL on the graphics side, and pytorch for deep learning.

Avantages

- Subsidized meals
- Partial reimbursement of public transport costs
- Leave: 7 weeks of annual leave + 10 extra days off due to RTT (statutory reduction in working hours) + possibility of exceptional leave (sick children, moving home, etc.)
- Possibility of teleworking (after 6 months of employment) and flexible organization of working hours
- Professional equipment available (videoconferencing, loan of computer equipment, etc.)
- Social, cultural and sports events and activities
- Access to vocational training
- Social security coverage