A propos du centre ou de la direction fonctionnelle

Grenoble Rhône-Alpes Research Center groups together a few less than 800 people in 35 research teams and 9 research support departments.

Staff is localized on 5 campuses in Grenoble and Lyon, in close collaboration with labs, research and higher education institutions in Grenoble and Lyon, but also with the economic players in these areas.

Present in the fields of software, high-performance computing, Internet of things, image and data, but also simulation in oceanography and biology, it participates at the best level of international scientific achievements and collaborations in both Europe and the rest of the world.

Contexte et atouts du poste

The project will take place in the Maverick team at Inria and be supervised by Joelle Thollot and Romain Vergne.

Mission confiée

Context

When stylizing a 3D scene, a tradeoff always has to be chosen to control the temporal continuity, the motion coherence and the apparent flatness of the drawn marks [BBT11].

For instance, a texture applied in screen-space [MSB+17] has a good flatness property, but also produces the so-called “shower-door” effect that makes the motion of the texture incoherent according to the motion of the 3D objects in the scene. The same is true when using image filters. Even if relying on 3D scene properties (e.g. via the use of G-Buffers), it is extremely difficult to ensure a coherent motion of the marks, especially when effects have to be achieved outside the silhouettes of objects [BVHT18].

Alternatively, brush strokes may be directly anchored on the 3D surfaces (or proxies) in order to ensure a good motion coherence [SSGS11], but in that case, the apparent flatness of the brushes decreases and it is difficult to ensure temporal continuity when the objects are moving or deforming. Brushes are also usually static images that cannot easily adapt to changes in the 3D scene properties.

A good control of coherence and continuity can be achieved by using (fractal) procedural textures, as shown by Benard et al [BBT09]. However, such textures only allow for a very limited range of styles, where marks or brushes highly depend on the chosen noise and appear only in the rasterized footprint of the objects (not outside silhouettes).

Goal

The goal of the Post-doc. student will be to combine the advantages of both image- and object-space methods in order to better control the motion coherence and temporal continuity of the marks when objects are moving or deforming, while still being able to obtain a wide range of styles, from...
traditional 2D (flat) painterly or watercolor renderings to more 3D looks such as digital paintings. An example is given in the figure above, created during a preliminary work in a master project: it shows how a 2D flat “hair” pattern can be convoluted with a 3D noise computed on object surfaces to obtain a coherent, implicit and interactive digital fur painting.

Approach

The first step of the Post-doc candidate will then be to explore what are the main capabilities and user-controls offered by this implicit convolution approach: the final rendering depends on many properties such as the noise type, density, anisotropy, and the way it has been filtered, warped or thresholded. We think that it will be interesting to better understand how the styles are affected by the properties of the noise and those of the strokes. Adapted “infinite” noises (e.g. https://www.shadertoy.com/view/XlBXWw) will also have to be considered to control the density of the marks whatever the foreshortening or distance of the considered surfaces.

The second step will be to find the rules that have to be used to obtain different kind of styles. Such an approach could be used to design smart brushes and obtain more 3D looks (as in the figure) but also 2D painting looks (such as painterly or watercolor renderings). The properties of the strokes (perspective, rotations, colors, blending, etc) indeed directly affect the final appearance of the objects in the scene. We plan to precisely control the appearance of the strokes themselves that could also be generated procedurally to create the final rendering.

The proposed approach only relies on auxiliary and G-buffers and thus does not require original images to be re-rendered when changing the style. It could thus be easily integrated at the compositing stage of interactive to offline graphics applications. More generally, this project opens the questions of how to implicitly stylize 3D scenes using only 2.5D information, what spatial and temporal constraints should be ensured for a specific style and which controls should be given to users artists to easily obtain an intended result. We expect the candidate to explore all these aspects during his Post-doc.

Bibliography


Principales activités

- Bibliography
- Implementation of prototypes
- Writing and presenting research papers

Compétences

The candidate should have taken courses in computer graphics and have a good experience of C++, OpenGL + GLSL/Cuda programming. Experiences in procedural methods and expressive rendering techniques would also be appreciated.

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

Rémunération

Gross salary: 2653 Euros per month.