2.5D procedural stylization

Master degree subject - M2R - MOSIG - GVR

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Context. Brush strokes are widely used to design complex 3D stylization effects. By applying visual attributes along some paths, it is indeed possible to create various and plausible styles, as shown in the figure below (left). However, this technique also suffers from many limitations. Strokes have to be well spread to cover the entire surfaces (this can be done by hand or with automatic sampling methods). Depending on the target style, the stroke distribution may have to change when the camera or objects are in motion in order to keep the "flatness" look of the final rendering, requiring expensive algorithms to add, remove, or modify strokes on the surfaces. Finally, brushes are usually static images that cannot easily adapt to changes in the 3D scene properties. On the other hand, procedural noises can be used as guides to add details or apply filters on an image [BVHT18]. These methods easily dynamically adapt to object motions or deformations. However, they also suffer from temporal coherency issues when filters extend outside object silhouettes and the range of styles is often limited.
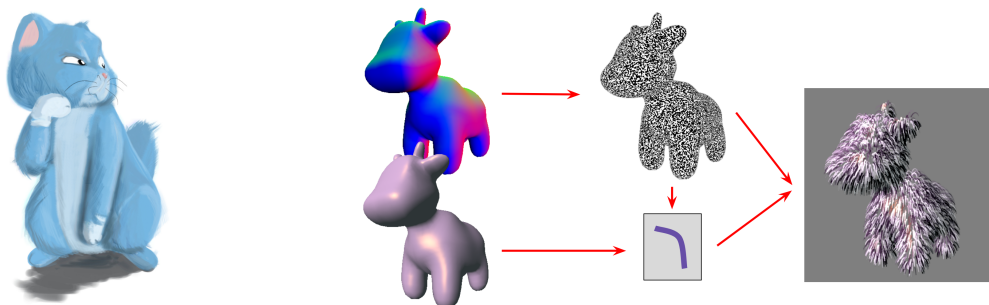
(a) Overcoat [SSGS11]　　　　　　　　　　　　(b) Proposed approach

Goal. The goal of this internship will be to try to combine the advantages of both methods in order to better control the variety and properties of the styles [BBT11]. As described in the figure (right), a procedural noise (evaluated on the fly), as well as other information (such as color map, normal map, etc) will be able to control how and where brushes are drawn. Splatting will be used to implicitly create the final look of the scene [VVC+11] and each brush may be generated using a proper procedure. For instance, plausible fur could be obtained by taking inspirations from the shadertoy website (e.g. https://www.shadertoy.com/view/XsfGWN).

Approach. A bibliography stage will first have to be made to explore the different techniques available to stylize a 3D scene and to better understand how complex appearance can be obtained in interactive applications (implicit approaches as in ShaderToy or explicit strokes that can be obtained in video-games for instance). The student will next have to design a proper graphics pipeline to obtain the desired effects (by programming on the GPU, using OpenGL and GLSL). Coherent (infinite) noises will have to be implemented to keep their frequencies constant whatever the zoom used in the scene (e.g. https://www.shadertoy.com/view/XlBXWw). Splats will then be instanciated per pixel. Each of them will contain a procedurally generated brush to obtain the final look of the scene. The size, length, color, shape and style of each stroke could be guided by input G-Buffers (e.g. normal map) and auxiliary buffers (e.g. noise map or color map). Particular attention will have to be paid to control the positions and the blending of the plats. An order-independant-transparency algorithm might be used to precisely control which strokes are in front and which ones are behind the others. A comparison with previous approaches will finally be done to assess the quality and impact of the proposed method. A specific style (such as plausible generation of dynamic fur) could be used as a proof of concept for the proposed solution.

References

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