Art-directable stylization of 3D animation trajectories

Location: Inria - Univ. Bordeaux, MANAO research team (http://manao.inria.fr)

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Duration: 4 to 6 months

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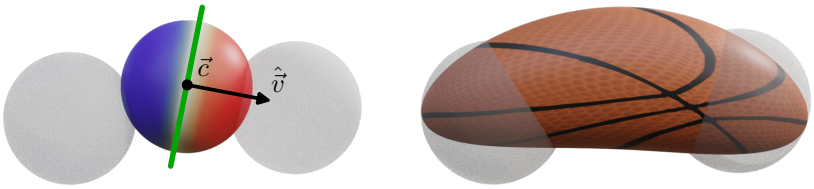
1 Motivation and Context

Smear frames are a stylization technique from traditional animation, designed to exaggerate the movement of a fast-moving object in order to expressively visualize its trajectory. In 2D, smear frames are created *e.g.* by stretching an object to cover the span of several frames (see Figure 1). This is more complex in 3D, as it requires to modify the surface of a 3D object. The Manao team has recently proposed SMEAR, a semi-automatic tool for creating smear frames for 3D animations, which offers numerous options for artistic control of the effects created [1]. A video demonstration of the tool is available at this address, and an implementation for Blender at this repository.

This approach works in two steps. We first compute spatially and temporally coherent motion offsets that describe to which extent parts of the input mesh should be leading in front or trailing behind. We then describe a framework to stylize these motion offsets in order to produce smear frames at an interactive rate, *e.g.* by stretching the surface of the object along its trajectory proportionally to its motion offsets (see Figure 2). This stylization is mainly based on the speed of the points of the object. When the trajectory of the object has important overlapping, such as in animations with impacts or strong rotations, this stretching can result in important self-intersections.

Figure 1: Example of smear frames in traditional 2D animation, "The Dover Boys at Pimento Academy", directed by Charles M. Jones (public domain).



(a) Motion offsets computed with our method.

(b) Elongated in-between.

Figure 2: Motion offsets, separation plane (in green), and corresponding stylization for a bouncing ball. Positive (resp. negative) motion offsets are painted red (resp. blue).

2 Objective

The goal of this internship is to propose new art-directable stylization techniques based on the SMEAR tool to create interesting smear frames effects in animations with important trajectory overlaps. The new techniques will be implemented in the existing add-on, using Blender's Python API and Geometry Nodes. **The first objective will be to study properties of the trajectories of the points composing the objects.** For example, the presence of discontinuities along the trajectories can indicate impacts, and differential properties of groups of trajectories (divergence, curl) can inform on the object's rotation. **The next step will be to explore the impact of these parameters on the perception of the animations, in order to propose new stylizations based on this information**, inspired by examples from traditional animation (*e.g.* Richard William's tutorials [2]).

Depending on the advancement of the internship and the student, other directions can be explored, such as extending stylization to non-rigid objects such as clothes or hair, or using sound to control the stylization.

3 Expected Skills

The successful candidate should have taken Master courses in Computer Graphics and have a strong experience in python programming. Additional skills in some of the following topics would be appreciated: computer vision, user interface, Blender's Geometry Nodes. Personal interest for 3D animation would be a plus.

References

[1] Basset, J., Bénard, P., and Barla, P. Smear: Stylized motion exaggeration with art-direction. In *ACM SIGGRAPH 2024 Conference Papers* (2024), pp. 1–11.

[2] Williams, R. *The Animator's Survival Kit.* Faber & Faber, 2001.