COMPUTER-ASSISTED ROUGH 2D ANIMATION

Keywords: animation, sketching, interpolation, deformation, computer graphics

Figure 1: Three rough drawings of a monkey character used to plan a 2D animation. The goal of the project is to produce in-between drawings in a similar style on the fly, hence providing instant visual feedback to 2D artists.

Scientific priorities

Human-centered digital world

Scientific research context

Despite the prevalence of 3D computer graphics tools in the creation of animated movies, 2D techniques are still used because of their unique look and feel. However, they require time and dedication since tens of thousands of frames need to be drawn by hand for a typical animation. There is thus a need for computer tools that not only to speed-up but also to ease the creation process and help swiftly explore different animation choices and motion designs.

In particular, 2D animation requires a lot of planing, not only at the level of storyboards, but also for animation itself where so-called rough drawings (see Figure 1) are used to test out different character or special effect (water, smoke) motions. This is a crucial step of the 2D animation process [1]: even though the rough animation itself is not directly visible in the final movie, its impact on the final motion design is vividly retained.

Rough animations remain tedious to produce (several hours of work for a few minutes). Computer-assisted solutions are thus needed that could provide direct feedback at intermediate frames between key rough drawings, granting new artistic exploration possibilities. However, this should not be done at the expense of artistic practices: the proposed solution should be compatible with traditional animation workflows.

Previous work in computer-assisted 2D animation (e.g., [2,3]) rather addressed issues raised with the production of clean-line animations. They have thus focused on so-called tight in-betweening, where keyframes that are very close in time must be interpolated to get a smooth motion; however, at this stage, motion has already been designed. In contrast, we consider keyframes over large time intervals, in potentially very different poses, targeting interactive feedback solutions that give artists the ability to design motion on the fly.
**Work description**

The main goal of this post-doc is to provide animation artists with a non-linear interactive approach, whereby a full 2D rough animation is updated after each artist input (e.g., new key drawing, change of trajectory, of timing, etc). This should work for the two common types of animation workflows: straight-ahead, where a keyframe is drawn, then deformed and redrawn at a later keyframe; and pose-to-pose, where separate keyframes are drawn and the motion trajectories between them is specified. Ideally, both workflows could be mixed.

The developed solution will rely on the degrees of freedom afforded by rough drawings, namely the less precise localization of strokes (they may even overlap), as illustrated in Figure 1. Moreover, we will not strive for temporal coherence at the stroke level, but rather synthesize stroke distributions that might “jitter” from frame to frame but still convey the intended motion. Multiple strokes might represent the same underlying curve, hence we will consider the grouping of strokes, adapting existing techniques (e.g., [4]) to our context. The merging and separation of groups from keyframe to keyframe (i.e., topological changes) will be considered in a second time.

A first challenge will consist in identifying the curves implicitly formed by stroke groups in each keyframe, followed by the estimation of correspondences between curves at successive frames. In this respect, we plan to start with the straight-ahead workflow as it seems easier to establish correspondences in this case. The pose-to-pose workflow will be addressed in a second time, relying on existing deformation & registration tools such as As-Rigid-As-Possible (ARAP) interpolation [5], adapted to the specific constraints of rough animation.

A second challenge will lie in the analysis of stroke distribution properties: how much they overlap, their density, looping, spreading apart, etc. Given such a parametric description, our aim will be to synthesize stroke distributions at intermediate frames, interpolating the distribution parameters from the same stroke group at different keyframes. Changes in topology will be dealt with by specific merging/separation events occurring at keyframes.

**Required knowledge and background**

The successful post-doc candidate should have taken courses in Computer Graphics and/or Computer Vision, and have a good experience in C++ programming. An experience in either sketch-based techniques or expressive rendering is required. Personal interest for drawing and 2D animation would be a plus.

**Duration:** 12 months (starting from October 2019)

**References**


