

2D ANIMATION PREVIEW: ROUGH DRAWINGS INTERPOLATION

Location: Inria Bordeaux Sud-Ouest, MANAO research team (<http://manao.inria.fr>)

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Context

In 2D cartoon animation, the inbetweening process consists in drawing intermediate images between keyframes (Figure 1). The key drawings define the main motion (character poses for instance); the goal of the inbetweens is to produce the illusion of a continuous motion between those keys [1]. Successful animation requires 12 to 24 drawings per second, making inbetweening highly labor intensive.

Computer-animation tools have been proposed (e.g., [2,3]) to mimic the pose-to-pose process, trying to partially automatize the inbetweening step through strokes interpolation (Figure 1). They usually represent the drawings as a graph of strokes, and either try to match those graphs at subsequent keyframes [2] – which can be very difficult when their topology changes – or build those correspondences by construction during user interactions [3].

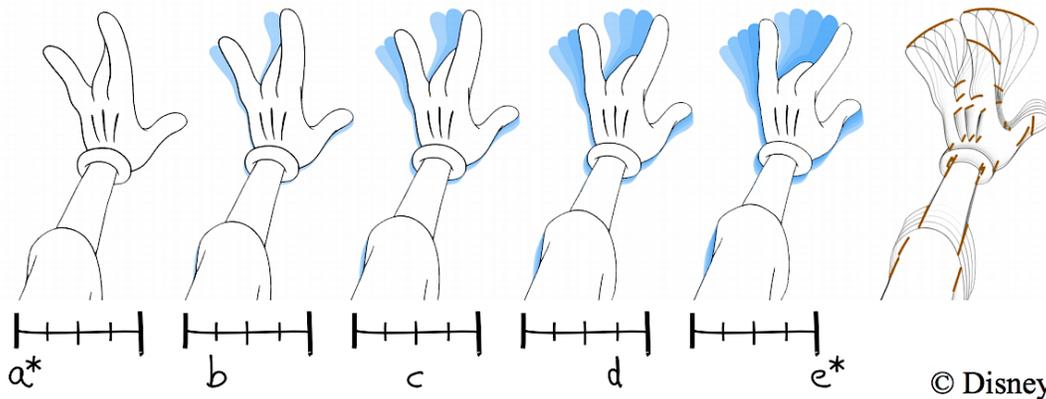


Figure 1: Images (a) and (e) are the keyframes. The inbetweens (b-d) are automatically generated using [2]. The rightmost figure superposes the 5 frames and visualizes the interpolation trajectories.

Unfortunately, those approaches only support clean smooth input networks of curves and relatively tight time interval between key drawings. In addition, they provide limited drawing and animation controls. These methods are thus not suitable for the very first stages of the 2D animation process that commonly involve very sketchy drawings (a.k.a., roughs) sparsely spread in time.

Goals

The overall goal of this internship will be to develop a novel technique to interpolate between rough raster drawings to generate interactive preview animations at the earliest stage of their creation. It requires to solve two main problems: sketch registration and morphing (i.e., warping and blending) [4].

To make these challenging problems more trackable, we propose to leverage a common practice in 2D animation which consists in drawing *lines of action (LOA)* that describe the main curve and force of a character (Figure 2). LOA have been used in past research as an intuitive interface for 3D character posing [5] and animation [6]. In our context, we could also leverage such LOA to guide both the registration and warping steps. For instance, they could be used to control an As-Rigid-As-Possible (ARAP) deformation algorithm, such as the one of Sýkora et al. [7]. Implementing such an approach will be the first task of this internship.

However, to generate relevant preview animations, the artist must be able to finely control the trajectories of those LOA through time. The second task of this internship will be to develop intuitive tools to edit those trajectories.

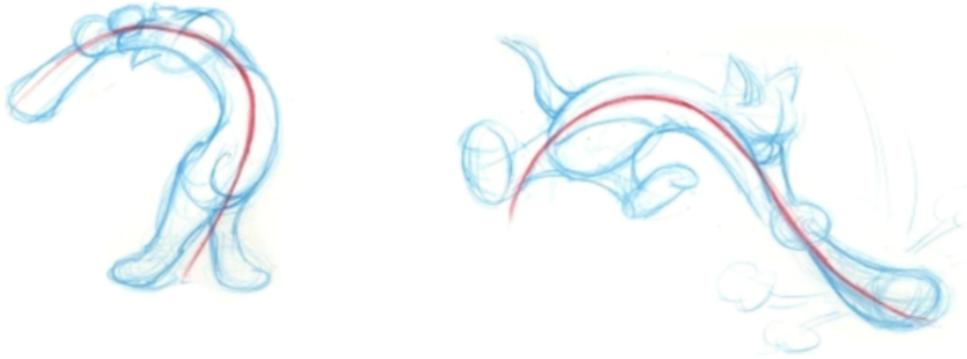


Figure 2: Drawings from Preston Blair's book *Cartoon Animation*. ©The Estate of Preston Blair.

Regarding the final blending step, uniform alpha-blending traditionally used for raster images is not well-suited for sketches as misaligned strokes produce severe ghosting artifacts. The final task of this internship will be to investigate alternative blending approaches that better preserve the look-and-feel of the input drawings.

Requirements

The successful candidate should have taken Master courses in Computer Graphics and have a strong experience in C++ programming. Additional skills in some of the following topics would be appreciated: expressive rendering, user interface, numerical optimization. Personal interest for drawing and 2D animation would be a plus.

References

- [1] Richard Williams. **The Animator's Survival Kit: A Manual of Methods, Principles and Formulas for Classical, Computer, Games, Stop Motion and Internet Animators**. Faber & Faber Inc. 2009. <http://www.theanimatorsurvivalkit.com>
- [2] Brian Whited, Gioacchino Noris, Maryann Simmons, Robert Sumner, Makus Gross, Jarek Rossignac. **BetweenIT: An Interactive Tool for Tight Inbetweening**. *Computer Graphics Forum*, 2010.
- [3] Boris Dalstein, Rémi Ronfard, Michiel van de Panne. **Vector Graphics Animation with Time-Varying Topology**. *ACM Transactions on Graphics*, 34, 4 (SIGGRAPH 2015).
- [4] Rahul Arora, Ishan Darolia, Vinay P. Namboodiri, Karan Singh, Adrien Bousseau. **SketchSoup: Exploratory Ideation Using Design Sketches**. *Computer Graphics Forum*, 2017.
- [5] Martin Guay, Marie-Paule Cani, Rémi Ronfard. **The line of action: an intuitive interface for expressive character posing**. *ACM Transactions on Graphics (SIGGRAPH 2013)*.
- [6] Martin Guay, Rémi Ronfard, Michael Gleicher, Marie-Paule Cani. **Space-time sketching of character animation**. *ACM Transactions on Graphics (SIGGRAPH 2015)*.
- [7] Daniel Sýkora, John Dingliana, Steven Collins. **As-Rigid-As-Possible Image Registration for Hand-drawn Cartoon Animations**. *NPAR 2009*