Synthesizing Structured Doodle Hybrids

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Motivation

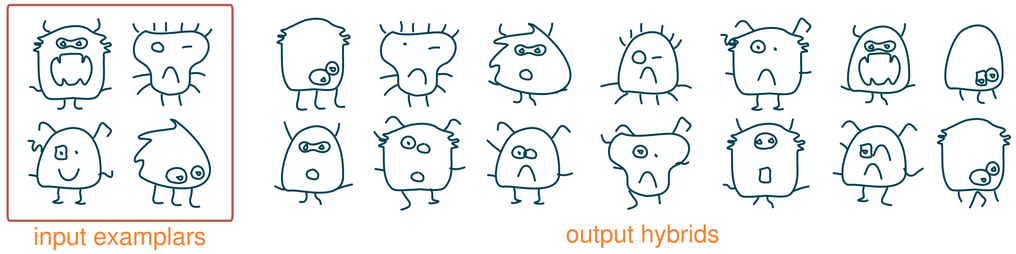
Creating large sets of similar objects is a common problem in many applications such as games, animation and illustration. Generally, cloning objects is not a decent solution. The issue then boils down to creating objects that are **similar, yet not identical to**, existing ones. This issue, known as **shape synthesis**, has been recently tackled in Computer Graphics for 2D images [Risser, 2010] and 3D objects [Kalogerakis, 2012]. Based on a few given examples, an automatic algorithm produces new objects that respect the above requirement. In this work, we propose an approach that deals with simple line-drawings, or **doodles**.

Previously, *Latent Doodle Space* proposes to embed given examplars in a feature space where interpolation can take place [Baxter, 2006]. Although capable of impressive results, but due to its interpolation scheme, this approach does not create new objects as combinations of some input doodles' subparts. Besides, in order for the interpolation to give continuously consistent results, their method requires the user to correct some of the stroke correspondences.

Our Contribution

We propose a jitter/correction approach producing discrete combinations of input strokes:

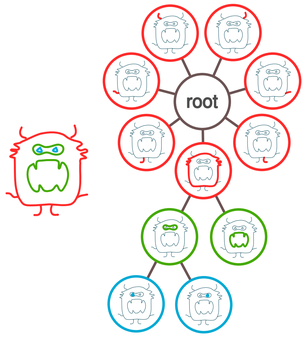
- Starting from one of the input doodles, we exchange each stroke by **jittering** it in a convenient feature space that gathers all input doodles' strokes.
- A geometric **relaxation** step ensures that the local spatial organization of the strokes is still plausible with respect to the given examplars.



Our Method

Inclusion Tree

A doodle is a collection of 1D strokes. A natural and practical data representation for strokes are cubic Bezier curves holding some style information such as color, etc. The counterpart of using a vector representation is the loss of the pixel grid that naturally structures the information of raster images. In order to infer a plausible doodle structure, we build an inclusion tree based on the **pairwise relative overlap** between the strokes' convex hulls. If the convex hull of one stroke has more than 50% of its area over another one, we consider it as included in the latter.

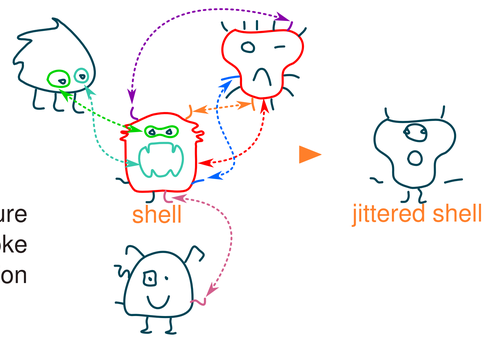


Jittering

Starting from one of the input doodles, or shell doodle, our method consists in exchanging each stroke from the shell with another doodle stroke similar in terms of:

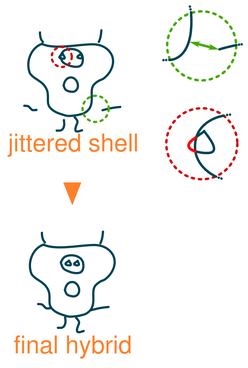
- **inclusion genealogy**, measured by its number of parents and children in its associated doodle's tree
- **path similarity**, estimated by the matching error given by thin plate spline warping.

The new stroke is randomly picked out in a nearby feature volume regarding these two features, around the shell stroke values. Finally, the new stroke is axis-aligned along the direction of the considered shell stroke.

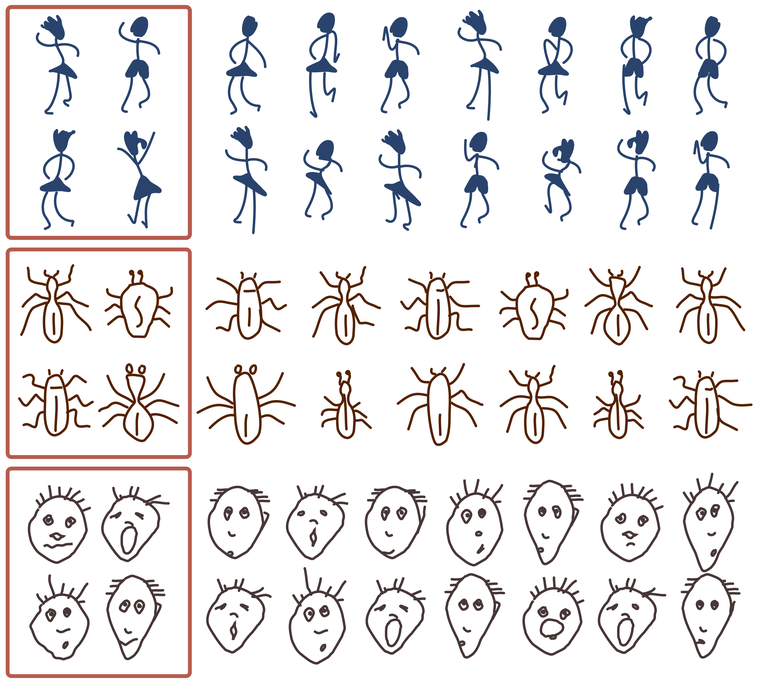


Spatial Relaxation

Once all shell strokes have been exchanged, the new doodle has inherited a plausible overall structure. Yet, the relative position of each stroke needs to be corrected, as the spatial extents of our hybrid doodle's strokes are likely to differ from the shell doodle's. We use a bottom-up relaxation method that goes from each leaf of the inclusion tree to its highest parent. Each node, along with its children, is translated respectively to its parent if any, or its nearest neighbor among its siblings otherwise. A **corrective translation vector** is then computed by equalizing the current distance and the distance observed within the shell. We use the Euclidean minimal distance between two strokes if they do not cross, or a symmetrized Hausdorff distance estimating the mutual penetration otherwise.

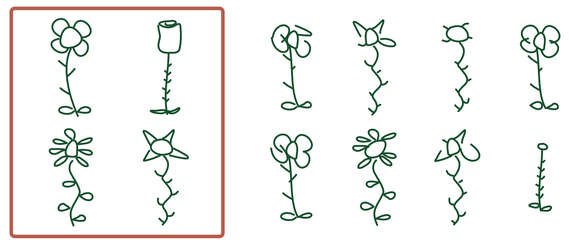


More Results



Future Work

By adjusting only one distance per stroke, the relaxation step does not handle complex drawings, where a strokes cross or connect others at multiple locations. We plan to tackle this limitation by using a **multiple anchor point** scheme.



References

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