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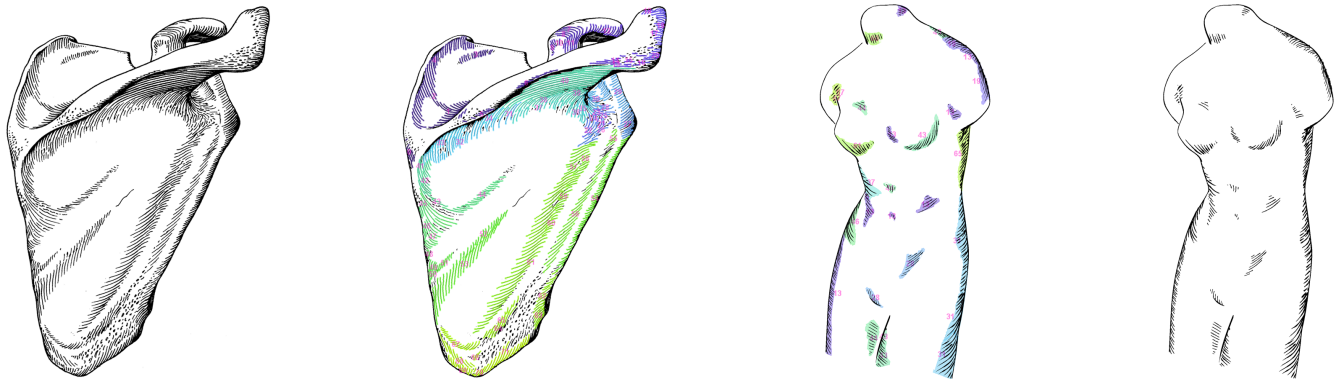
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# Visual Showcase: Interactive Example-based Hatching

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**Figure 1:** We learn the hatching style from a hand-drawn example (left) and use it to synthesize example-based hatching illustrations (right).

## Abstract

We exhibit two printouts of computer-generated pen-and-ink hatching illustrations. These illustrations were created semi-automatically using an interactive example-based hatching method [Gerl and Isenberg 2013]. We would need space for two picture frames of 30 cm × 30 cm.

## 1 Introduction

We present results of a hatching method that incorporates human virtuosity into the computer generation of pen-and-ink hatching illustrations. The method aims at improving upon the aesthetic appeal of such imagery. Our method facilitates influence on the illustrative rendering result by human virtuosity in two ways. First, our approach is example-based and allows us to transfer the hatching styled learned from hand-drawn and scanned-in examples to new 3D objects. Second, our approach is interactive and allows users to modify the result according to their needs and preferences. We briefly outline these two functionalities below.

## 2 Example-based Hatching

We use image processing and machine learning to learn a model of the drawing style present in a hand-drawn example illustration. We detect the trajectories of the strokes in an example illustration in a pre-processing step. We then use a 3D model registered with the example illustration to infer 3D information related to the 2D drawing elements. Using this setup, we employ machine learning to learn how the hatching regions, hatching directions, and local distances between neighboring strokes correspond to surface and lighting properties. These correlations are learned in a manner such that the hatching properties can be inferred from the surface and lighting properties during the object-space synthesis of new hatching illustrations. Finally, we transfer low-level properties such as the width and shape of individual hatching strokes on a pixel basis using texturing. The resulting illustration can be interactively modified by the user as outlined next.

## 3 Interaction Capabilities

Our approach provides four different user interactions that facilitate an interactive modification of the result. These interactions allow users to improve the aesthetic quality of the generated illustrations and to adjust the result according to their requirements. Our interactions are facilitated by object-space representations of drawing elements. One of these representations are surface patches, which are sets of connected triangles that we use as the basis for generating hatching strokes on the surface. The final illustration consists of a set of such hatching patches. As a first user interaction, the type of strokes that are generated within one of the described hatching patches can be modified by the user. As a second interaction, the general hatching direction within each of the hatching patches can be rotated. The third interaction is a set of brushing tools that allows users to modify the directions of hatching strokes via brushing. The fourth interaction allows users to brush with patches of hatching strokes. This key interaction can be used to add, reshape, or remove patches of hatching strokes. We made use of all of these interactions while semi-automatically creating our results.

## 4 Examples

The two images that we exhibit are shown on the following pages: illustrations of a vertebra and of a hip bone. Both images use a hatching style that we learned from a hand-drawn illustration in an anatomy textbook [Dauber et al. 2005] (a shoulder blade illustration, left in Figure 1). These images exemplify how the specific hatching style of an illustrator can be captured and re-applied to new shapes, how interactive example-based hatching can be applied to medical illustration, and how people who have little training in pen-and-ink hatching can create aesthetically pleasing medical illustrations with a semi-automatic illustration tool.

## References

- DAUBER, W., SPITZER, G., AND FENEIS, H. 2005. *Feneis' Bild-Lexikon der Anatomie*, 9<sup>th</sup> ed. Georg Thieme Verlag.
- GERL, M., AND ISENBERG, T. 2013. Interactive Example-Based Hatching. *Computers & Graphics* 37, 1–2 (Feb.–Apr.), 65–80. DOI: 10.1016/j.cag.2012.11.003

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