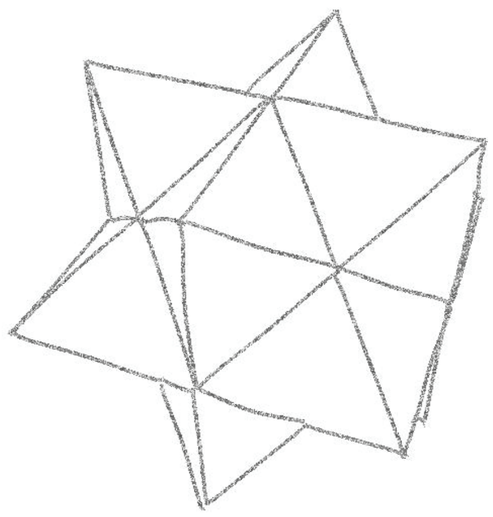
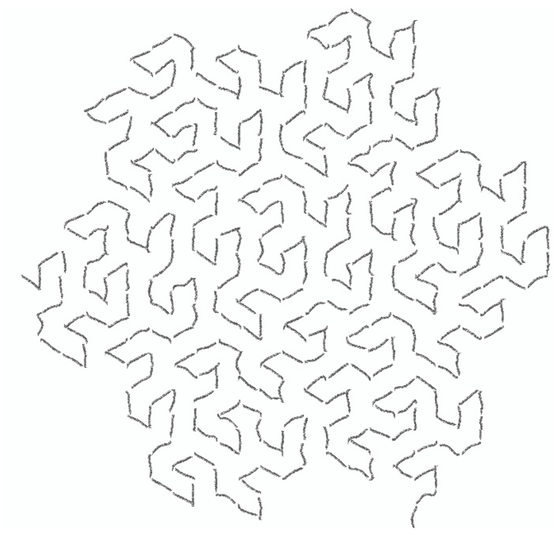
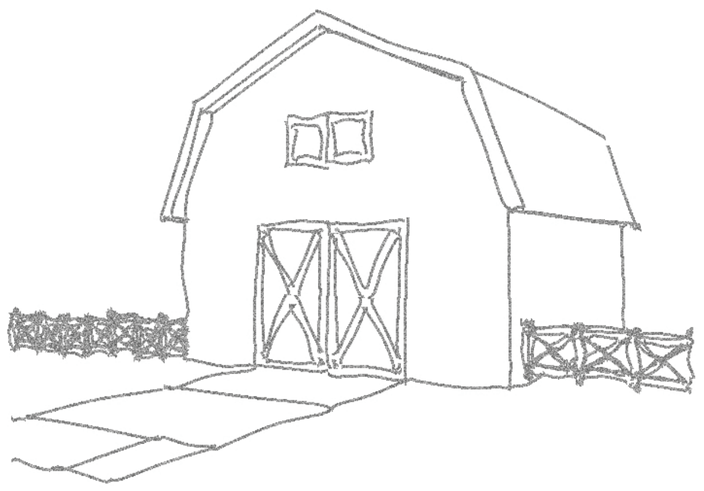
# Mimicking Hand-Drawn Pencil Lines

Zainab Meraj  Brian Wyvill  Tobias Isenberg  Amy Gooch  Richard Guy







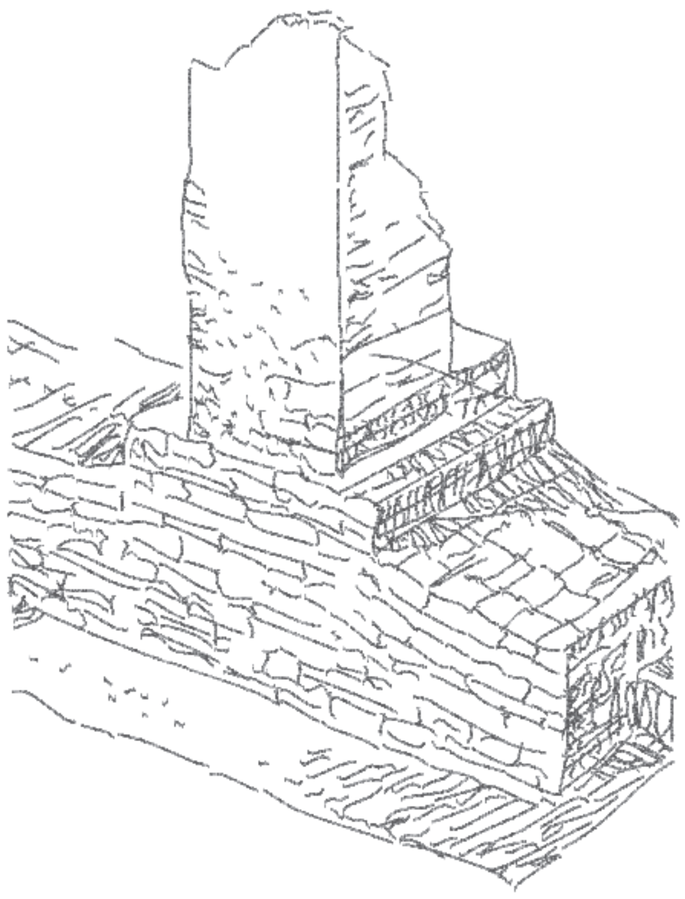
## Goal

- to capture the essence of a single stroke drawn by humans as straight pencil lines of arbitrary length, and encode it into an algorithm to generate strokes.

- produce a lines resembling human-drawn lines, and use them to replace traditional computer-drawn lines (e.g. [Bresenham 1965]).

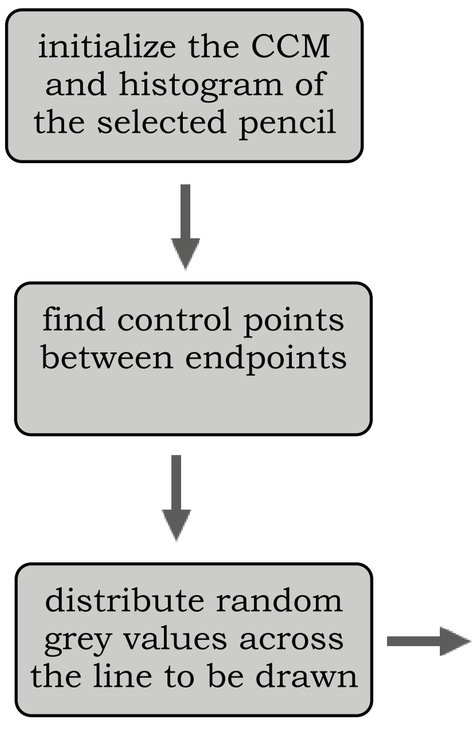
## Path

The Flash and Hogan [1985] arm trajectory model is used as it provides a smooth motion "to bring the hand from an initial position to a final position in a given time" .
Each two points that are read into the system are used to specify the start and end position of the path to be generated.
We add a "squiggle" parameter as a slight deviation from the original path.



## Texture

We simulate 2H,H,HB,F,B,3B,6B, and 8B pencils.
The textural properties of the pencil are pre-calculated by collecting the histograms of grey-levels and the co-occurrence matrix (CCM) off original pencil scans.
A grey value distribution technique is formulated according to these statistical observations. The synthesis is them achieved by placing and manipulating grey values along the path.




## Algorithm Design

The Human Line Algorithm (HLA) is comprises two stages:

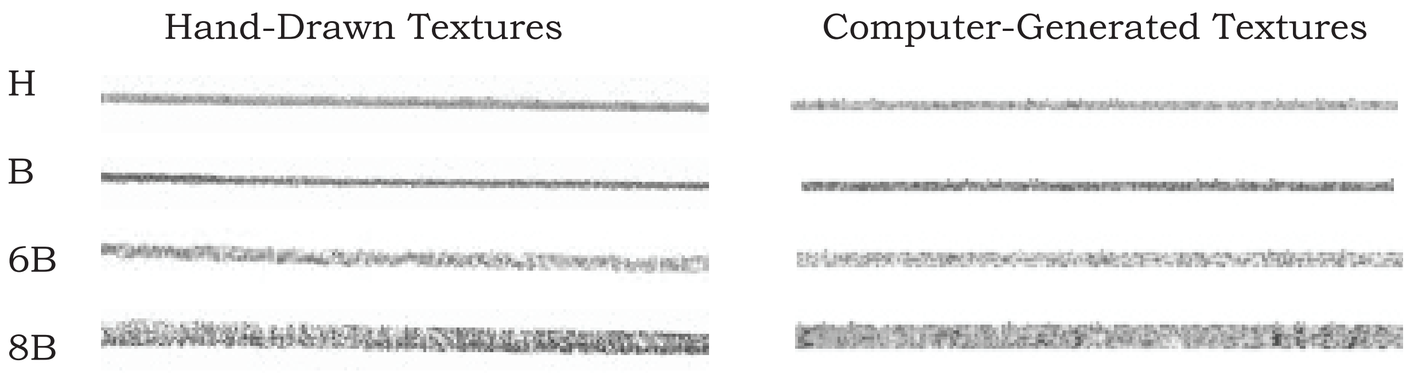
(a) synthesizing a path that corresponds to natural human arm movement.

(b) synthesizing a pencil texture along this path.

The composition of both stages results in an efficient method to produce realistic hand-drawn pencil lines.

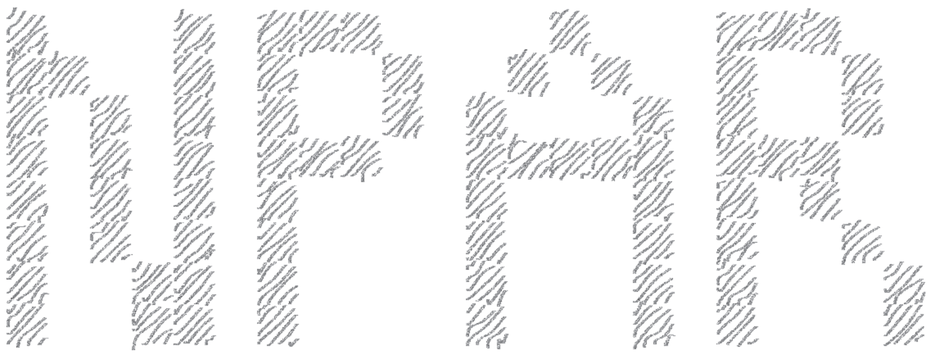
## Results

A comparison between hand-drawn lines and synthesized lines (below) shows that the approach is successful in mimicking hand-drawn pencil lines. We also conduct a use study to confirm our results. A paired sample t-test showed that our computer-generated lines were significantly more often thought to be hand-drawn than the other way around (paired $t(11) = 2.849; p < .05$).




## Conclusion

We provide a system that will serve as a high quality pencil media line reproduction agent for creating aesthetically pleasing lines that mimic human-drawn lines.
The method avoids computationally expensive techniques and large storage space.
The system is not intended to replace artists or illustration, but to provide a tool for users with no training to produce traditional images using a pencil medium.



## Example Applications

- space filling curves
- architectural drawings (CAD, Google Sketch Up)
- Life Game patterns
- reproduction of artists drawings

University of Victoria
university of groningen
UNIVERSITY OF CALGARY

**Contact:**
Zainab Meraj (zmeraj@cs.uvic.ca)
University of Victoria, BC, Canada

NSERC CRSNG