The Choices We Make

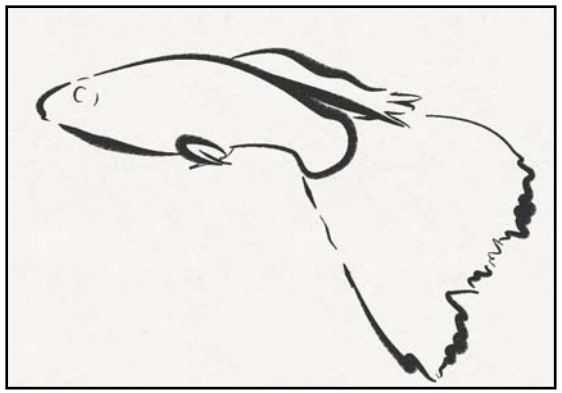
Frédo Durand

MIT CSAIL

Introduction

- **My background**
  - Math/CS
  - I have read much perception litterature
  - Amateur photographer
  - No artistic training, terrible draftsman
- **Two example projects**
  - Photography tonal management

  - Line drawing from 3D models



Introduction

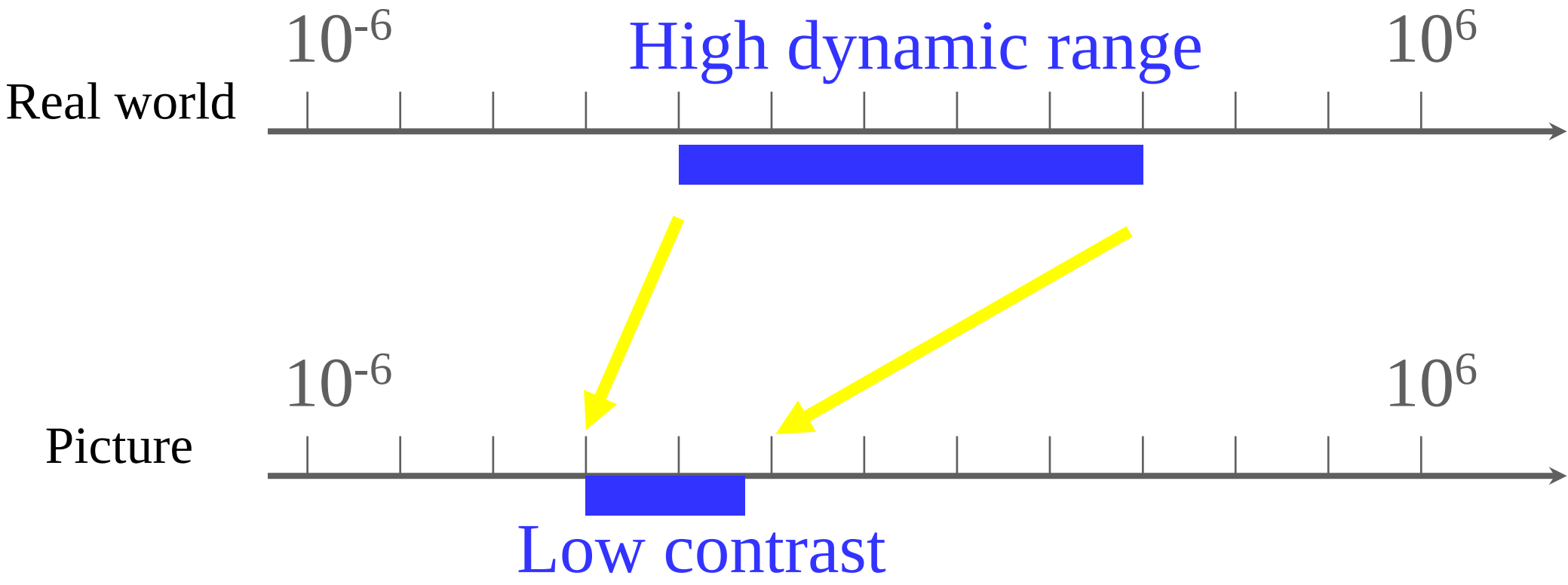
- **I don't build tools, I am an academic researcher, my deliverables are articles, not software**
  - But it's not a complete excuse to write about useless tools
- **Two types of "consumers/users"**
  - Computer scientists who implement/extend my techniques
    - Do they understand choices I made, choices they can make?
  - En-users who use these tools
    - Are my choices relevant to them?

Tonal management

- **Over and under-exposure is the largest cause of bad photographs**
  - Here's a choice I make!
- **Both for professional and consumers**

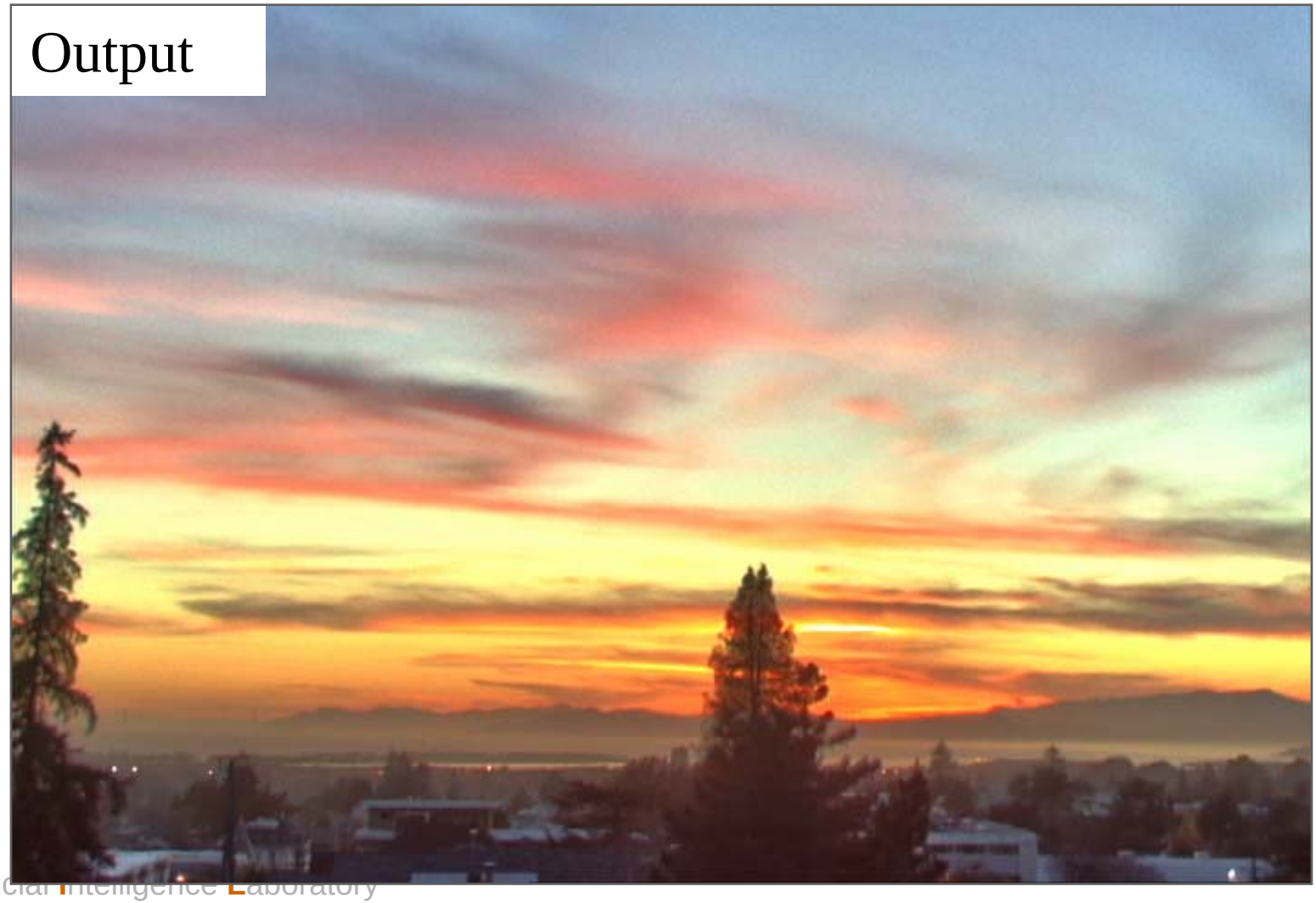
High Dynamic Range

- **Real-world contrast is high**
- **Display contrast is low**

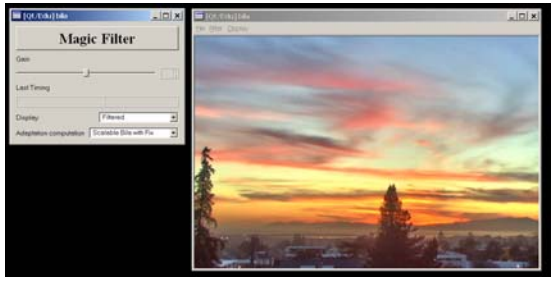


Our approach

- **Non-linear two-scale decomposition**
- **Reduce contrast of large scale; preserve local detail**

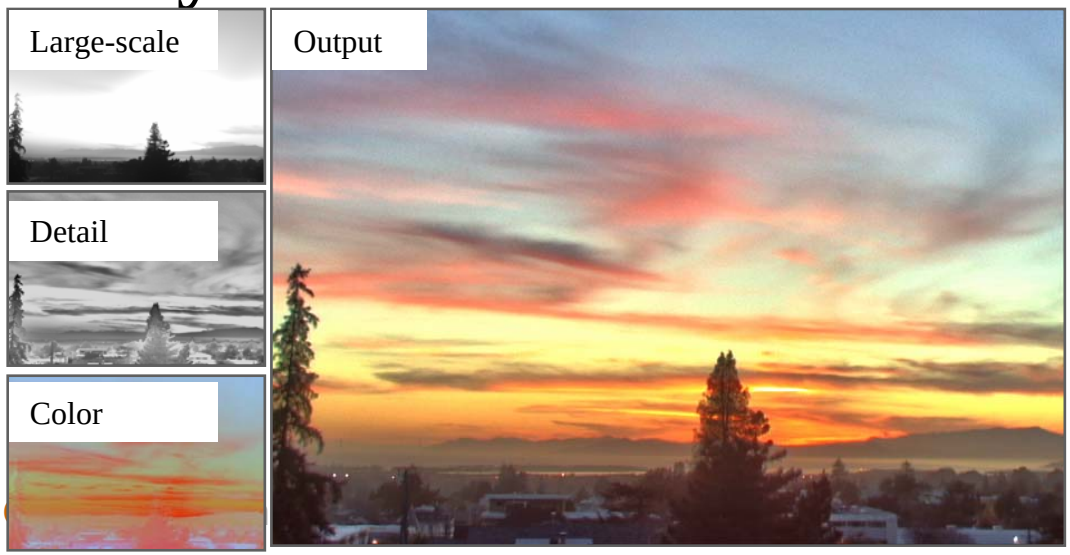


Live demo



Choices I made

- **Decomposition: my contribution**
- **Compute in log space: I have good reasons**
- **How to separate intensity/color - incidental**
- **How to reduce large-scale layer – incidental**
- **Parameters I expose**
- **Default parameters – matter of taste**
- **Maybe other choices I don't realize I made**



Anecdote about tone mapping evaluation

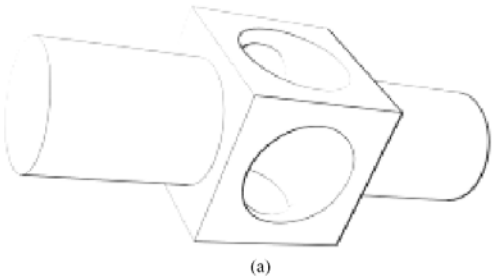
- **Recent work has performed user experiments to evaluate competing tone mapping operators**
  - [Ledda et al. 2005, Kuang et al. 2004]
- **Interestingly, the former concludes my method is the worst, the latter that my method is the best!**
  - They choose to test a different criterion: fidelity vs. preference
- **More importantly, they focus on algorithm and ignore parameters**

A programmable approach to Line Drawing

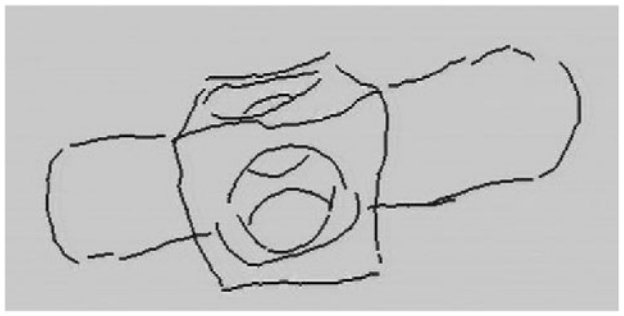
With Stephane Grabli, Emmanuel Turquin & François Sillion

Motivation: Style vs. Technique

- **Non-Photorealistic Rendering**
  - Imitate traditional media
- **Each paper focuses on one particular style, which is usually hardcode with a only few available parameters**
- **Stylistic choices mixed with technical ones**

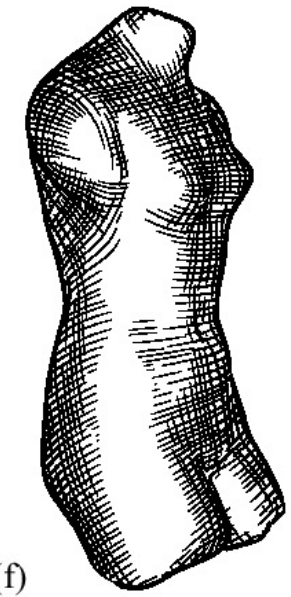


(a)



(b)

(d)



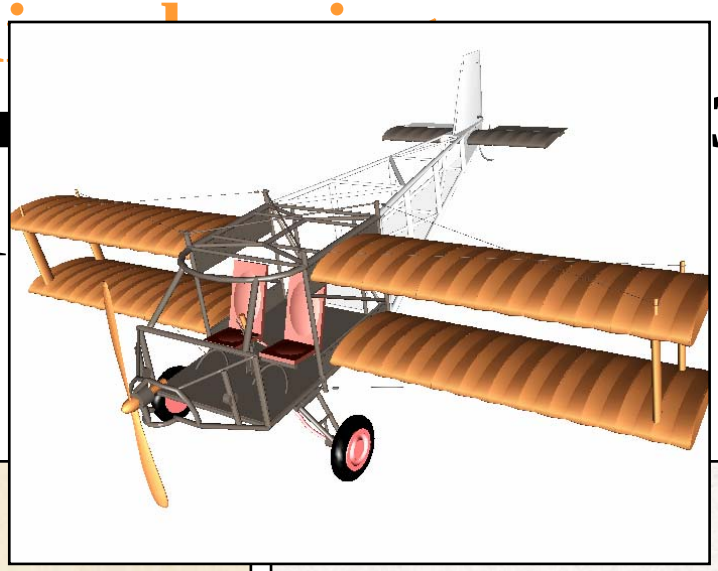
(f)

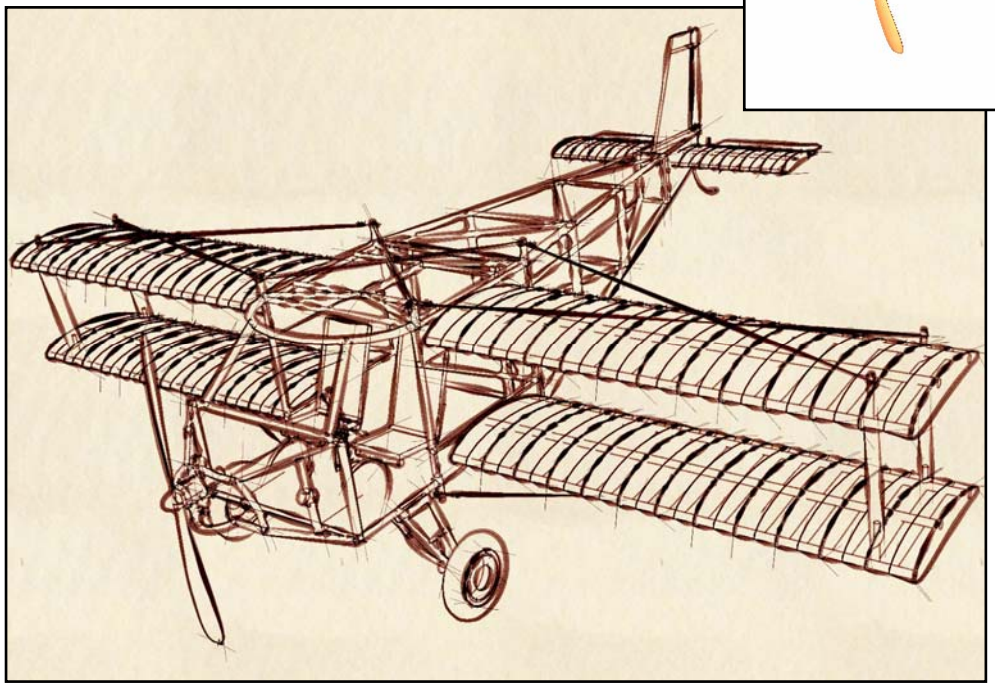
Goal: Decouple style from technique

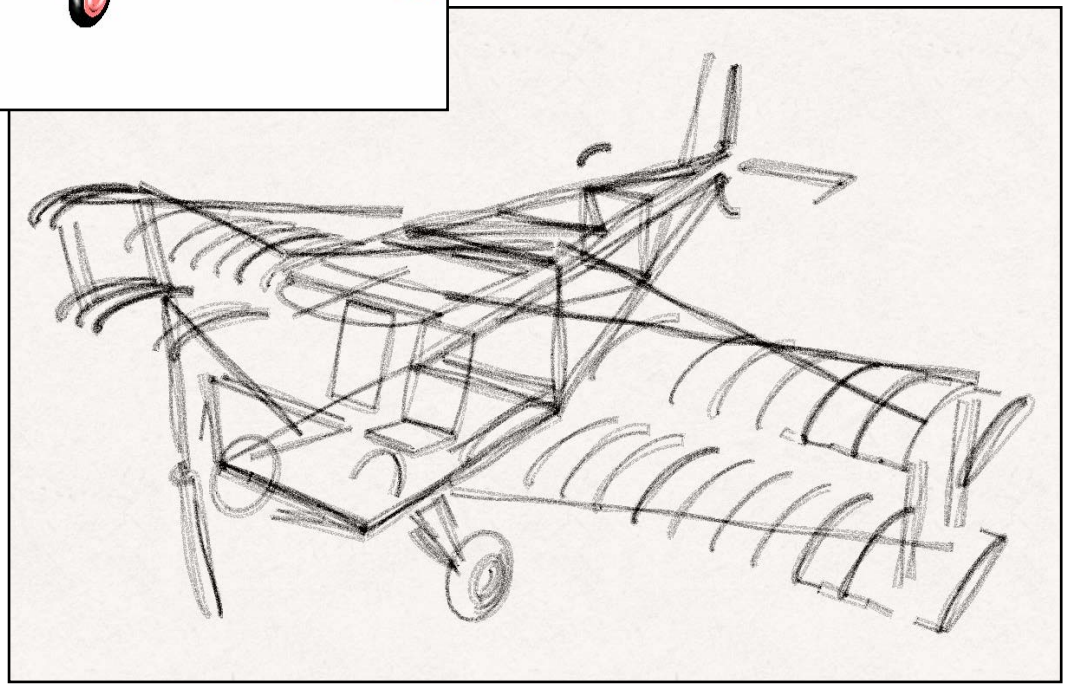
- **First step: pure line drawing**
  System for rendering line drawing from 3D scenes
  – Including a flexible style description tool

Goal: Decouple style from technique

- **First step: pure li**
  System for renderi **3D scenes**
  – Including a flexibl







Goal: Decouple style from technique

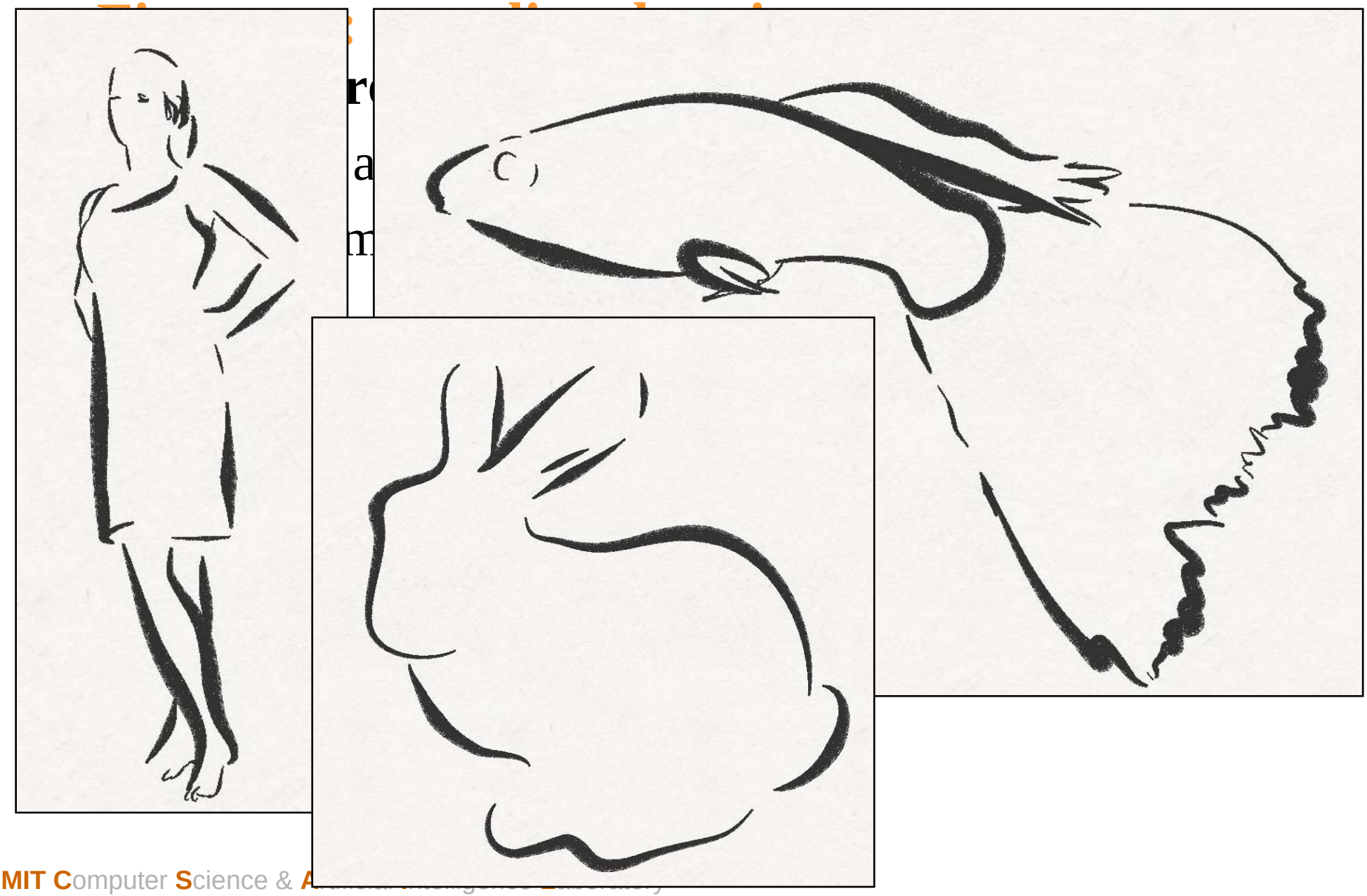
- **First step: pure line drawing**

  System for rendering line drawing from 3D scenes

  – Including a flexible style description tool

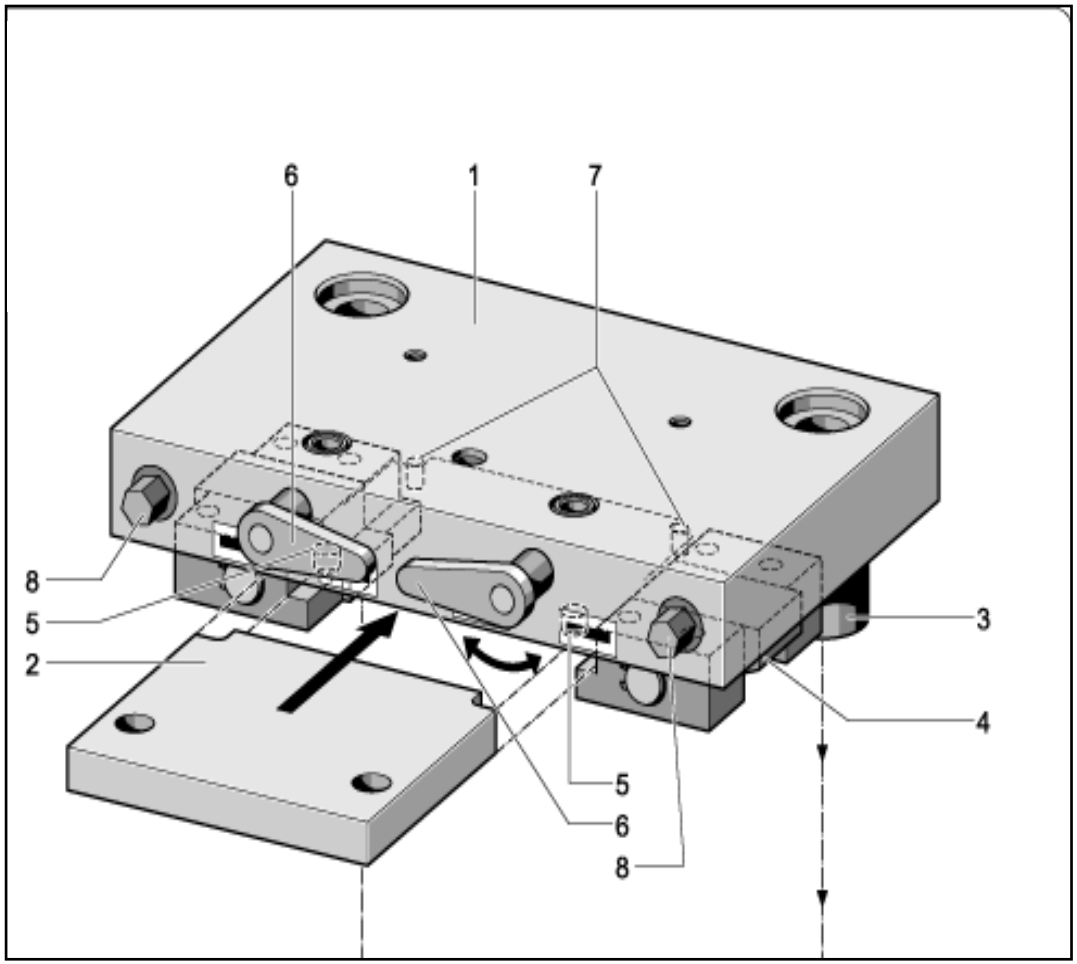
  – Ensuring model independence

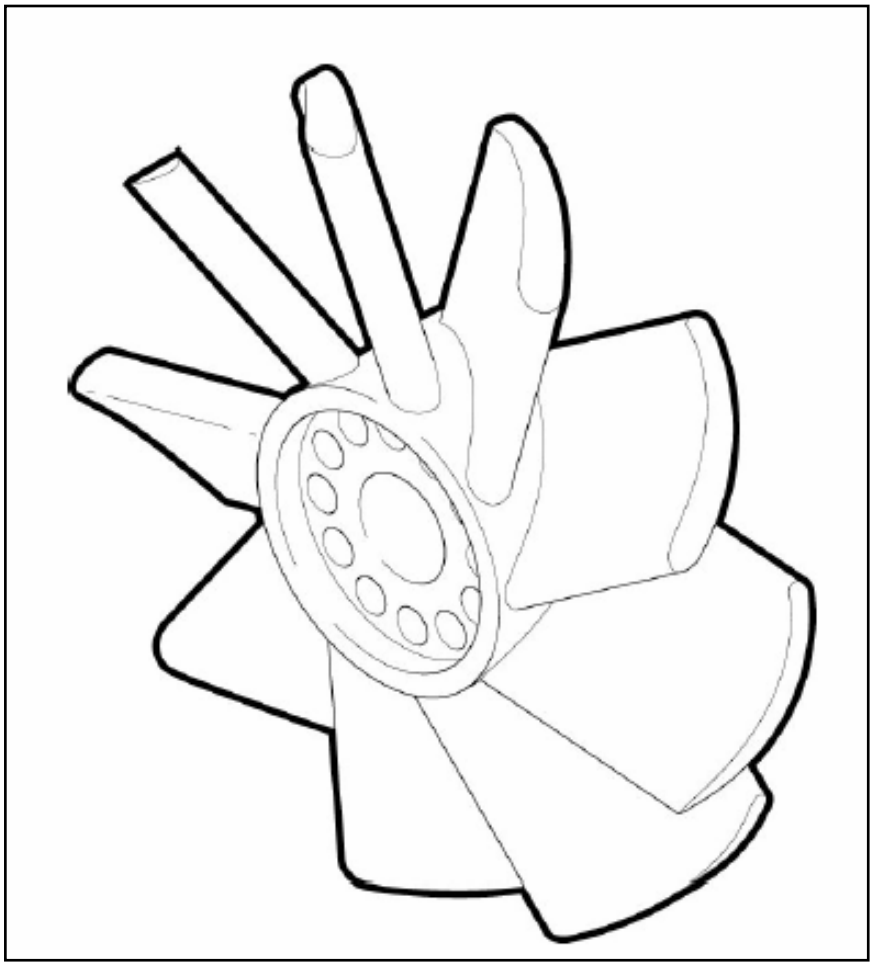
Goal: Decouple style from technique



Style in line drawing

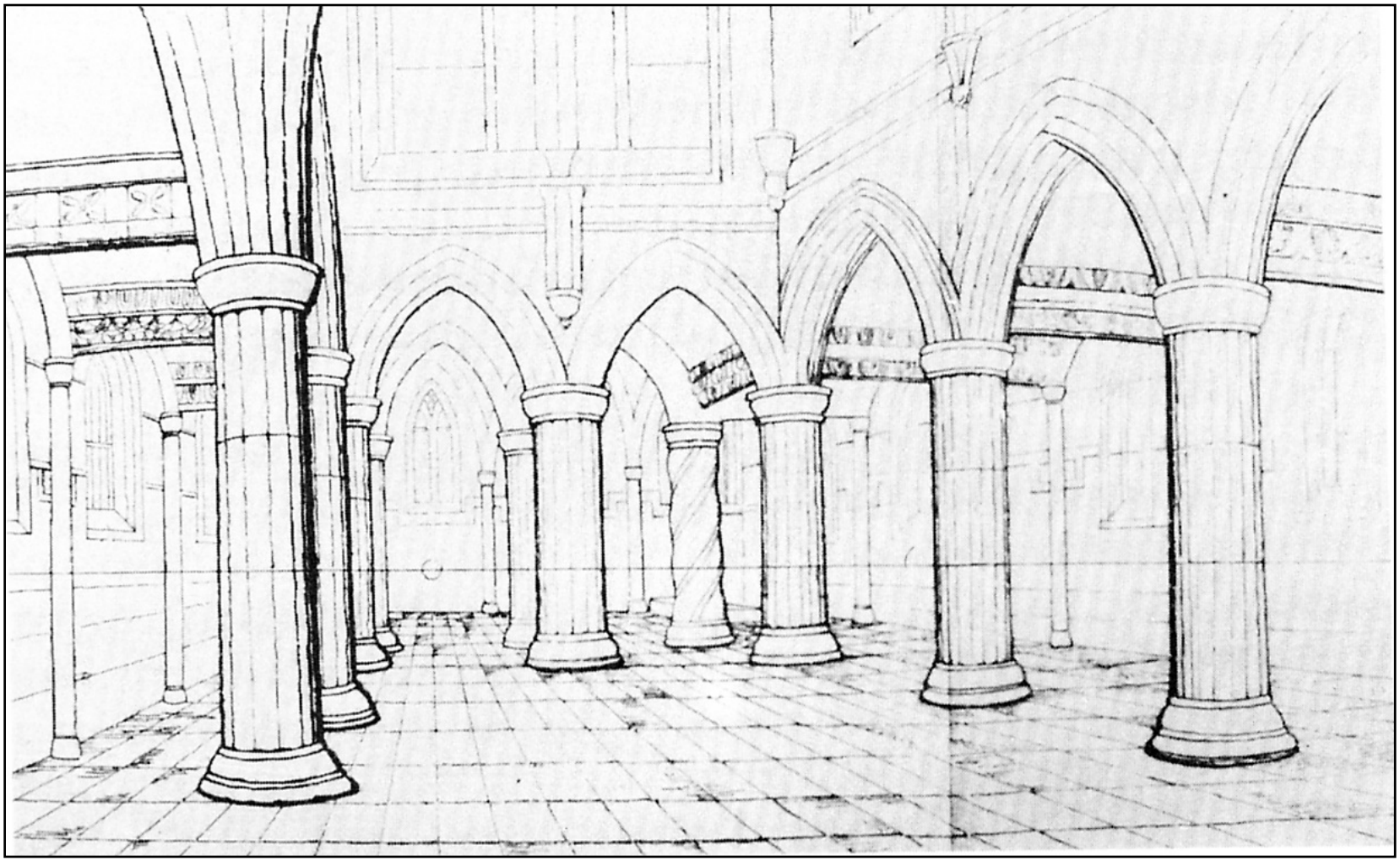
- **Occlusion and nature → thickness**





Style in line drawing

- **Depth discontinuity → thickness**



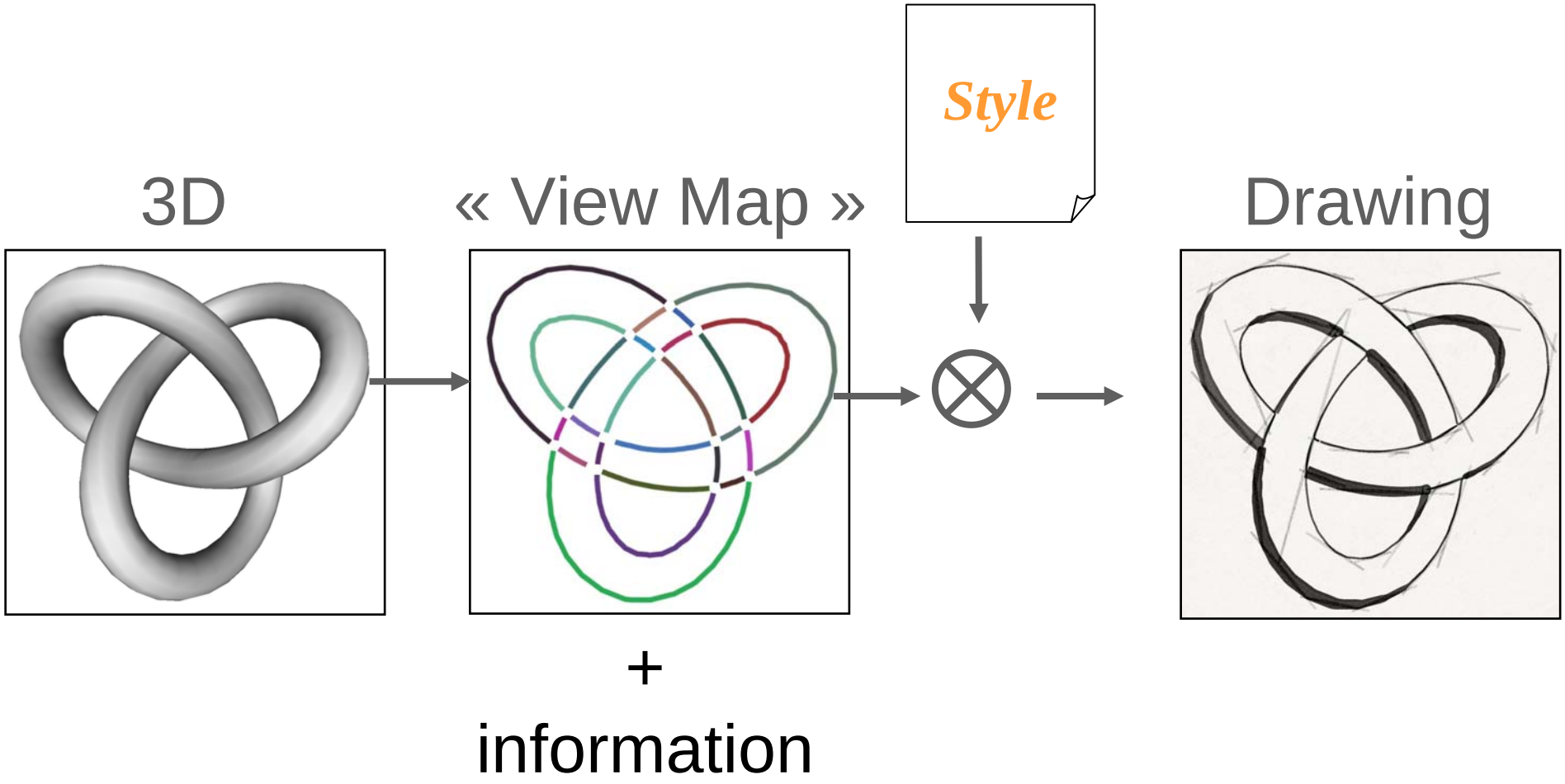
Hypothesis

- **Drawing can be described as a process**
- **Stylistic decisions (line thickness, omission) are related to scene and image information**
- **These decision strategies can be embedded in procedures**

Some relevant information

- **Geometry (2D, 3D coordinates, normals, …)**
- **Differential geometry (2D, 3D curvatures, …)**
- **Line adjacency**
- **Line nature (silhouette, crease, contour, …)**
- **Occluding information (visibility, occluder, depth discontinuity, …)**
- **Material**
- **Object id**
- **Drawing density**

Approach

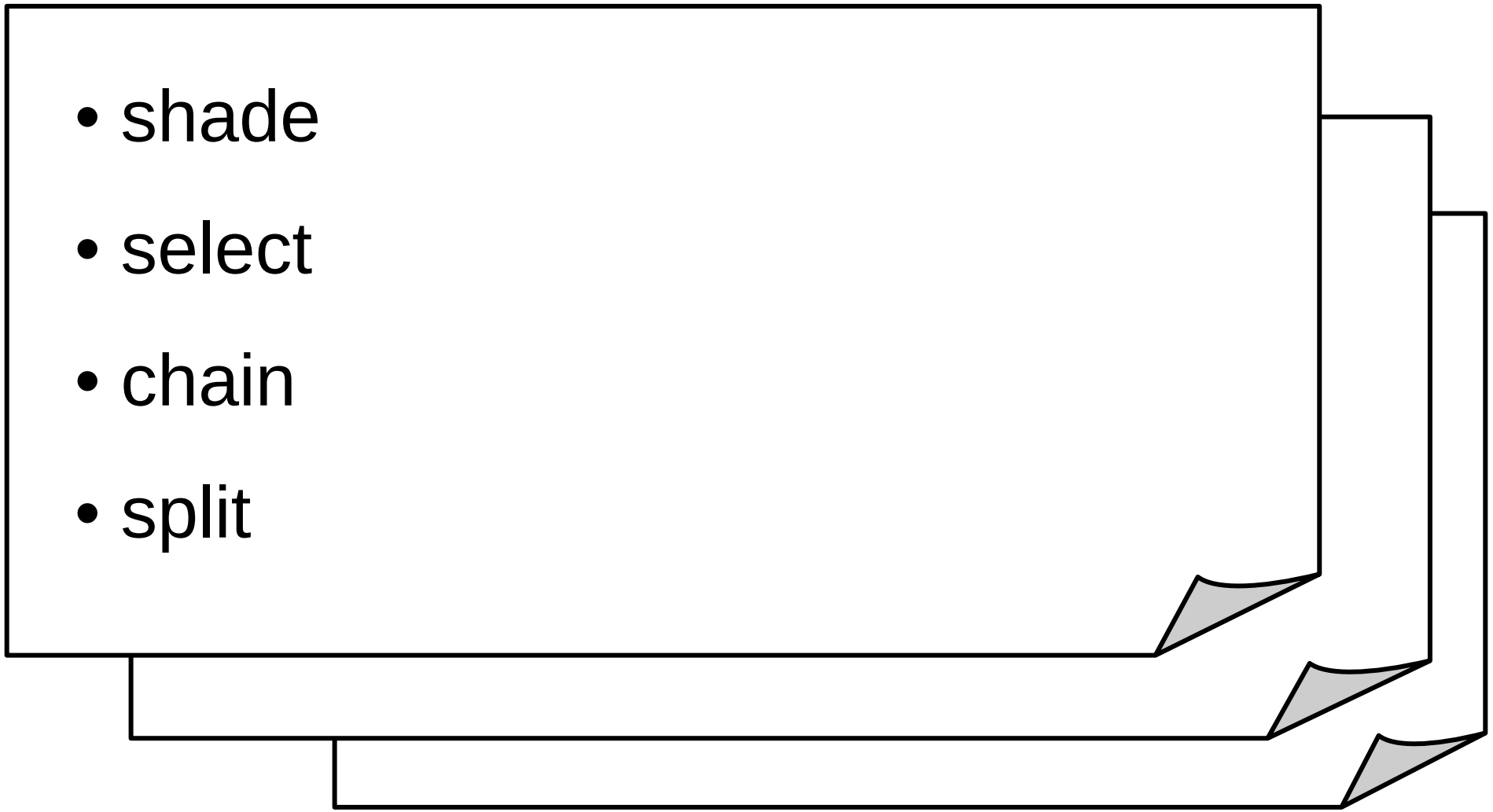


Style: code

```
class pyGuidingLineShader(StrokeShader):
        def shade(self, stroke):
                it = stroke.strokeVerticesBegin()
                itlast = stroke.strokeVerticesEnd()
                itlast.decrement()
                t = itlast.getObject().getPoint() - it.getObject().getPoint()
                itmiddle = StrokeVertexIterator(it)
                while(itmiddle.getObject().u()<0.5):
                        itmiddle.increment()
                while(it.isEnd() == 0):
                        it.getObject().SetPoint(itmiddle.getObject().getPoint() \
                        +t*(it.getObject().u()-itmiddle.getObject().u()))
                        it.increment()

Operators.select(QuantitativeInvisibilityUP1D(0))
Operators.bidirectionalChain(ChainSilhouetteIterator())
Operators.recursiveSplit(     Curvature2DF0D(),
                              pyParameterUP0D(0.2,0.8),
                              NotUP1D(LengthHigherUP1D(75)), 2)

shaders_list =                [             StrokeTextureShader("pencil.jpg", Stroke.DRY_MEDIUM, 1),
                              ConstantColorShader(0,0,0,1),
                              ConstantThicknessShader(2.0),
                              pyGuidingLineShader(),
                              pyBackboneStretcherShader(0.2)]

Operators.create(TrueUP1D(),shaders_list)
```

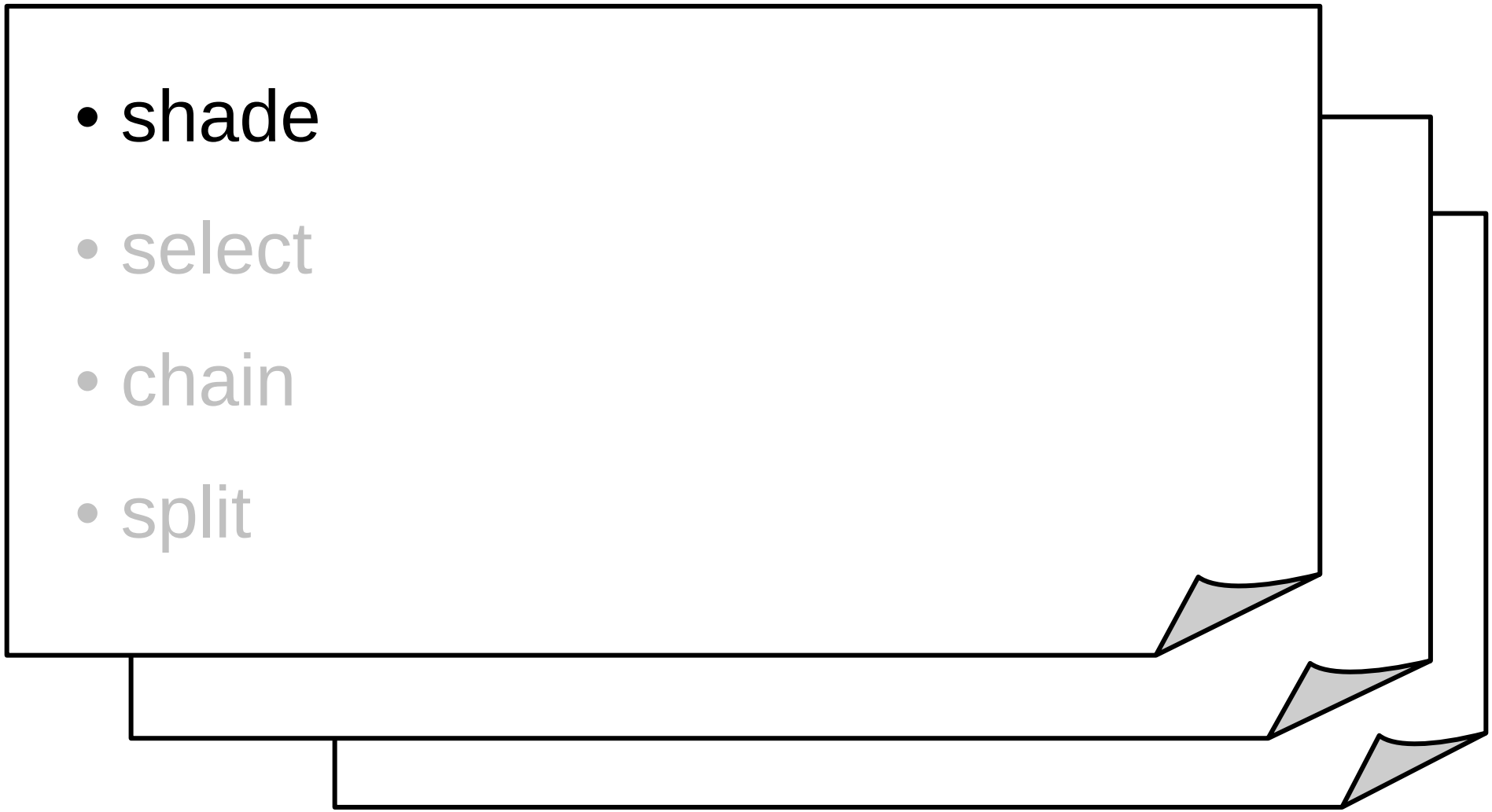
Style operators

- shade
- select
- chain
- split



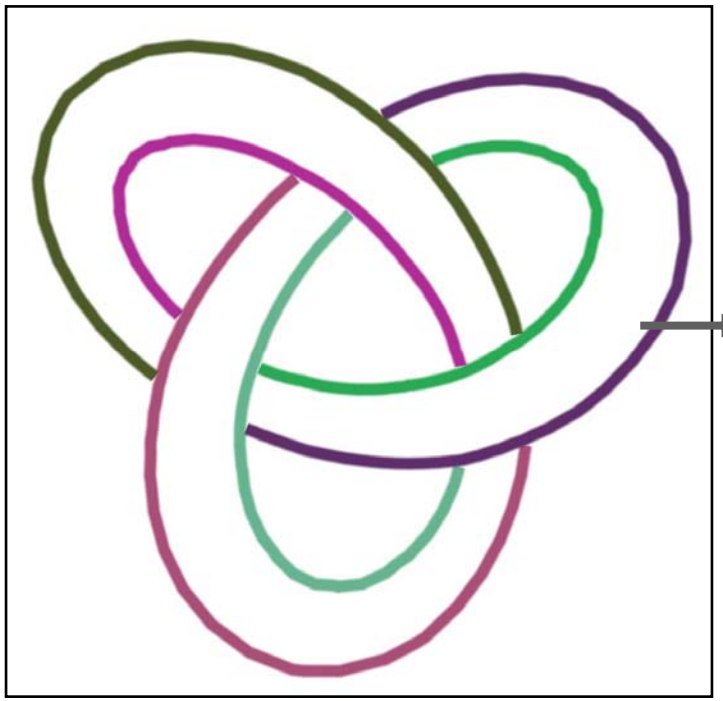
Style operators

- shade
- select
- chain
- split



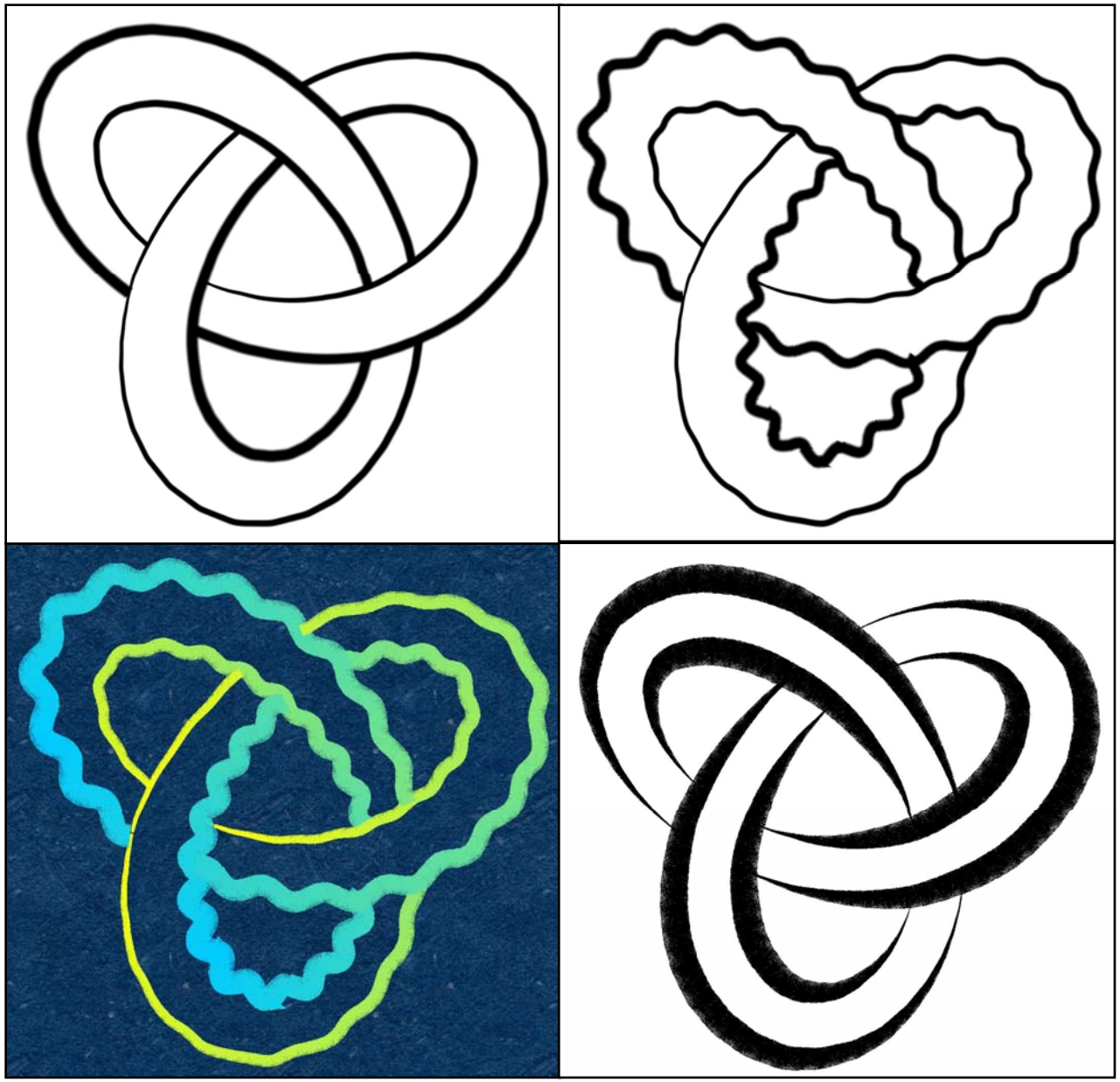
Shading

Plain strokes



Thickness

Geometry

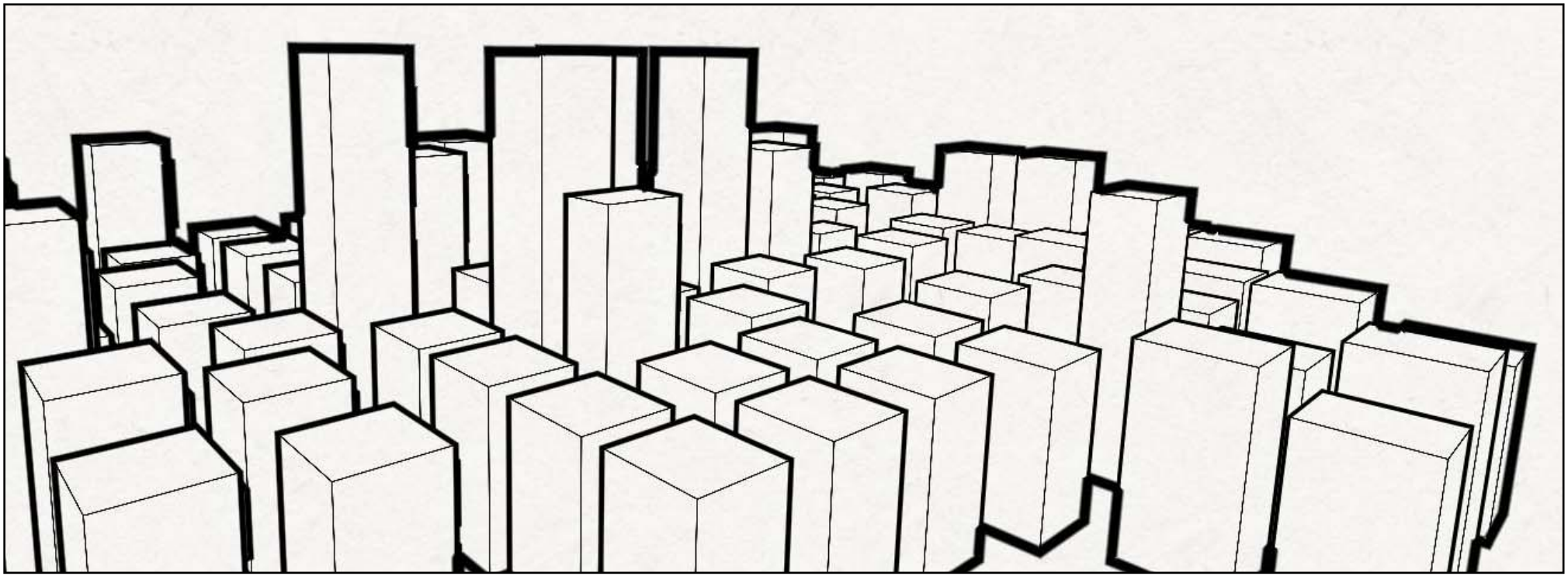


Color

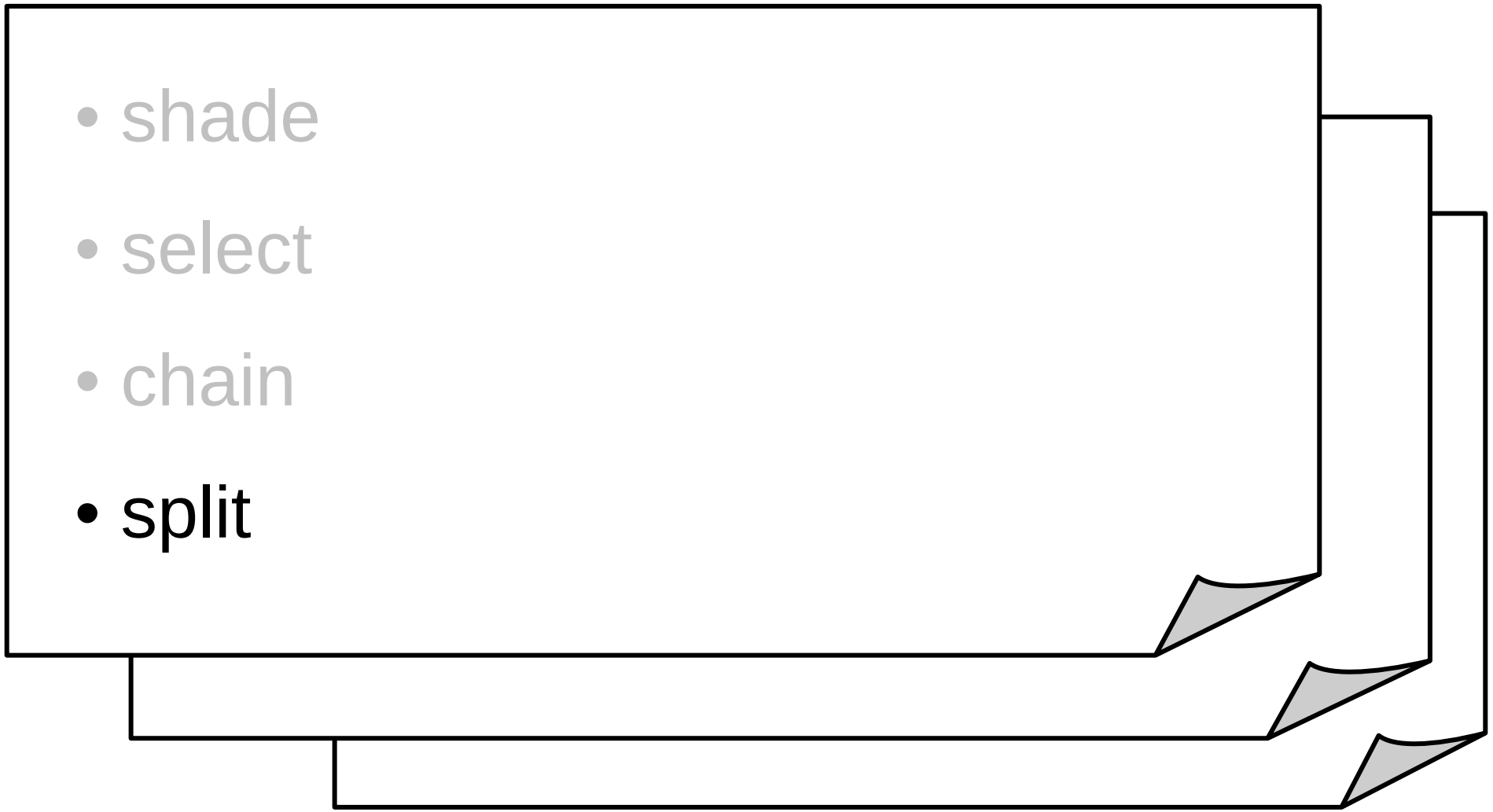
Information dependent

Shading

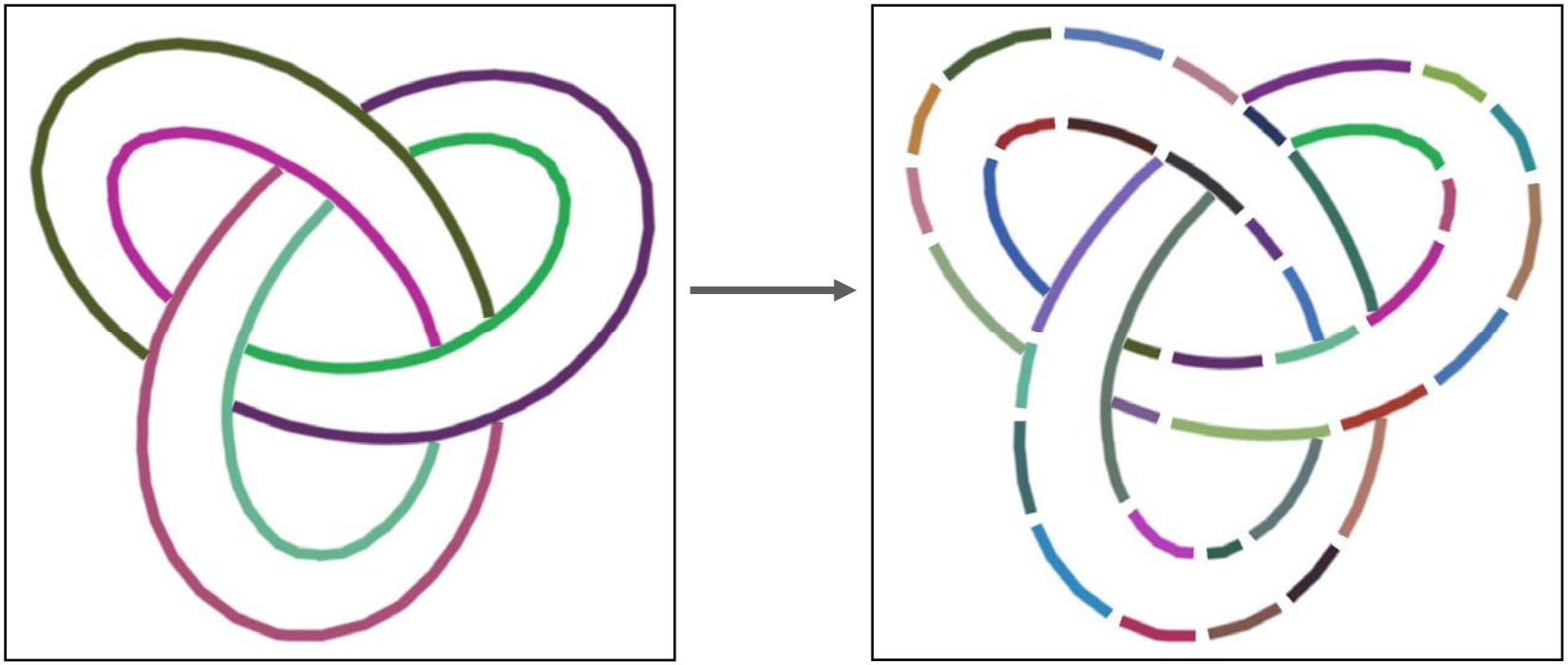
Depth discontinuity → thickness



Style operators

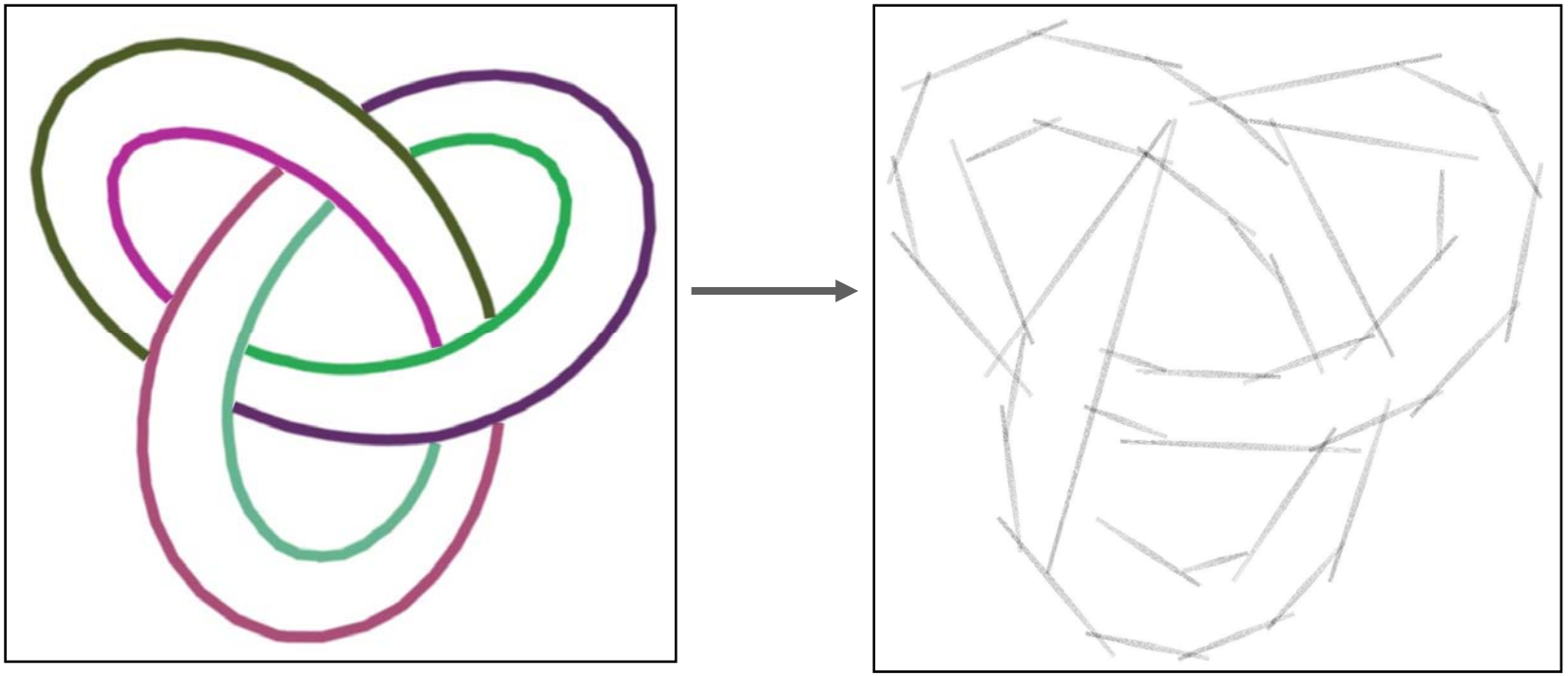


Splitting



Split at points of highest 2D curvature

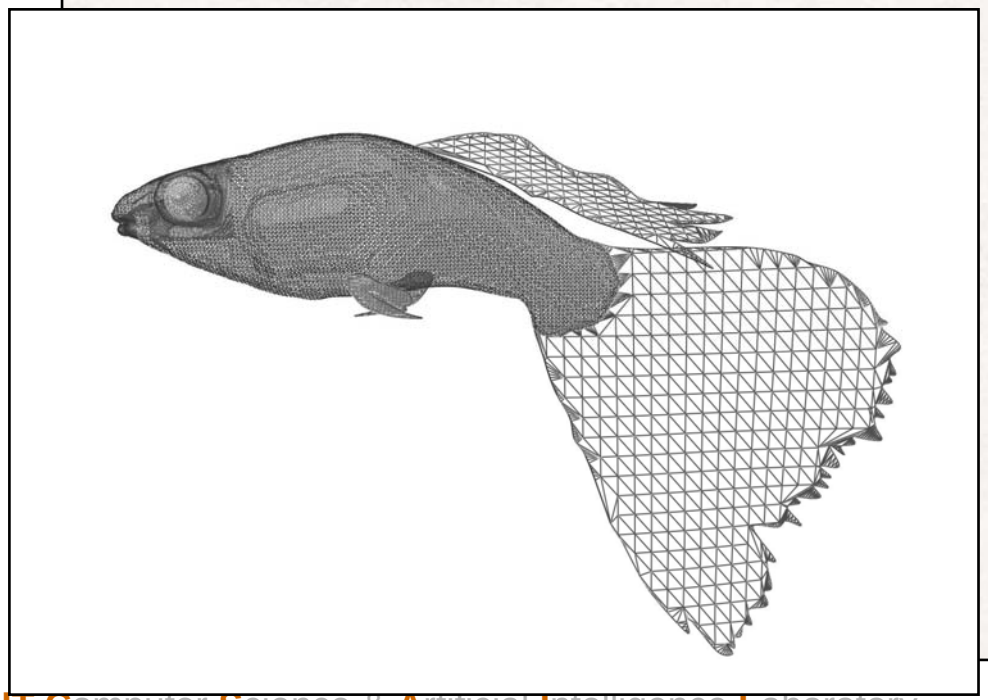
Splitting



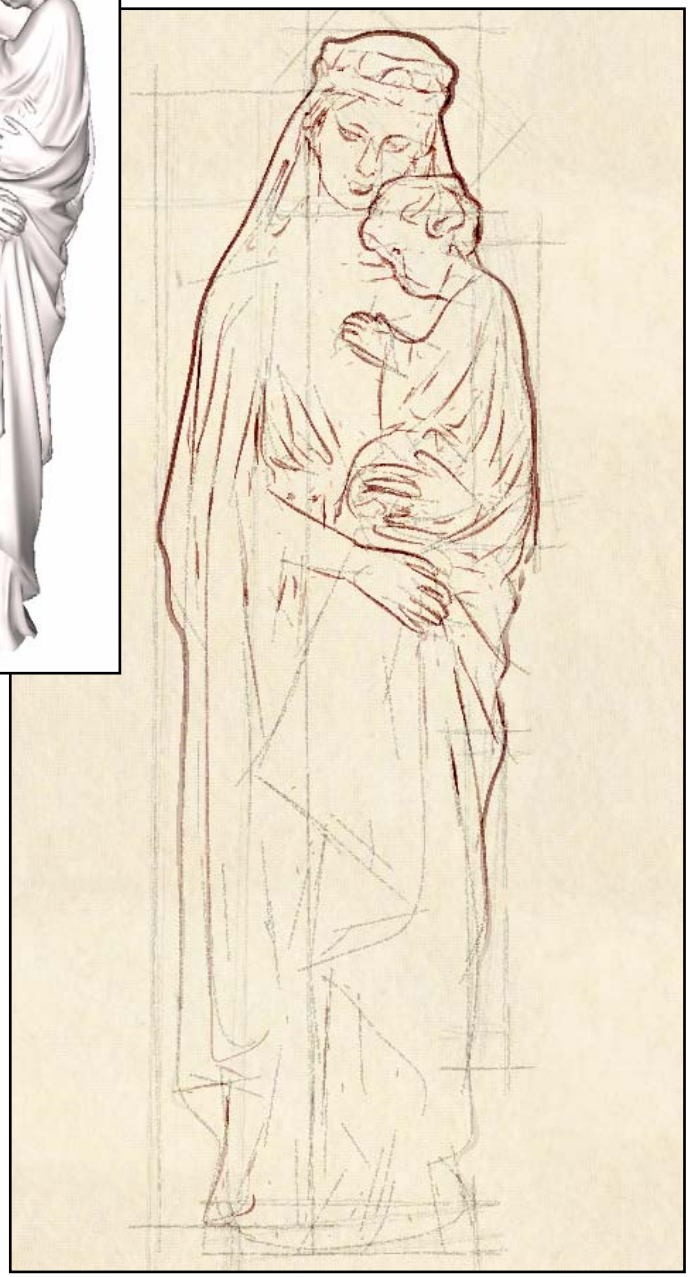
Split at points of highest 2D curvature

Results

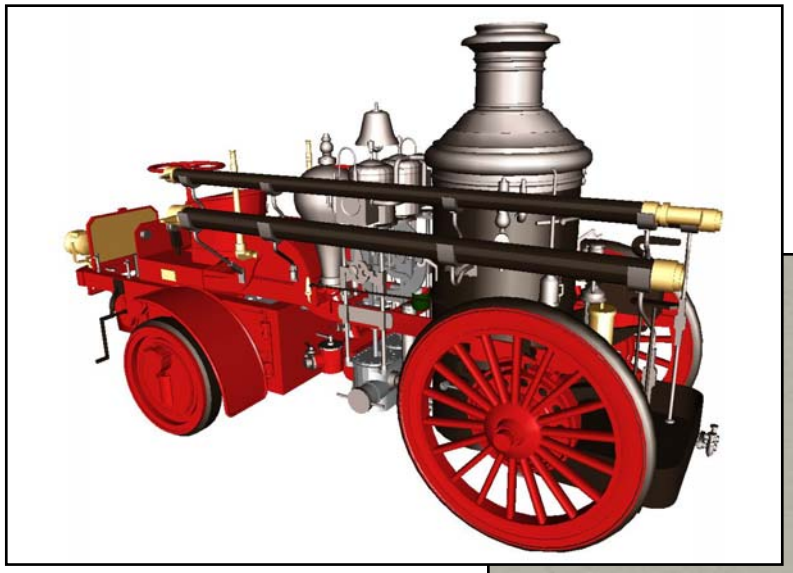
Oriental style

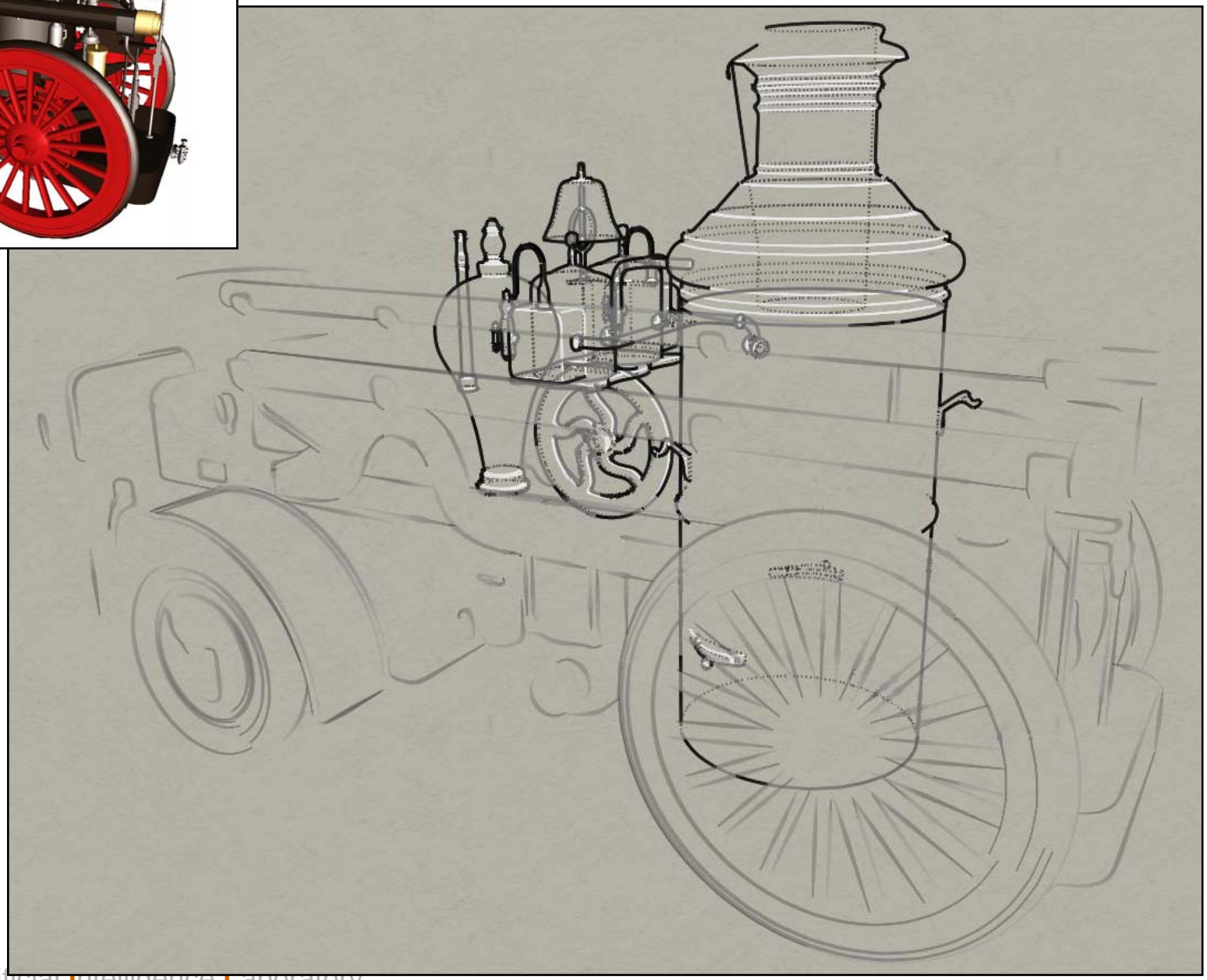


Density-based emphasis



Technical illustration style





Recap

- **Procedural description for style in line drawing**
  - Line drawing from 3D models
  - Control topology, geometry & attributes of strokes
- **Choices**
  - Automatic picture generation from 3D model
  - Restrict to pure line drawing
  - Describe style using procedures
  - View map, types of lines
  - Information we provide
  - Types of operators

Choices We Make

- **Model**
- **Algorithms**
- **Parameters**
- **User Interface**

- **Problems we choose**
- **Evaluation criteria**

- **In articles, we must explain the respective importance of choices**

It's the question, stupid!

- **The important is not the answer to a choice, it's the choice of the question**

- **And even more importantly, the implicit choices we make without asking the question**

Other choices

- **Do we target pro of casual users?**
- **How automatic should things be?**

Bad choice consequences

- **No uses our technique: we don't address any problem, or give the wrong solution**
- **People are frustrated by our technique**
- **We make something too easy, becomes uniform**

- **Ethical problems**