SIGGRAPH ASIA 2020 VIRTUAL

Pre-recorded sessions:
From 4 December 2020

Live sessions:
10 – 13 December 2020

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A Benchmark for Rough Sketch Cleanup

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David Vanderhaeghe — IRIT CNRS, Université de Toulouse
Yotam Gingold — CraGL, George Mason University

GEORGE MASON UNIVERSITY

CraGL
Creativity and Graphics Lab

IRIT

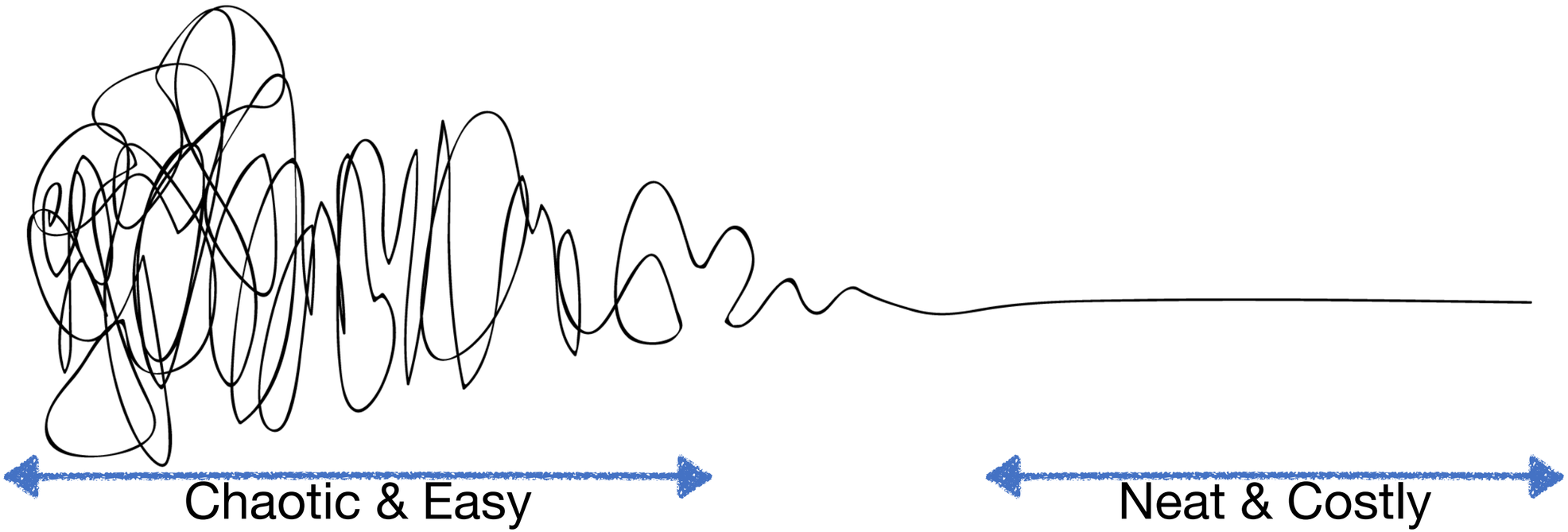
The Design Process

The Design Process

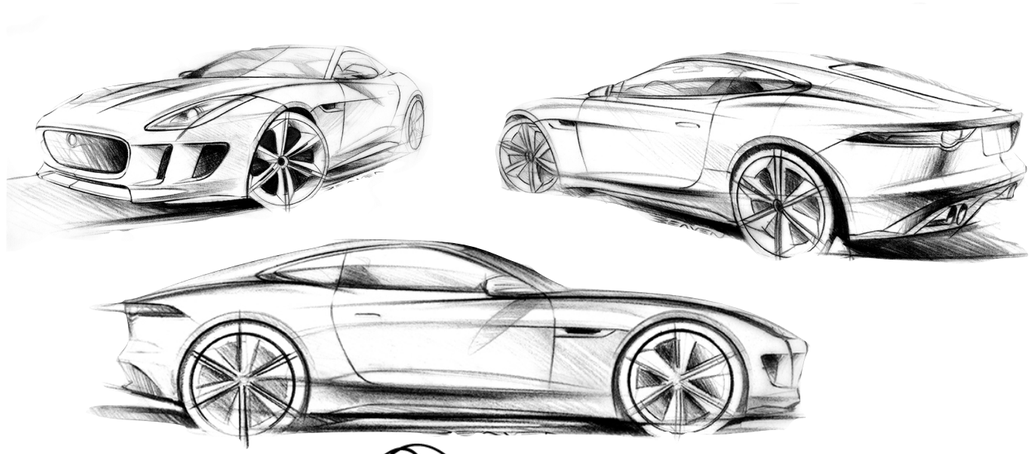
The Design Process

The design squiggle: Damien Newman (CC-BY-ND 3.0)

The Design Process



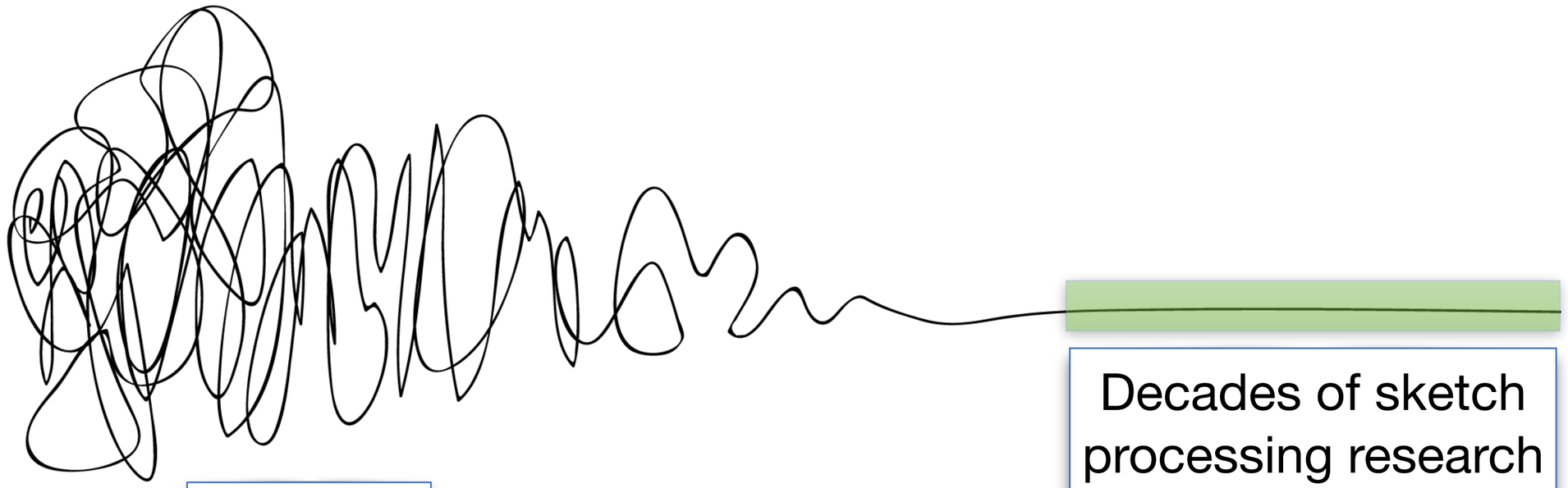
The Design Process



Chaotic & Easy

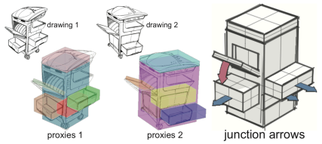
Neat & Costly

The Design Process



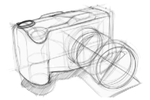
The Design Process

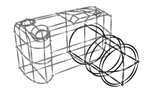
SILK [Landay and Myers 1994]

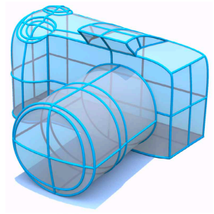


[T. Shao, et al 2013]

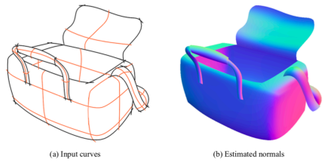
FTP-SC [Yang et al 2018]





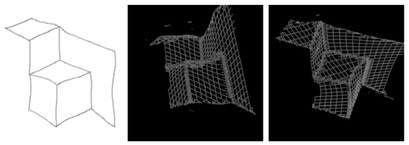


True2Form [Xu et al 2014]

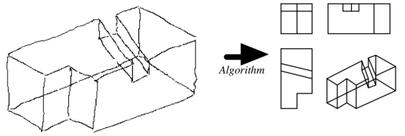


CrossShade [C. Shao et al 2012]

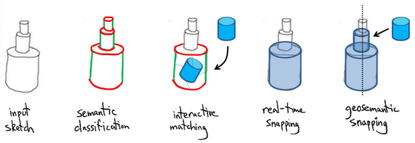
BetweenIT [Whited et al 2010]



[Kaplan and Cohen 2006]



[Lipson and Shpitalni 1996]



[Shtof et al. 2013]

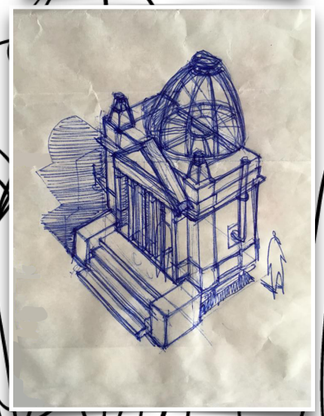
Sketches

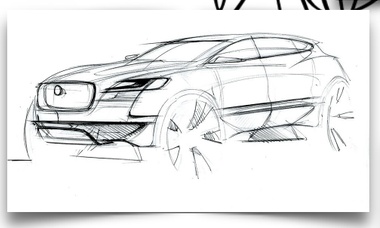
Decades of sketch processing research

The Design Process



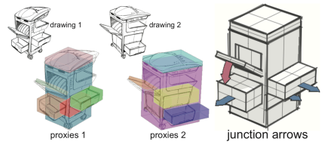




Sketches

SILK [Landay and Myers 1994]



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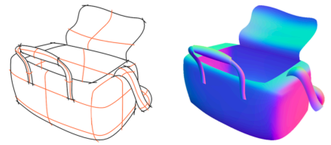
FTP-SC [Yang et al 2018]



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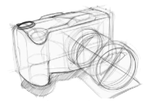
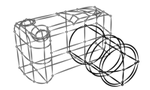
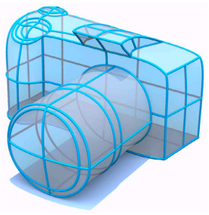
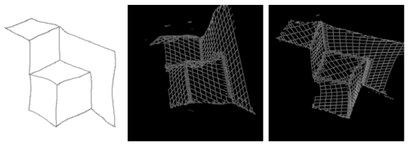


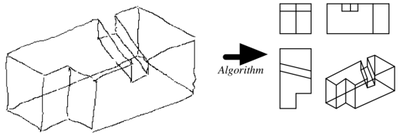




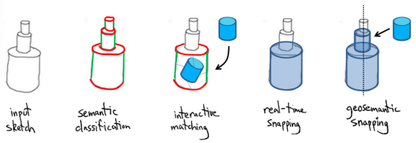
True2Form [Xu et al 2014]



[Kaplan and Cohen 2006]



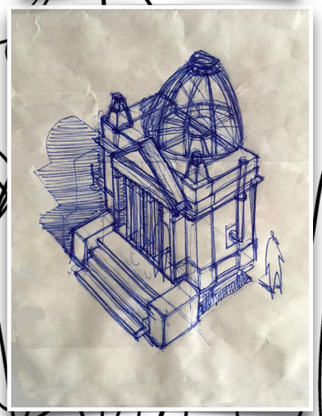
[Lipson and Shpitalni 1996]

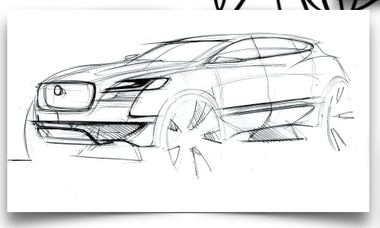


[Shtof et al. 2013]

Decades of sketch processing research

The Design Process

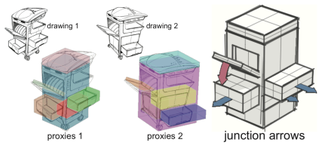




Sketches

Neatness Gap

SILK [Landay and Myers 1994]



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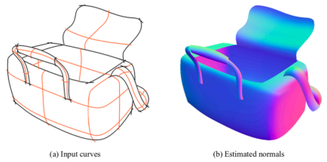

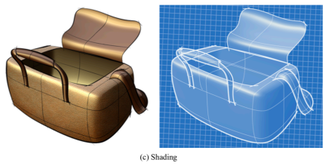

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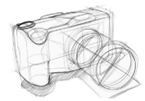

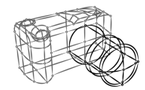

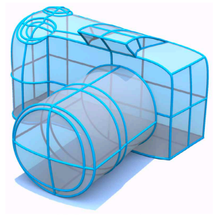

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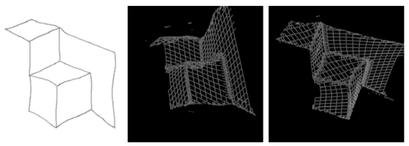

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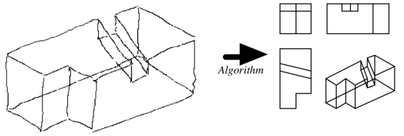

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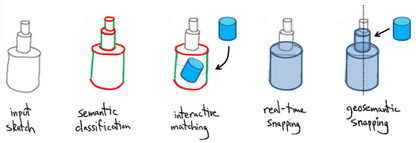


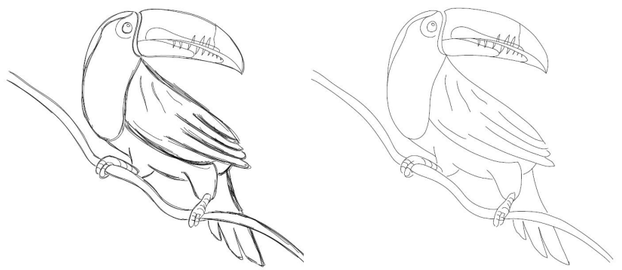
[Shtof et al. 2013]

Decades of sketch processing research

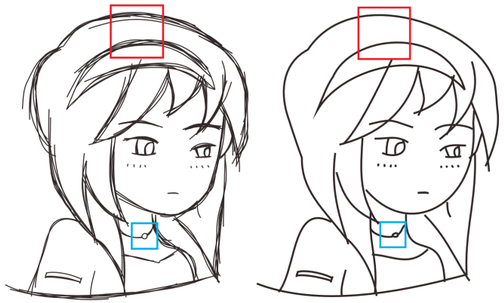
Existing Sketch Cleanup Algorithms

[Noris et al. 2013]

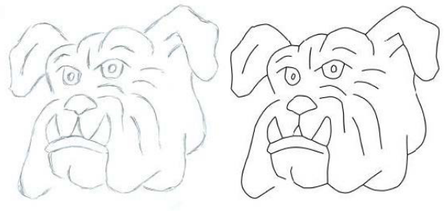
[Simo-Serra et al. 2018a]



[Liu et al. 2018]

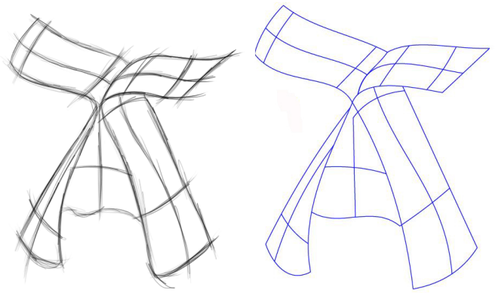


[Liu et al. 2015]

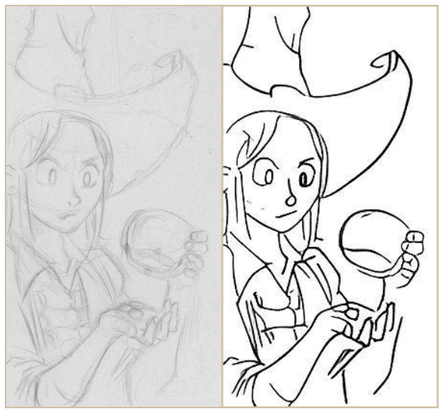


[Parakkat et al. 2018]

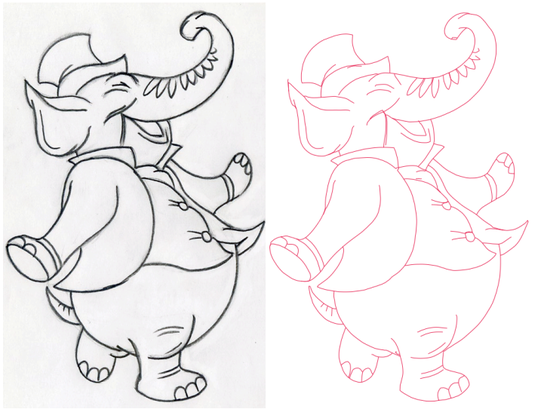
[Simo-Serra et al. 2018b]



[Favreau et al. 2016]



[Xu et al. 2019]



[Bessmeltsev and Solomon 2019]

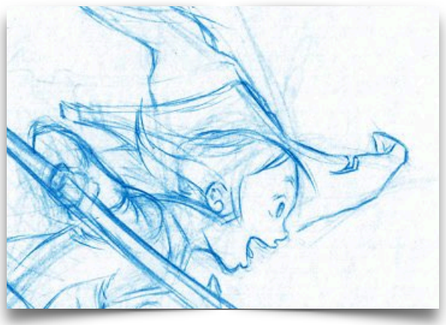
Sketches in the Wild

- Mostly raster

Sketches in the Wild

- Mostly raster
- **Messy & ambiguous strokes**

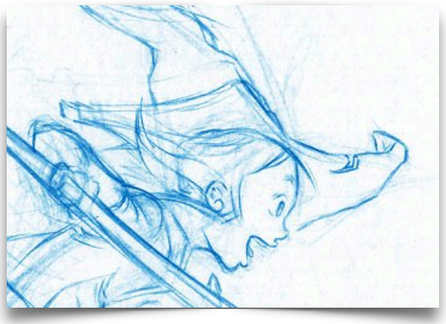
Messy & ambiguous strokes



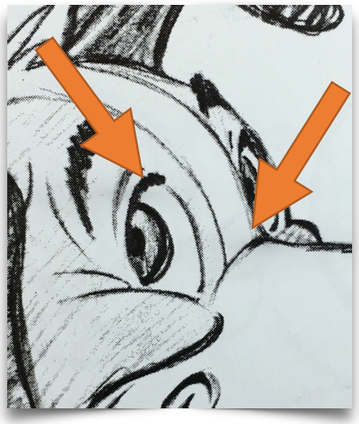
Sketches in the Wild

- Mostly raster
- **Messy & ambiguous strokes**
- **Varying stroke thickness & color**

Messy & ambiguous strokes



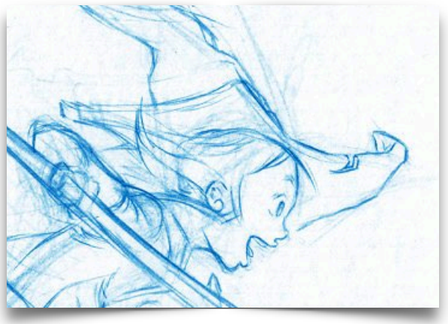
Stroke thickness



Sketches in the Wild

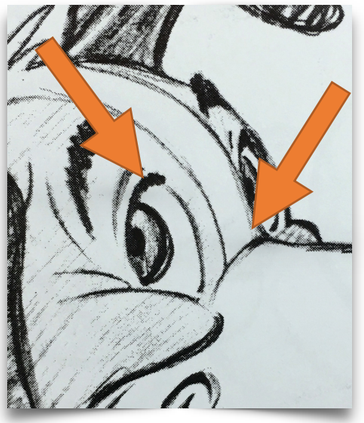
- Mostly raster
- **Messy & ambiguous strokes**
- **Varying stroke thickness & color**
- **Physical artifacts**

Messy & ambiguous strokes



Physical artifacts

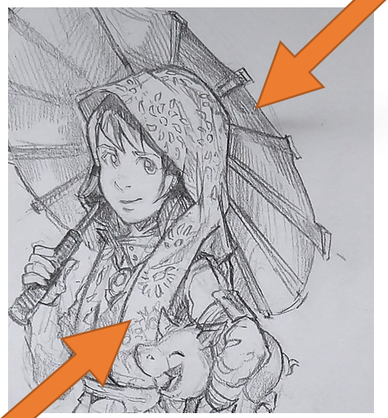
Stroke thickness



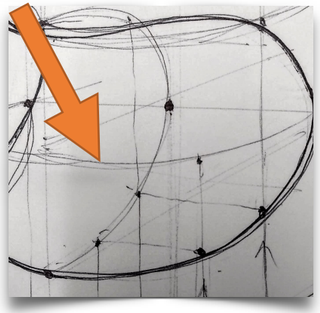
Sketches in the Wild

- Mostly raster
- **Messy & ambiguous strokes**
- **Varying stroke thickness & color**
- **Physical artifacts**
- **Non-shape strokes**

Texture & shading

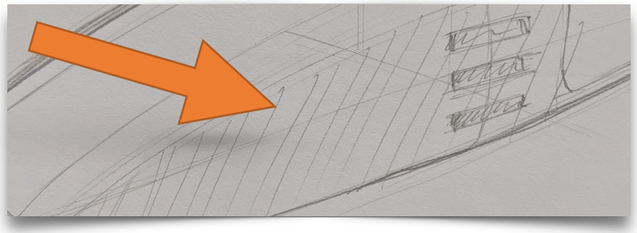


Scaffolds

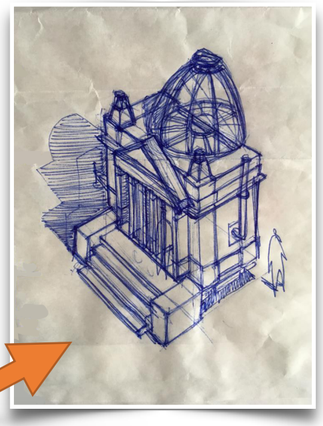


Messy & ambiguous strokes

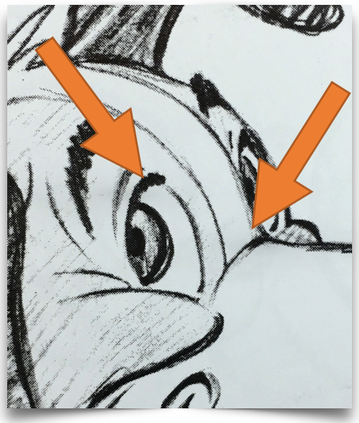
Hatching lines



Physical artifacts



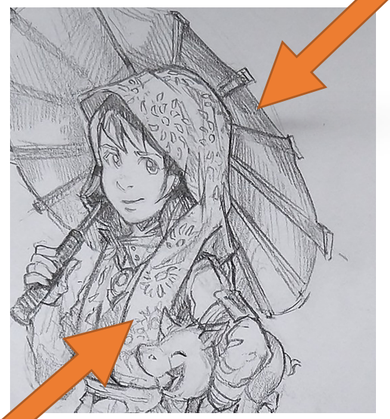
Stroke thickness



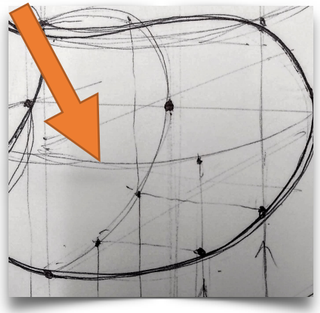
Sketches in the Wild

- Mostly raster
- **Messy & ambiguous strokes**
- **Varying stroke thickness & color**
- **Physical artifacts**
- **Non-shape strokes**
- **Local ambiguity**

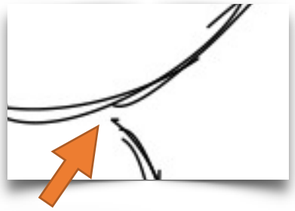
Texture & shading



Scaffolds

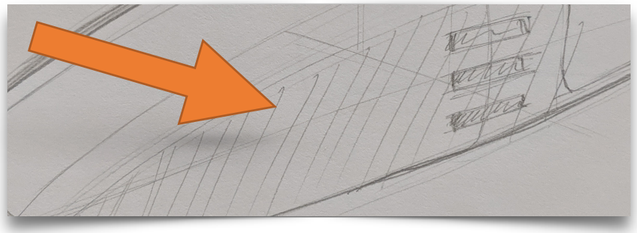


Junction closure

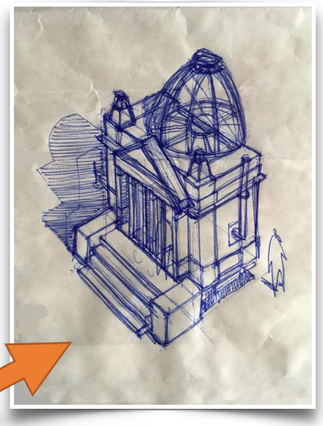


Messy & ambiguous strokes

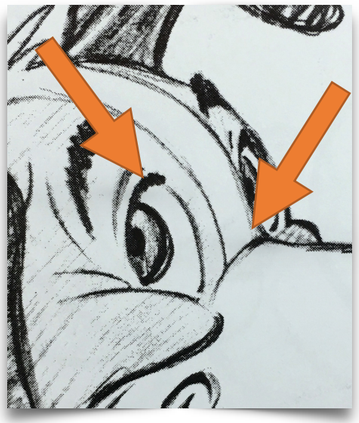
Hatching lines



Physical artifacts



Stroke thickness

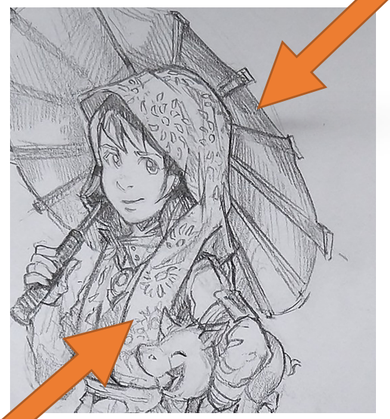


Sketches in the Wild

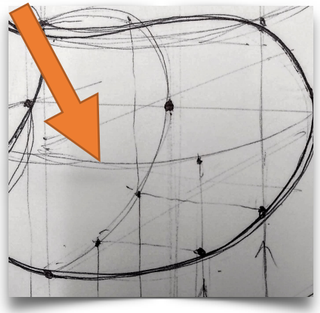
- Mostly raster
- **Messy & ambiguous strokes**
- **Varying stroke thickness & color**
- **Physical artifacts**
- **Non-shape strokes**
- **Local ambiguity**
- **Global change**

Global change

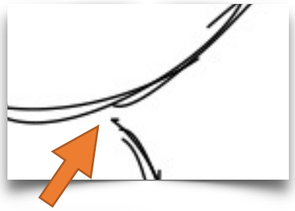
Texture & shading



Scaffolds

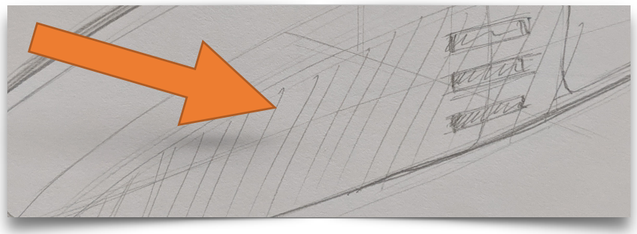


Junction closure

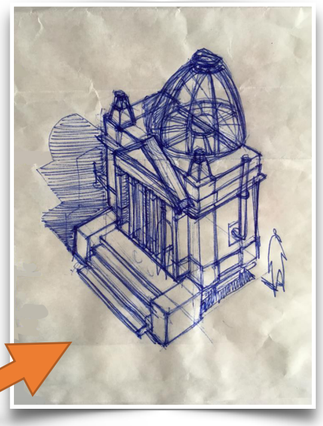


Messy & ambiguous strokes

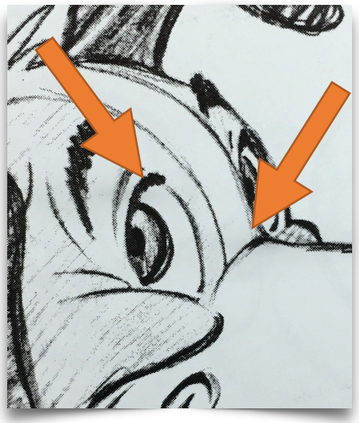
Hatching lines



Physical artifacts



Stroke thickness

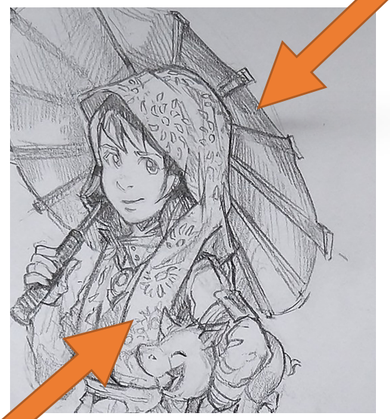


Sketches in the Wild

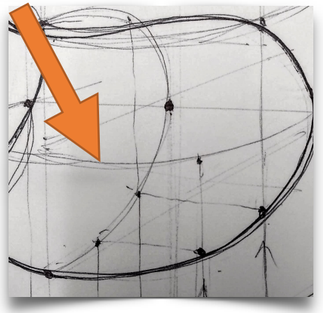
- Mostly raster
- **Messy & ambiguous strokes**
- **Varying stroke thickness & color**
- **Physical artifacts**
- **Non-shape strokes**
- **Local ambiguity**
- **Global changes**
- **Deliberately non-smooth strokes**

Global change

Texture & shading



Scaffolds

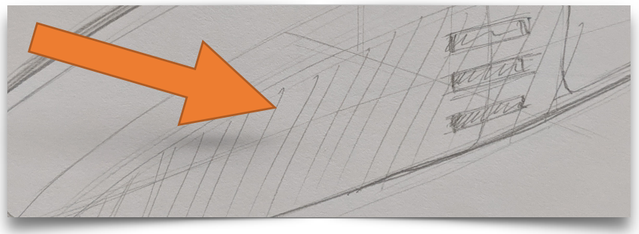


Deliberately non-smooth

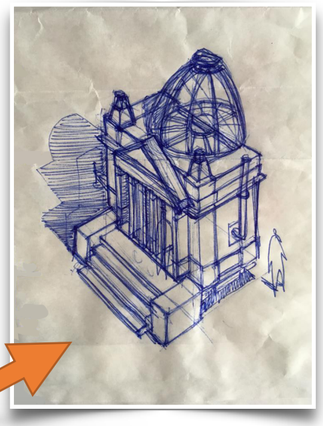
Junction closure

Messy & ambiguous strokes

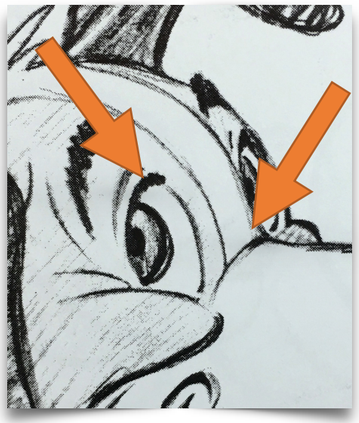
Hatching lines



Physical artifacts



Stroke thickness

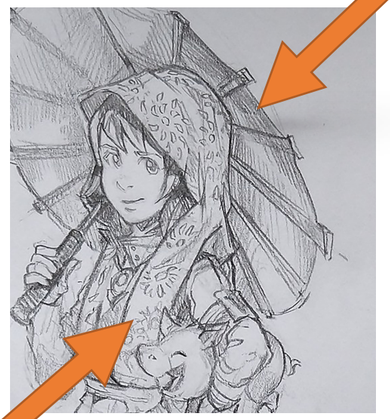


Sketches in the Wild

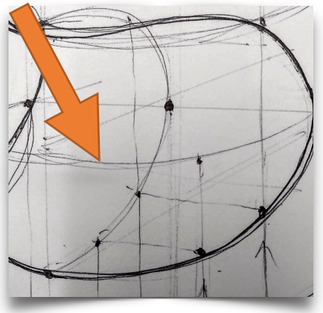
- Mostly raster
- **Messy & ambiguous strokes**
- **Varying stroke thickness & color**
- **Physical artifacts**
- **Non-shape strokes**
- **Local ambiguity**
- **Global changes**
- **Deliberately non-smooth strokes**
- Many genres

Global change

Texture & shading



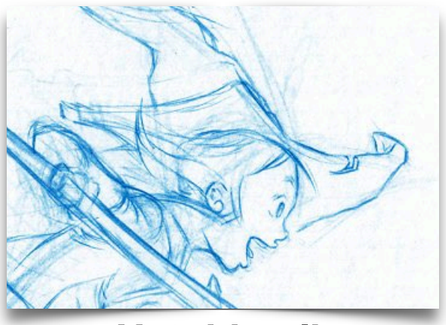
Scaffolds



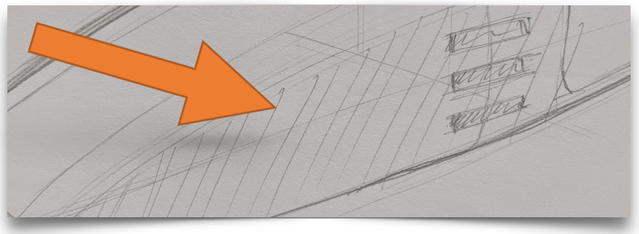
Deliberately non-smooth

Junction closure

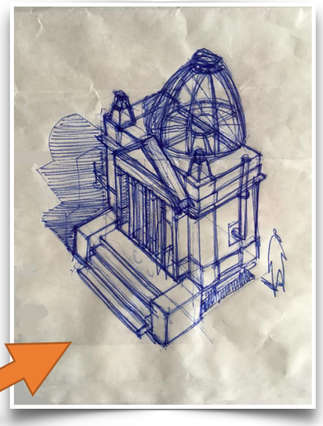
Messy & ambiguous strokes



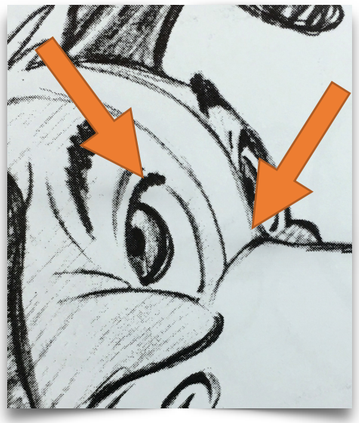
Hatching lines



Physical artifacts



Stroke thickness

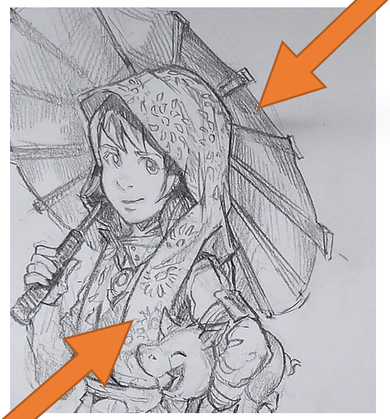


Sketches in the Wild

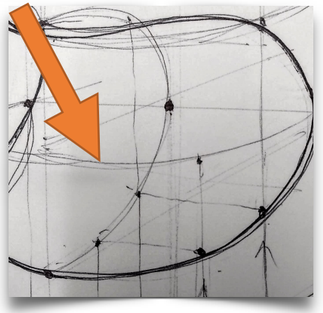
- Mostly raster
- **Messy & ambiguous strokes**
- **Varying stroke thickness & color**
- **Physical artifacts**
- **Non-shape strokes**
- **Local ambiguity**
- **Global changes**
- **Deliberately non-smooth strokes**
- Many genres
- Which algorithm works best?

Global change

Texture & shading



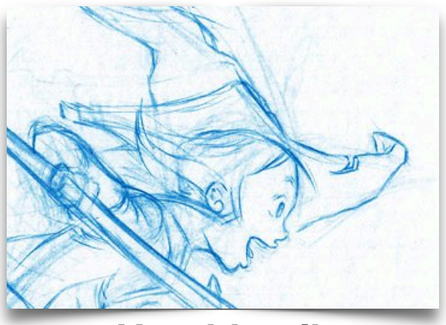
Scaffolds



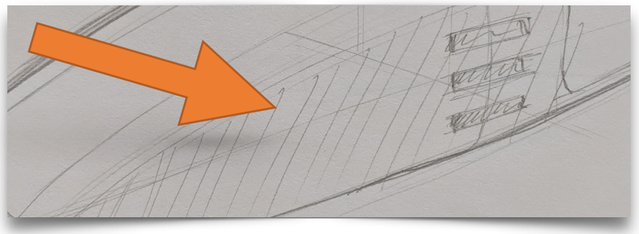
Deliberately non-smooth

Junction closure

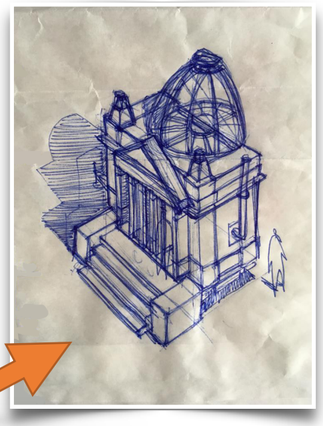
Messy & ambiguous strokes



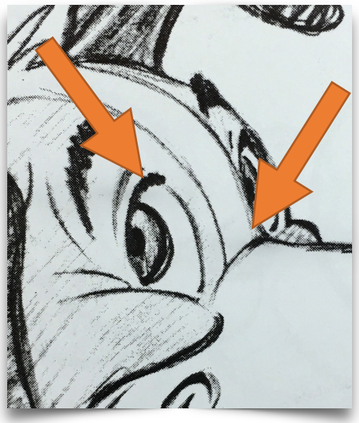
Hatching lines



Physical artifacts



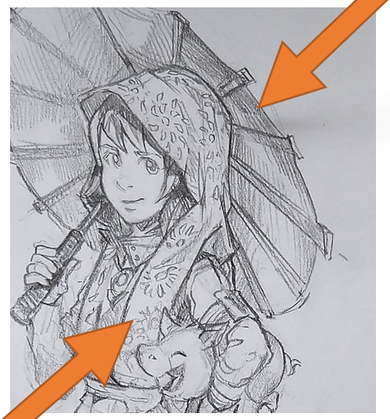
Stroke thickness



Ideal Cleaned Sketch

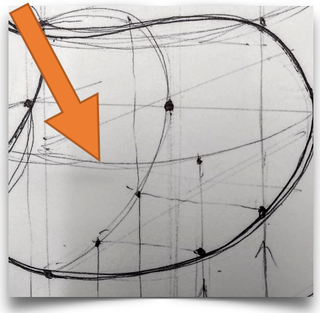
Global change

Texture & shading

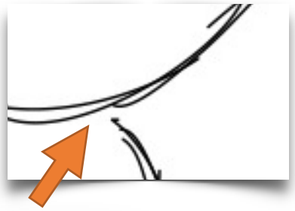


Deliberately non-smooth

Scaffolds

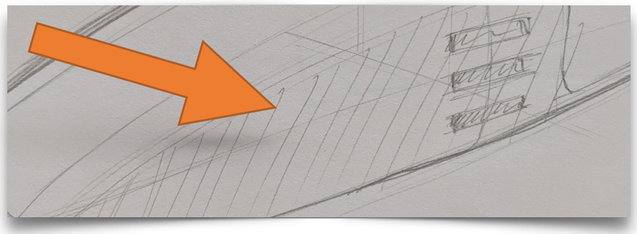


Junction closure

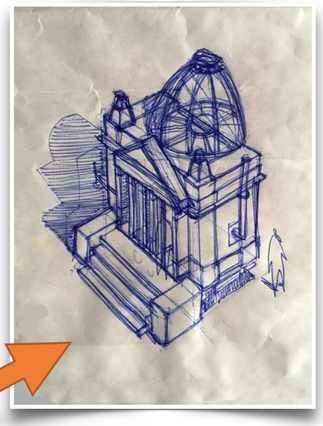


Messy & ambiguous strokes

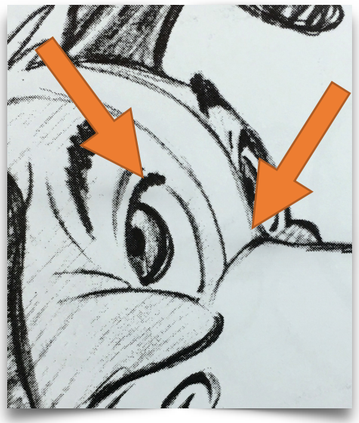
Hatching lines



Physical artifacts



Stroke thickness

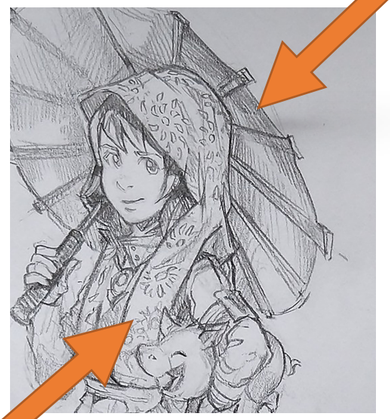


Ideal Cleaned Sketch

- **Consolidate rough strokes**
  - Messy & ambiguous strokes
  - Physical artifacts

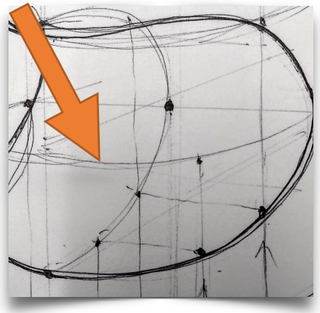
Global change

Texture & shading

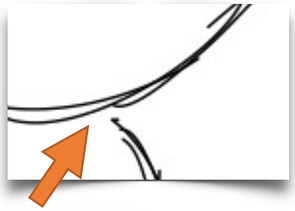


Deliberately non-smooth

Scaffolds

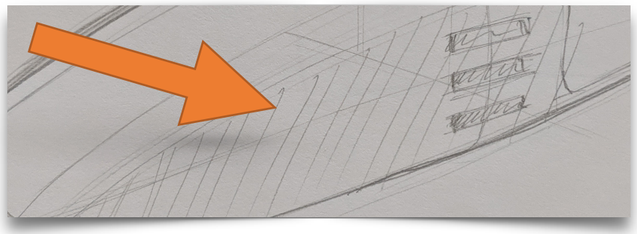


Junction closure

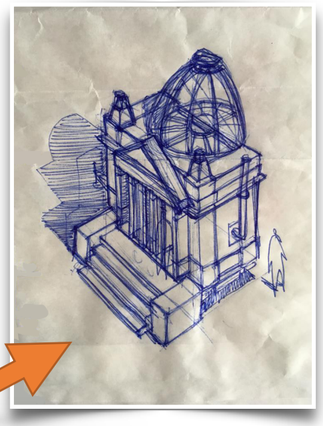


Messy & ambiguous strokes

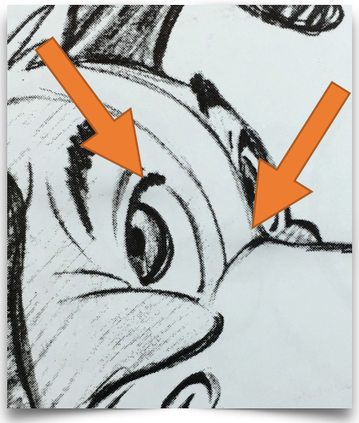
Hatching lines



Physical artifacts



Stroke thickness

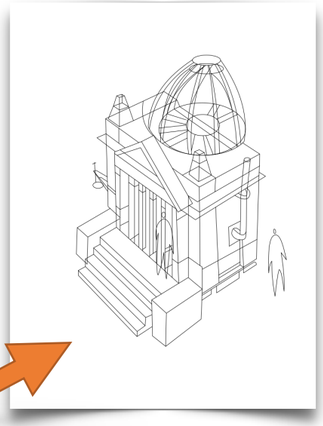


Ideal Cleaned Sketch

- **Consolidate rough strokes**
  - Messy & ambiguous strokes
  - Physical artifacts

Messy & ambiguous strokes

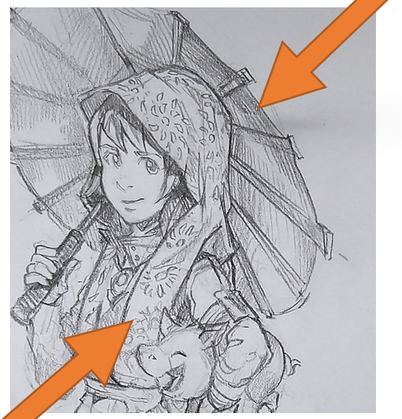
Physical artifacts



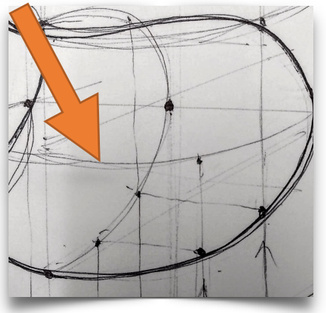
Ideal Cleaned Sketch

- **Consolidate rough strokes**
  - Messy & ambiguous strokes
  - Physical artifacts
- **Identify and separate non-shape strokes**

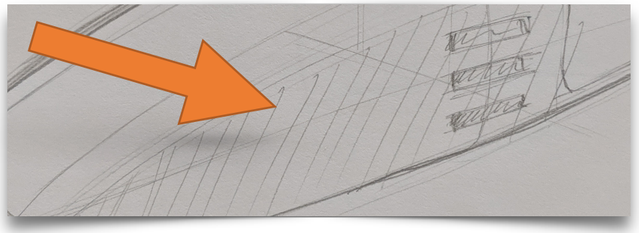
Texture & shading



Scaffolds



Hatching lines



Ideal Cleaned Sketch

- **Consolidate rough strokes**
  - Messy & ambiguous strokes
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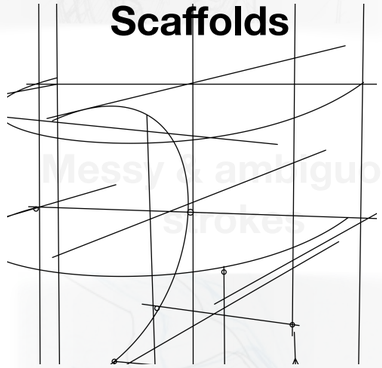
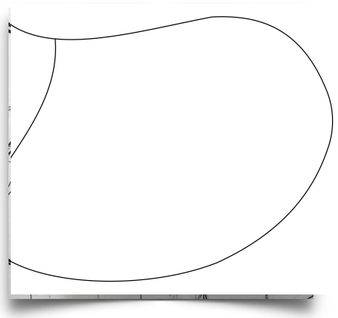
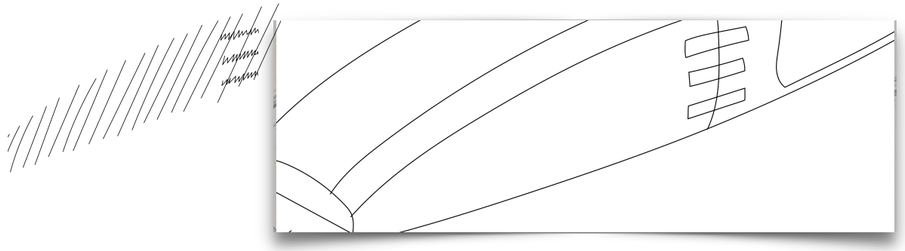
Texture & shading

Scaffolds





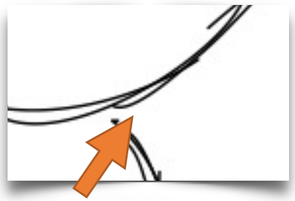
Hatching lines



Ideal Cleaned Sketch

- **Consolidate rough strokes**
  - Messy & ambiguous strokes
  - Physical artifacts
- **Identify and separate non-shape strokes**
- **Close junctions**

Junction closure



Texture & shading

Global change

Scaffolds

Deliberately non-smooth

Messy & ambiguous strokes

Physical artifacts

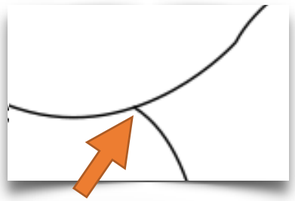
Stroke thickness

Hatching lines

Ideal Cleaned Sketch

- **Consolidate rough strokes**
  - Messy & ambiguous strokes
  - Physical artifacts
- **Identify and separate non-shape strokes**
- **Close junctions**

Junction closure



Texture & shading

Global change

Scaffolds

Deliberately non-smooth

Messy & ambiguous strokes

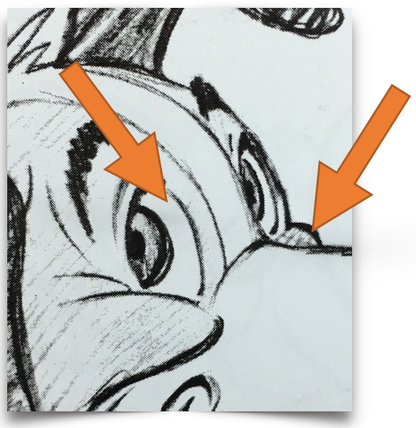
Physical artifacts

Stroke thickness

Hatching lines

Ideal Cleaned Sketch

- **Consolidate rough strokes**
  - Messy & ambiguous strokes
  - Physical artifacts
- **Identify and separate non-shape strokes**
- **Close junctions**
- **Retain**
  - Stroke thickness & color



Ideal Cleaned Sketch

- **Consolidate rough strokes**
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  - Physical artifacts
- **Identify and separate non-shape strokes**
- **Close junctions**
- **Retain**
  - Stroke thickness & color

Texture & shading

Global change

Scaffolds

Deliberately non-smooth

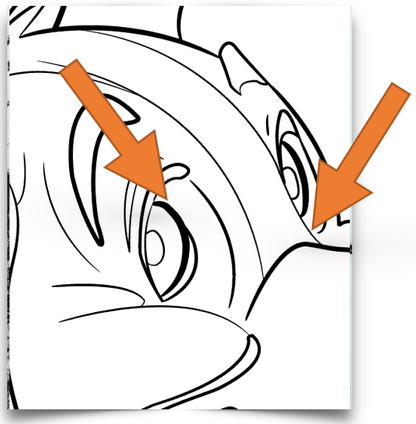
Messy & ambiguous strokes

Junction closure

Physical artifacts

Hatching lines

Stroke thickness



Ideal Cleaned Sketch

- **Consolidate rough strokes**
  - Messy & ambiguous strokes
  - Physical artifacts
- **Identify and separate non-shape strokes**
- **Close junctions**
- **Retain**
  - Stroke thickness & color
  - Deliberately non-smooth

Texture & shading

Global change

Scaffolds

Deliberately non-smooth

Messy & ambiguous strokes

Junction closure

Stroke thickness

Physical artifacts

Hatching lines

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Texture & shading

Global change

Scaffolds

Deliberately non-smooth

Junction closure

Messy & ambiguous strokes

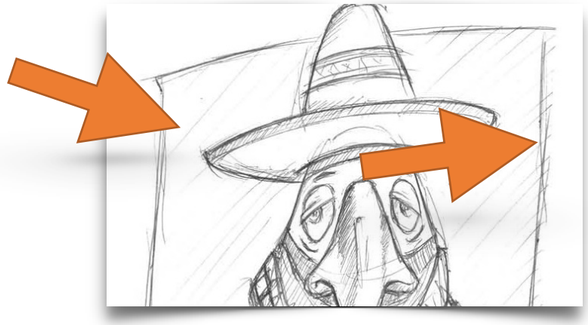
Stroke thickness

Physical artifacts

Hatching lines

Ideal Cleaned Sketch

Global change



- **Consolidate rough strokes**
  - Messy & ambiguous strokes
  - Physical artifacts
- **Identify and separate non-shape strokes**
- **Close junctions**
- **Retain**
  - Stroke thickness & color
  - Deliberately non-smooth
  - Global change (out of scope)

Texture & shading

Scaffolds

Deliberately non-smooth

Junction closure

Messy & ambiguous strokes

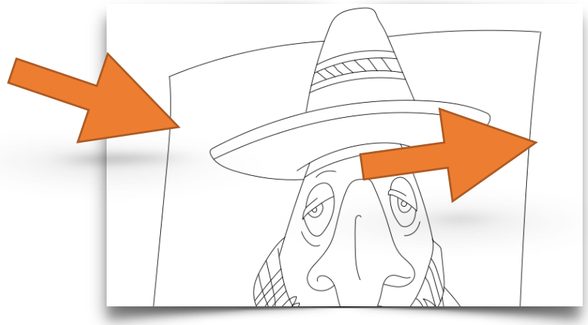
Physical artifacts

Stroke thickness

Hatching lines

Ideal Cleaned Sketch

Global change



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- **Identify and separate non-shape strokes**
- **Close junctions**
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  - Global change (out of scope)

Texture & shading

Scaffolds

Deliberately non-smooth

Junction closure

Messy & ambiguous strokes

Hatching lines

Physical artifacts

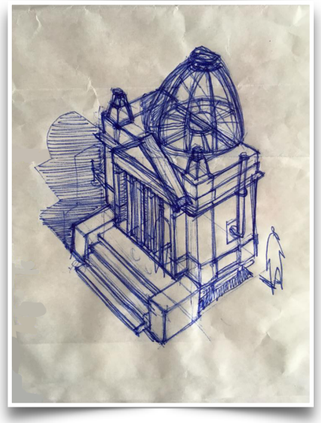
Stroke thickness

Dataset Creation

- **5 genres, 281 sketches**

Genre (#curated/#total)

Architecture (12/26)



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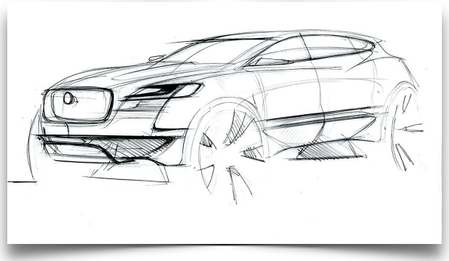
Design (33/40)



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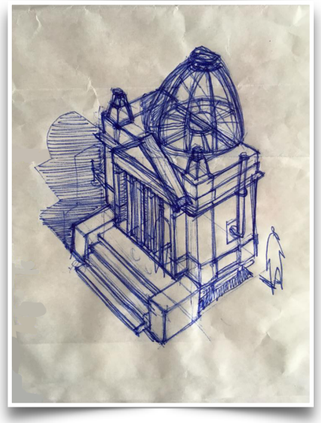
Dataset Creation

- **5 genres, 281 sketches**
- **94% Creative Commons**

Genre (#curated/#total)

Architecture (12/26)



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Freeform (33/86)

© Preston Blair

Logo (12/29)

CC-BY-NC-2.0 © Anna a

Fashion (11/40)

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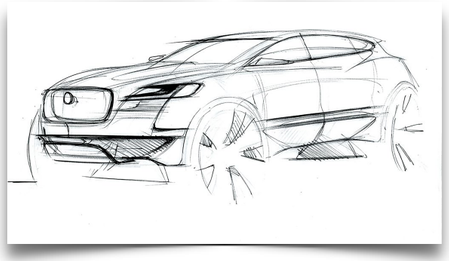
Design (33/40)



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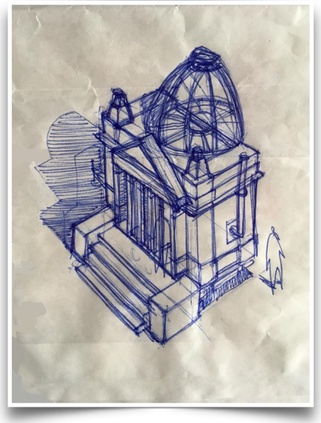
Dataset Creation

- 5 genres, 281 sketches
- 94% Creative Commons
- 39 authors

Genre (#curated/#total)

Architecture (12/26)



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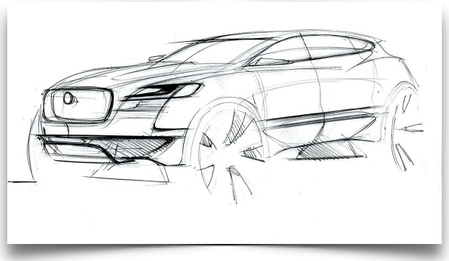
Design (33/40)



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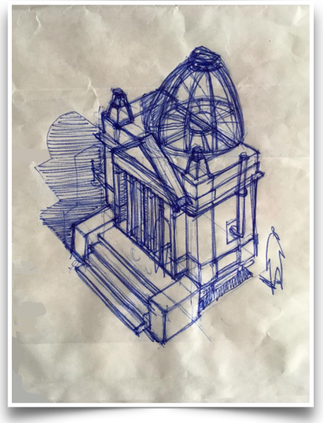
Dataset Creation

- **5 genres, 281 sketches**
- **94% Creative Commons**
- **39 authors**
- **101 curated sketches**, **3 ground truth** per curated sketch

Genre (#curated/#total)

Architecture (12/26)



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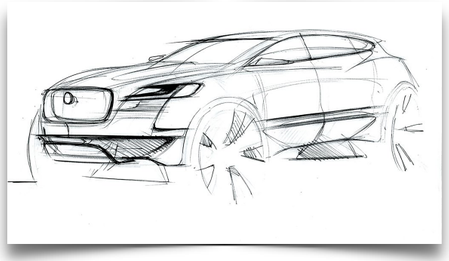
Fashion (11/40)

CC-BY-SA-4.0 © Myriam Lasserre

Design (33/40)



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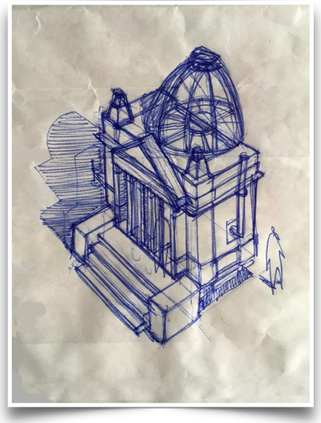
Dataset Creation

- **5 genres, 281 sketches**
- **94% Creative Commons**
- **39 authors**
- **101 curated sketches**, **3 ground truth** per curated sketch
- Curated sketches contain **both raster & vector** versions

Genre (#curated/#total)

Architecture (12/26)



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Fashion (11/40)

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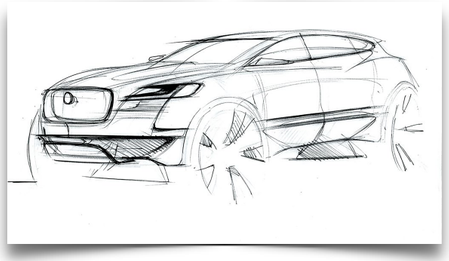
Design (33/40)



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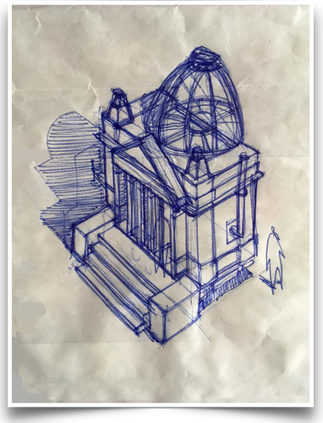
Dataset Creation

- **5 genres, 281 sketches**
- **94% Creative Commons**
- **39 authors**
- **101 curated sketches**, **3 ground truth** per curated sketch
- Curated sketches contain **both raster & vector** versions
- **40 baseline** rough sketches

Genre (#curated/#total)

Architecture (12/26)



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Logo (12/29)

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Fashion (11/40)

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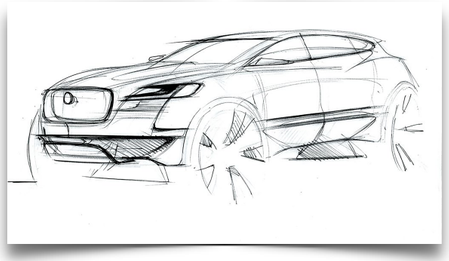
Design (33/40)



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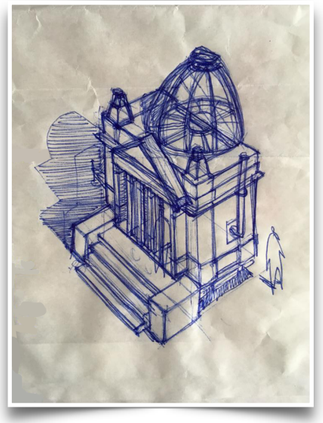
Dataset Creation

- **5 genres, 281 sketches**
- **94% Creative Commons**
- **39 authors**
- **101 curated sketches**, **3 ground truth** per curated sketch
- Curated sketches contain **both raster & vector** versions
- **40 baseline** rough sketches
- Rich tags (author, genre, stroke type, back ground, …)

Genre (#curated/#total)

Architecture (12/26)



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Freeform (33/86)

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Logo (12/29)

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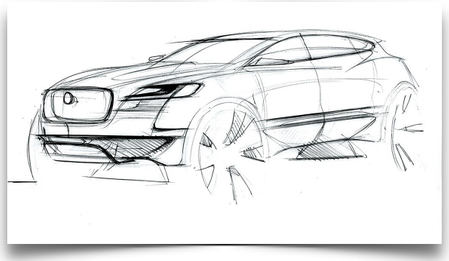
Fashion (11/40)

CC-BY-SA-4.0 © Myriam Lasserre

Design (33/40)



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Ground Truth Creation

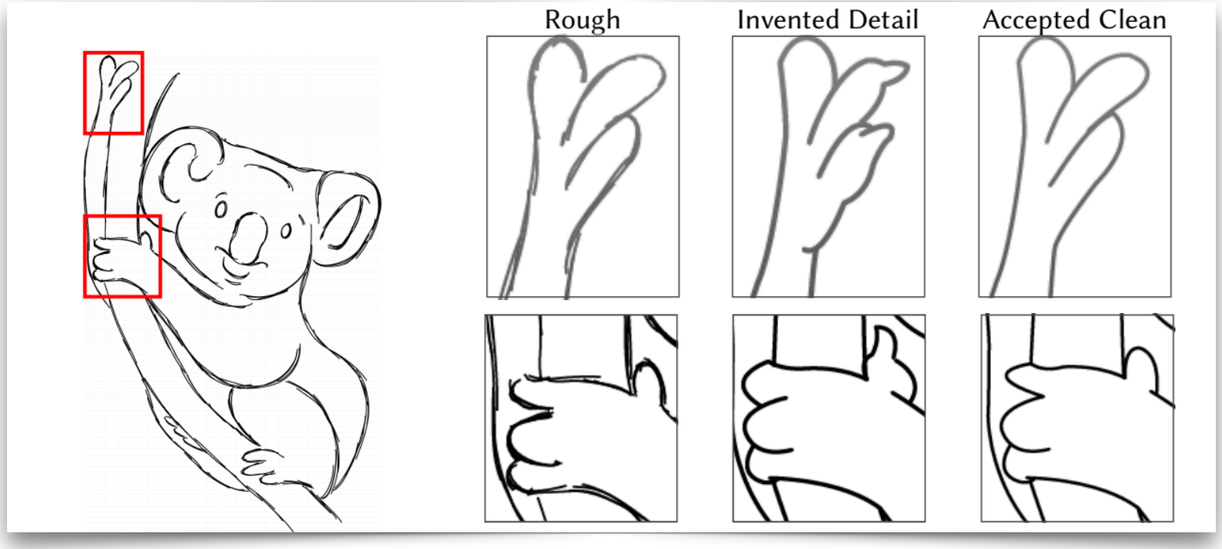
- 7 professional artists

Ground Truth Creation

- 7 professional artists
- Vector strokes, close junctions

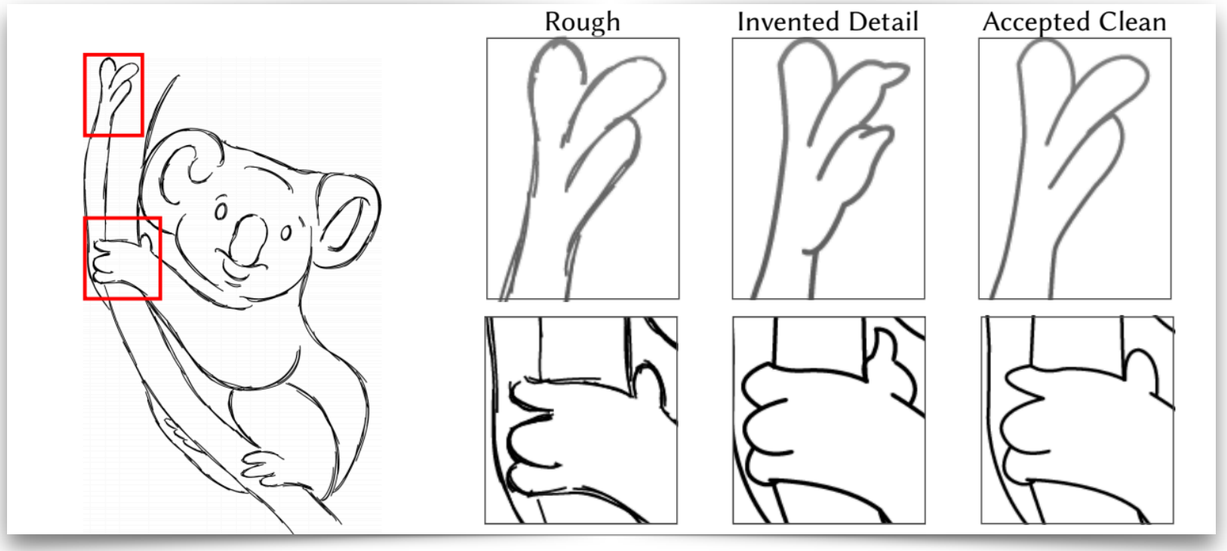
Ground Truth Creation

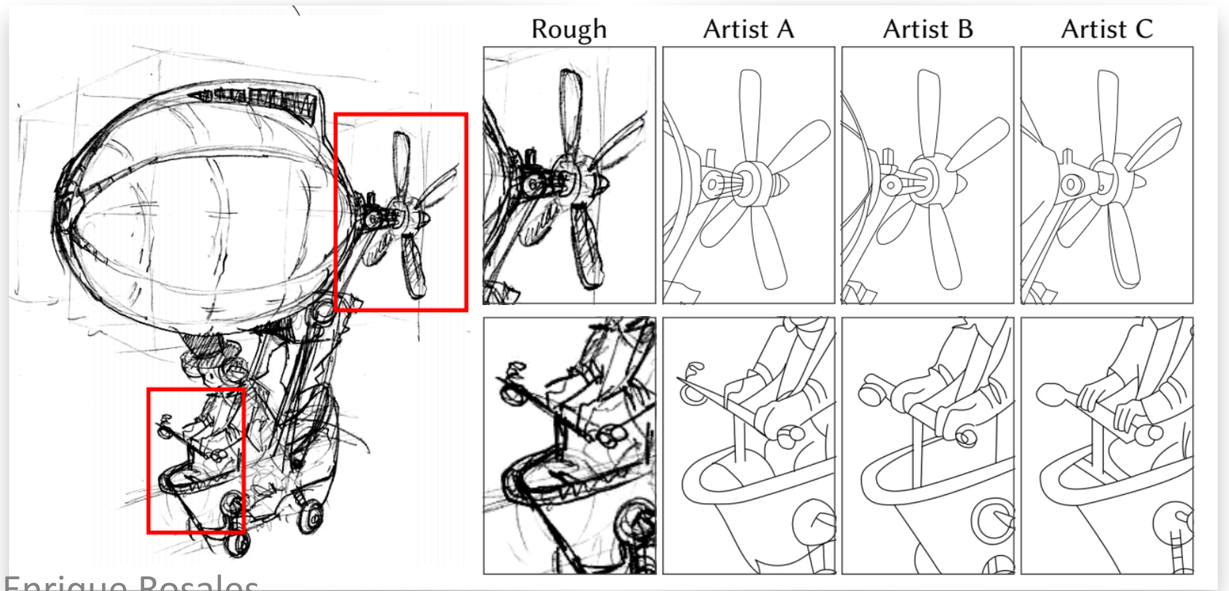
- 7 professional artists
- Vector strokes, close junctions
- No iteration



Ground Truth Creation

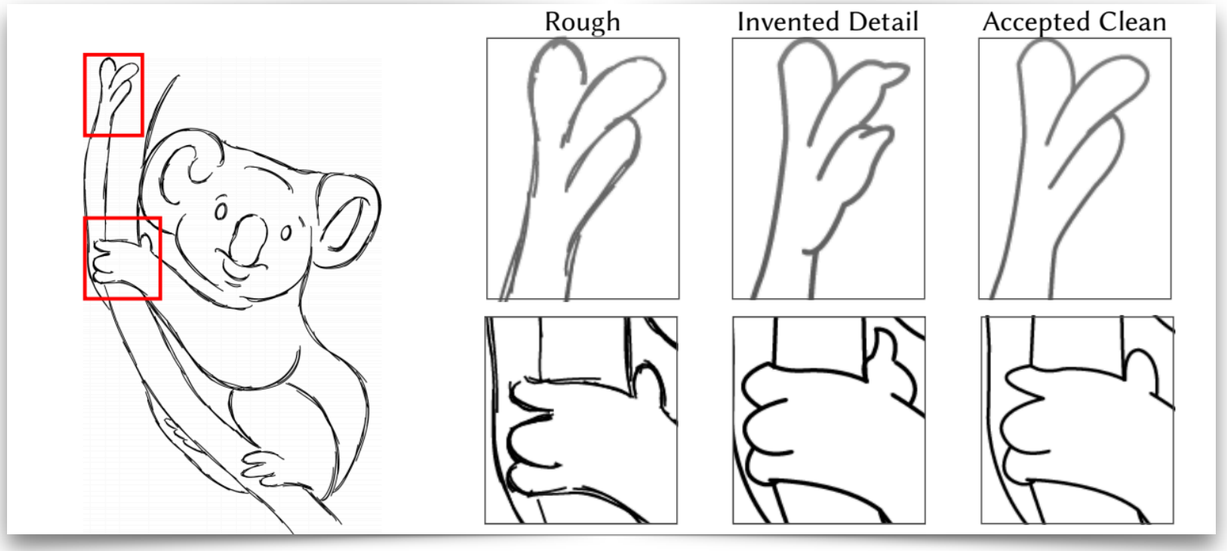
- 7 professional artists
- Vector strokes, close junctions
- No iteration
- Make best guess

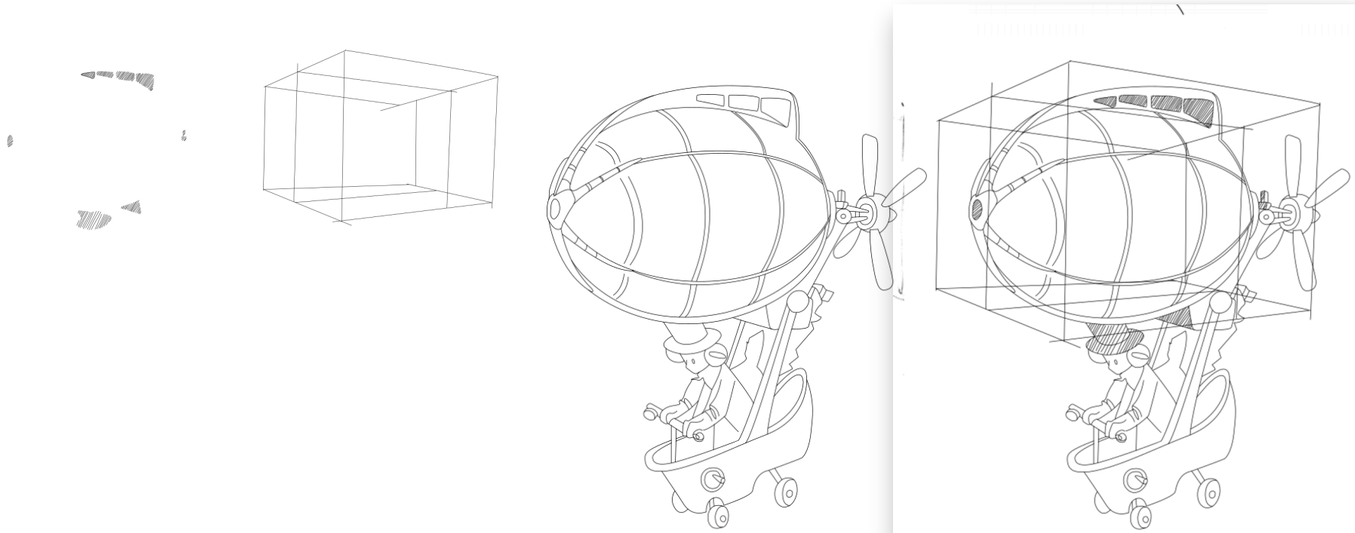


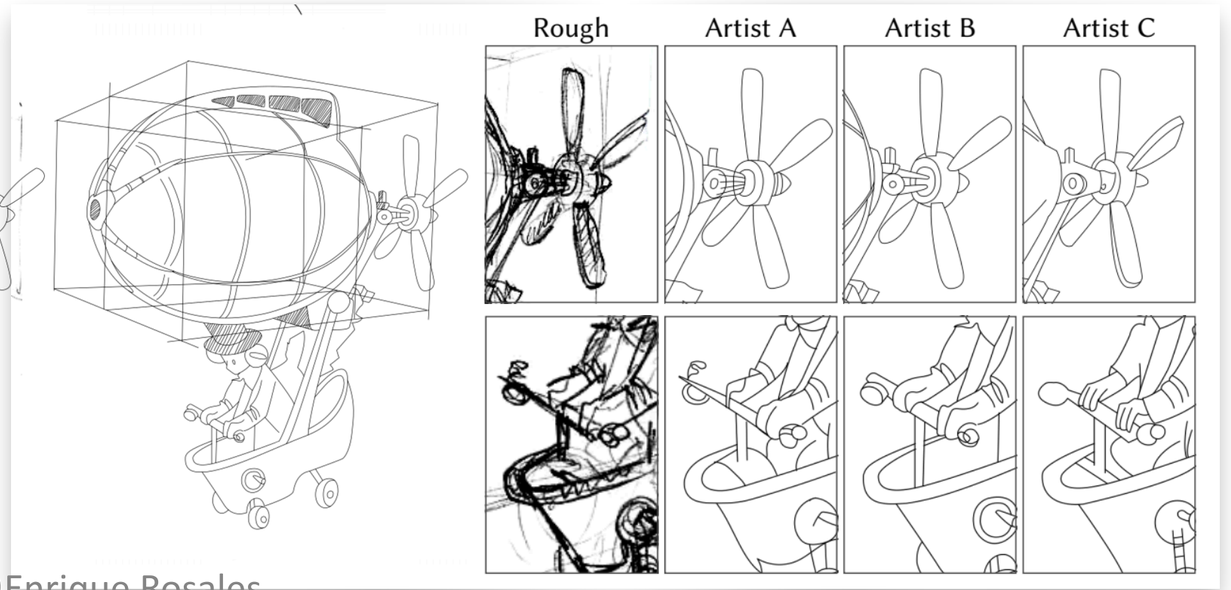


Ground Truth Creation

- 7 professional artists
- Vector strokes, close junctions
- No iteration
- Make best guess
- Layer separation

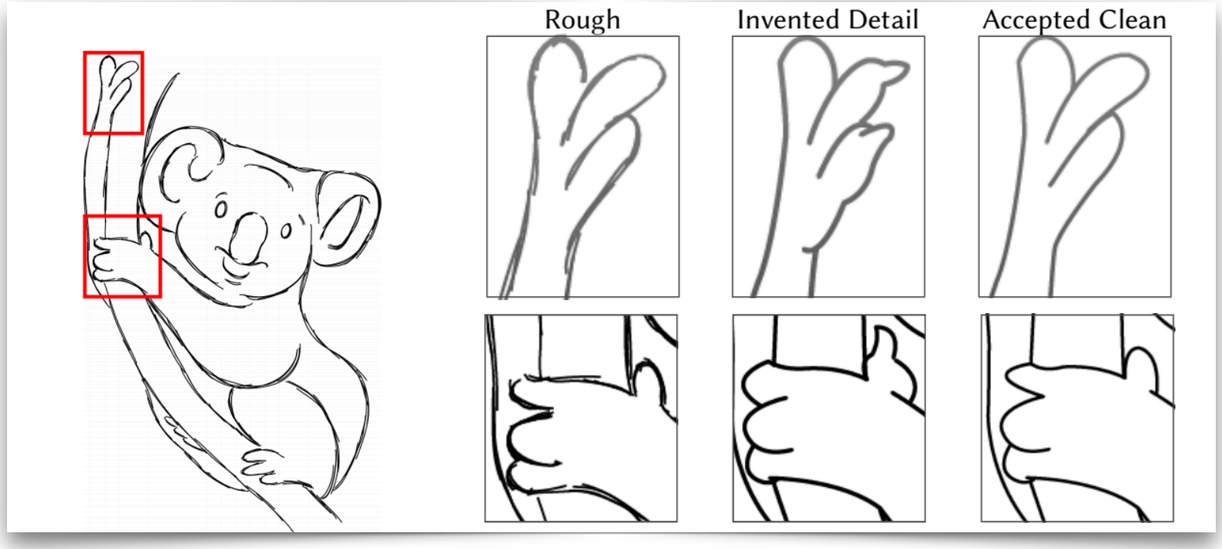


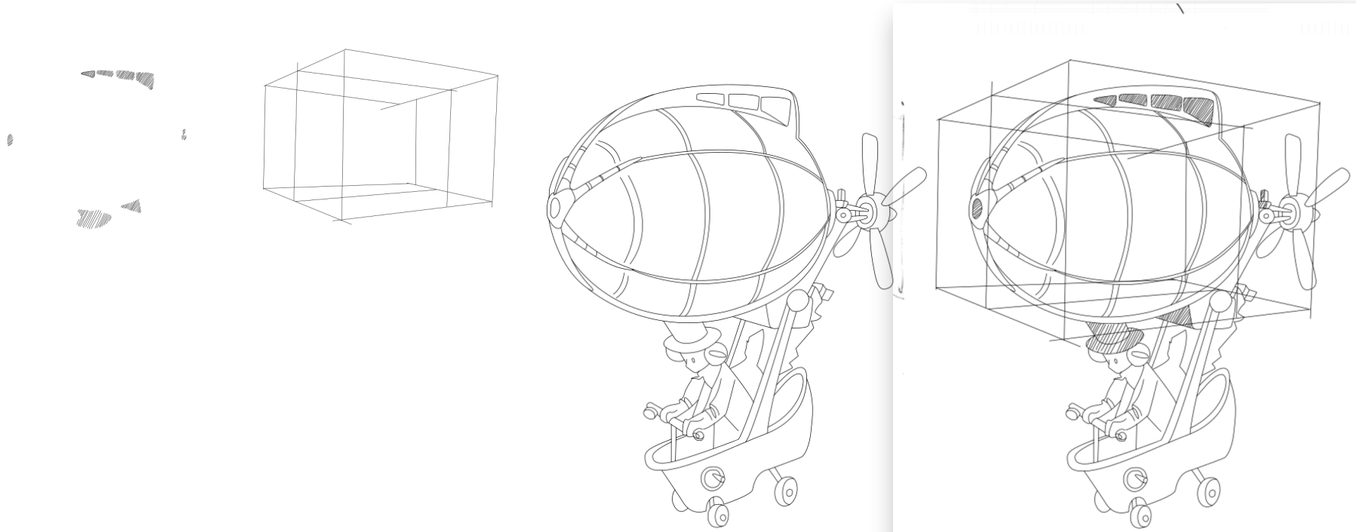


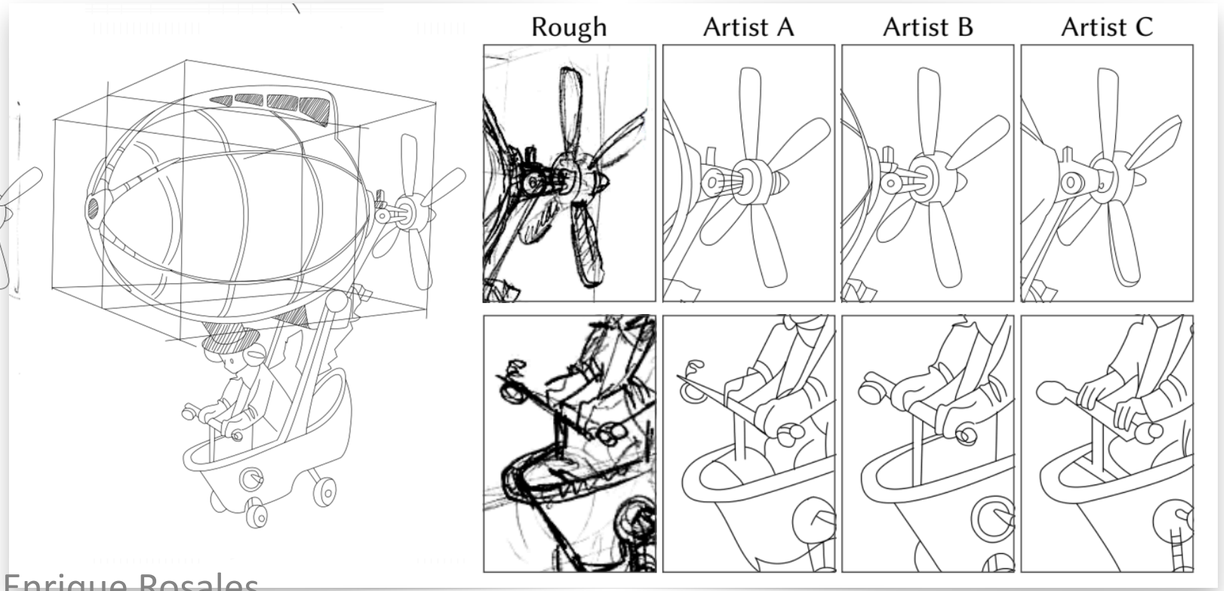


Ground Truth Creation

- 7 professional artists
- Vector strokes, close junctions
- No iteration
- Make best guess
- Layer separation
- Uniform stroke color & width

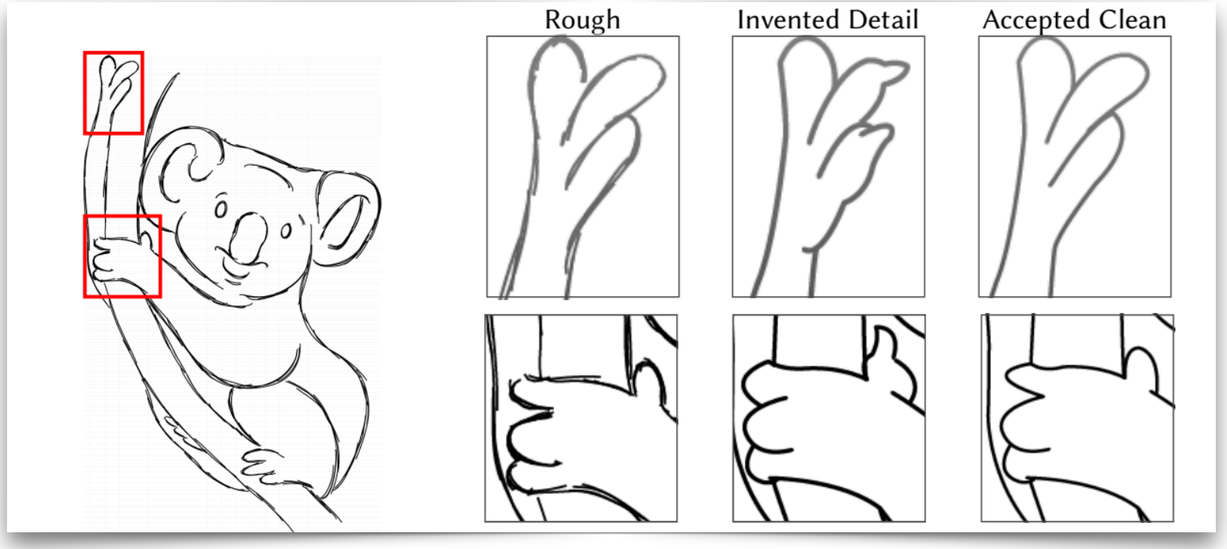


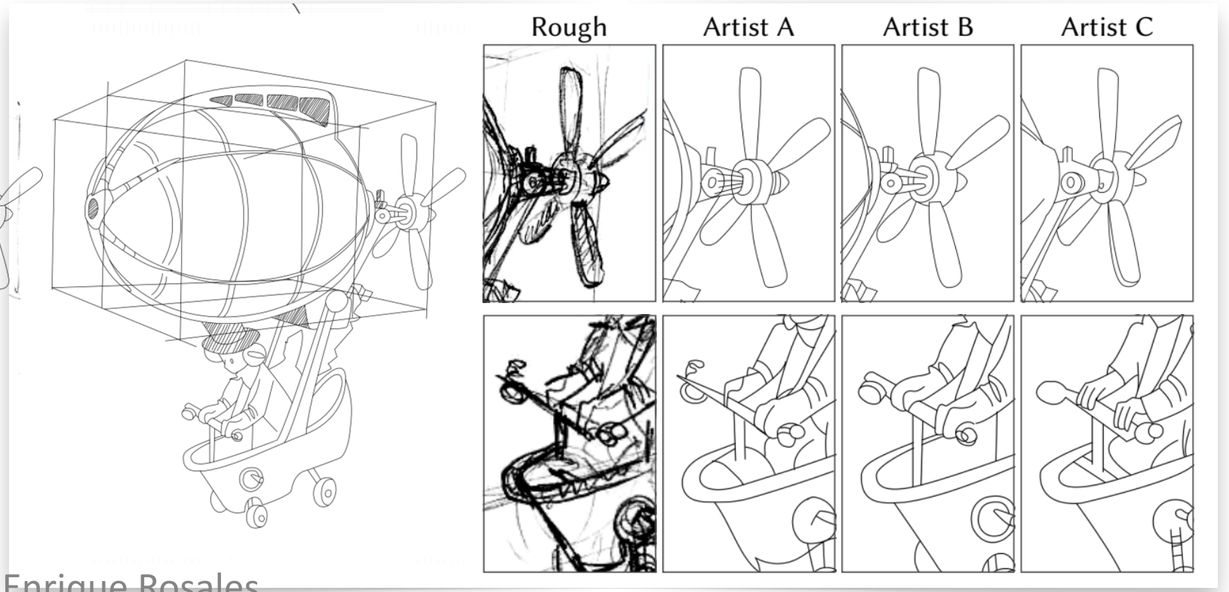




Ground Truth Creation

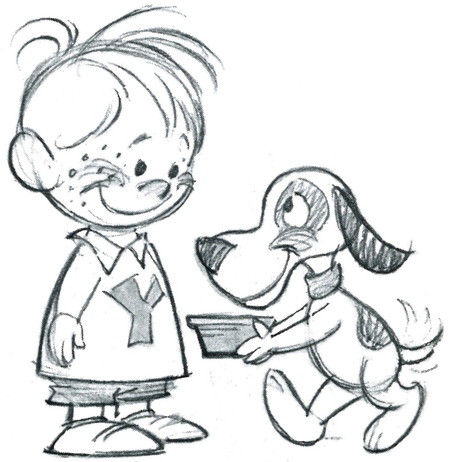
- 7 professional artists
- Vector strokes, close junctions
- No iteration
- Make best guess
- Layer separation
- Uniform stroke color & width
- Imperfect junctions





Metrics

Rough sketch



Sketch cleanup algorithms

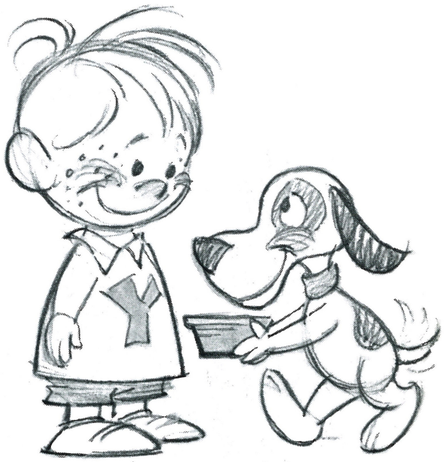
Automatic cleaned sketch

Image: ©Preston Blair

Metrics

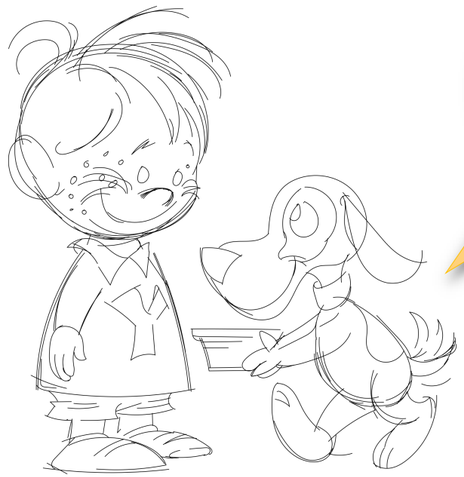
- How well do algorithmically cleaned rough sketches match ground truth?

Rough sketch



Sketch cleanup algorithms

Automatic cleaned sketch



Similar to ground truth?

Image: ©Preston Blair

Metrics

- How well do algorithmically cleaned rough sketches match ground truth?
- What is the quality of vector paths in the output?

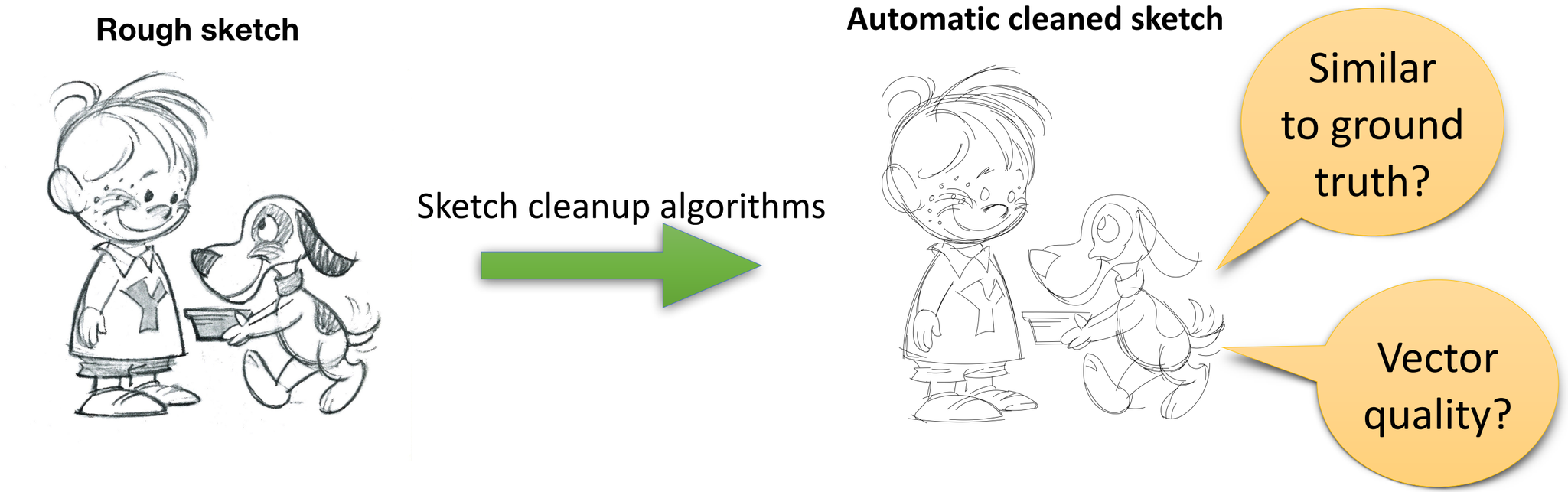


Image: ©Preston Blair

Metrics

- How well do algorithmically cleaned rough sketches match ground truth?
- What is the quality of vector paths in the output?
- How fast and reliable are the algorithms?

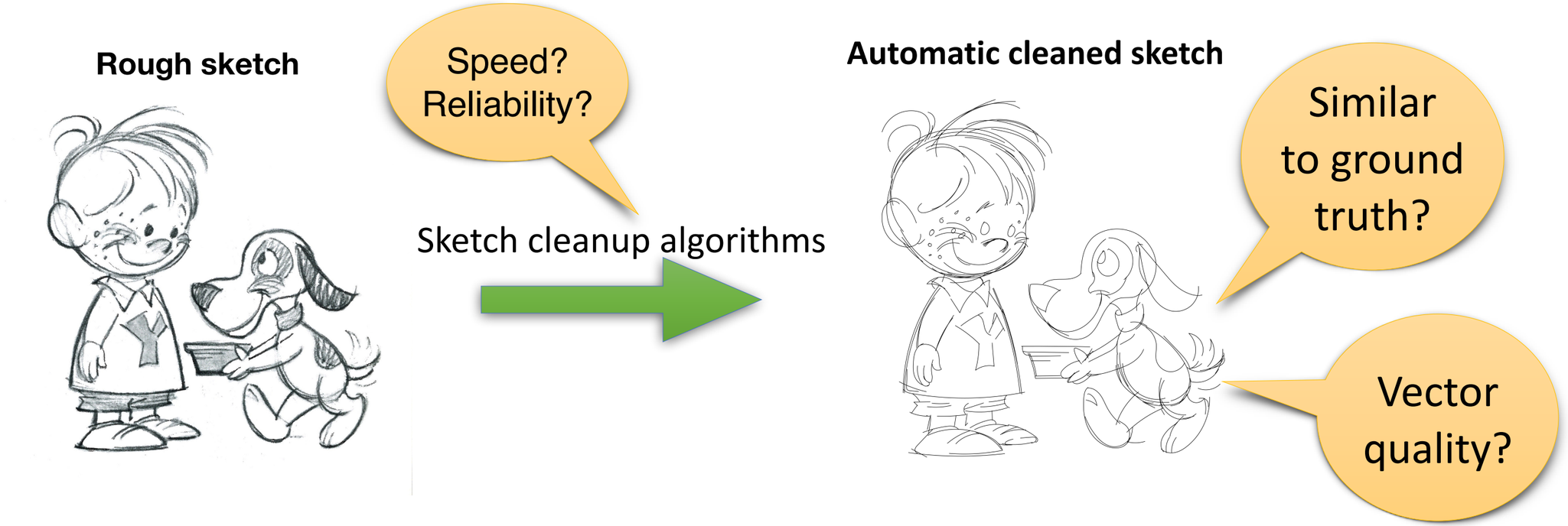
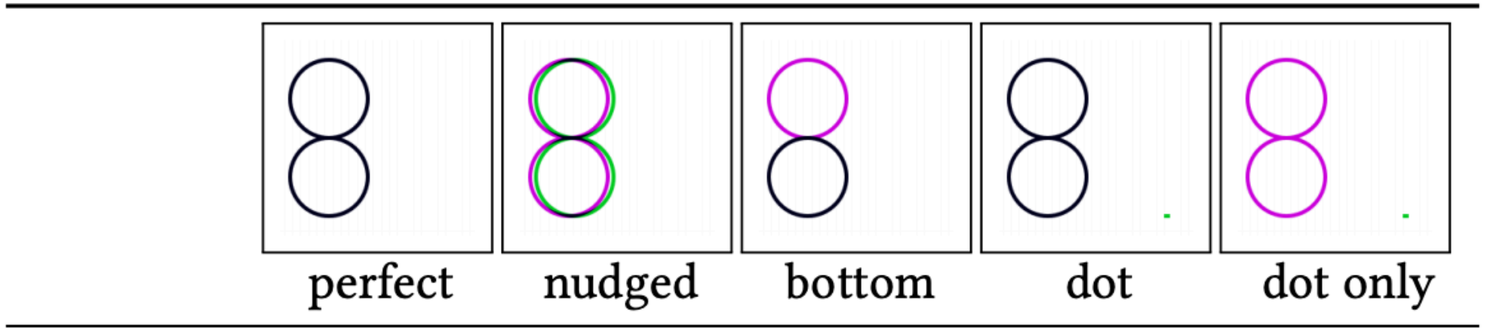


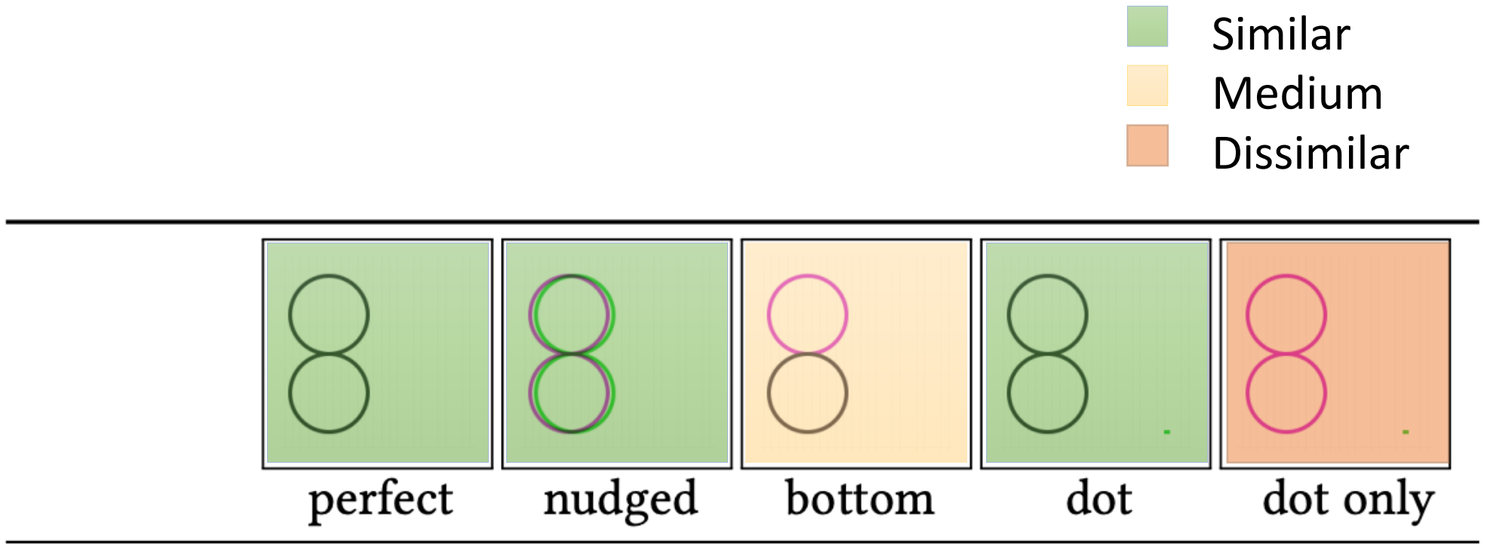
Image: ©Preston Blair

Metrics



Metrics

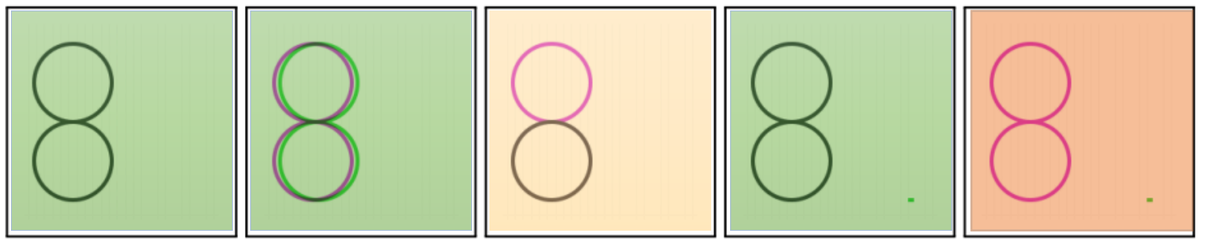
- **Similarity metrics**



Metrics

- **Similarity metrics**
  - Chamfer distance (lower is better)

Similar
Medium
Dissimilar

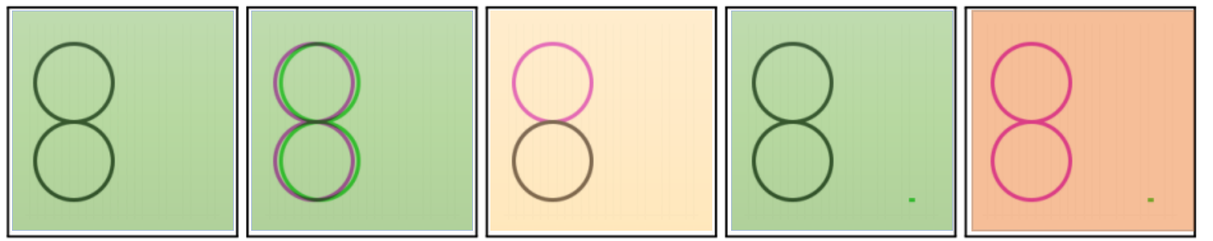


	perfect	nudged	bottom	dot	dot only
Chamfer	0.00	0.01	0.06	0.002	**0.60**

Metrics

- **Similarity metrics**
  - Chamfer distance (lower is better)
  - F-score (higher is better)

Similar
Medium
Dissimilar

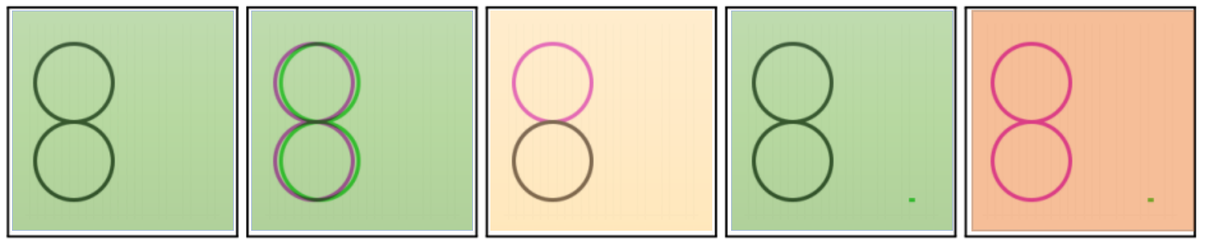


	perfect	nudged	bottom	dot	dot only
Chamfer	0.00	0.01	0.06	0.002	**0.60**
F-score 0%	1.00	**0.23**	0.68	0.99	0.00
F-score 5%	1.00	**1.00**	0.73	0.99	0.00

Metrics

- **Similarity metrics**
  - Chamfer distance (lower is better)
  - F-score (higher is better)
  - Hausdorff distance (lower is better)

Similar
Medium
Dissimilar

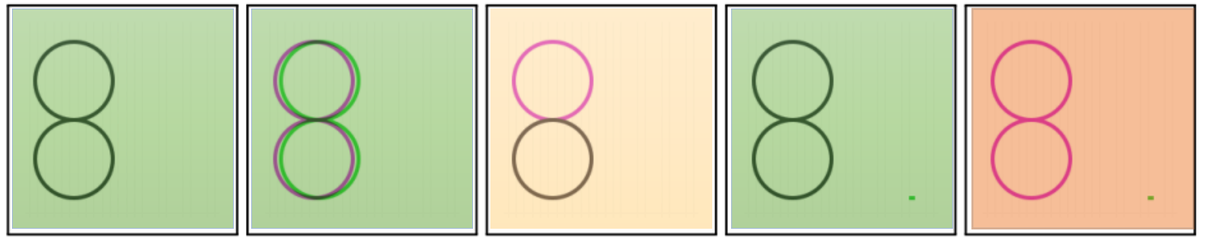


	perfect	nudged	bottom	dot	dot only
Chamfer	0.00	0.01	0.06	0.002	**0.60**
F-score 0%	1.00	**0.23**	0.68	0.99	0.00
F-score 5%	1.00	**1.00**	0.73	0.99	0.00
Hausdorff	0.00	0.03	0.40	**0.45**	1.05

Metrics

- **Similarity metrics**
  - Chamfer distance (lower is better)
  - F-score (higher is better)
  - Hausdorff distance (lower is better)
  - IOU (higher is better)

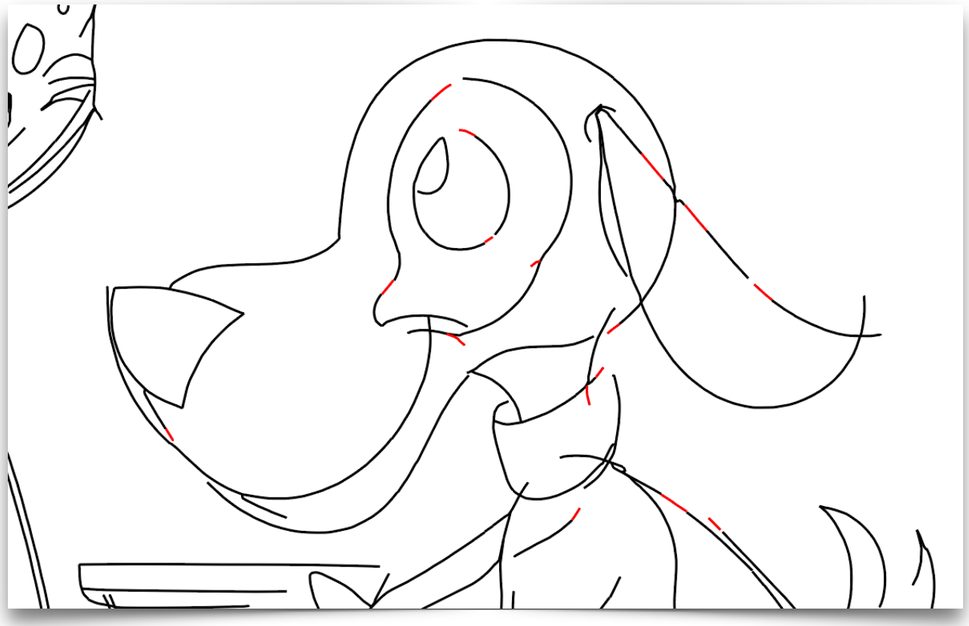
Similar
Medium
Dissimilar



	perfect	nudged	bottom	dot	dot only
Chamfer	0.00	0.01	0.06	0.002	**0.60**
F-score 0%	1.00	**0.23**	0.68	0.99	0.00
F-score 5%	1.00	**1.00**	0.73	0.99	0.00
Hausdorff	0.00	0.03	0.40	**0.45**	1.05
IOU	1.00	**0.11**	0.51	0.99	0.00

Metrics

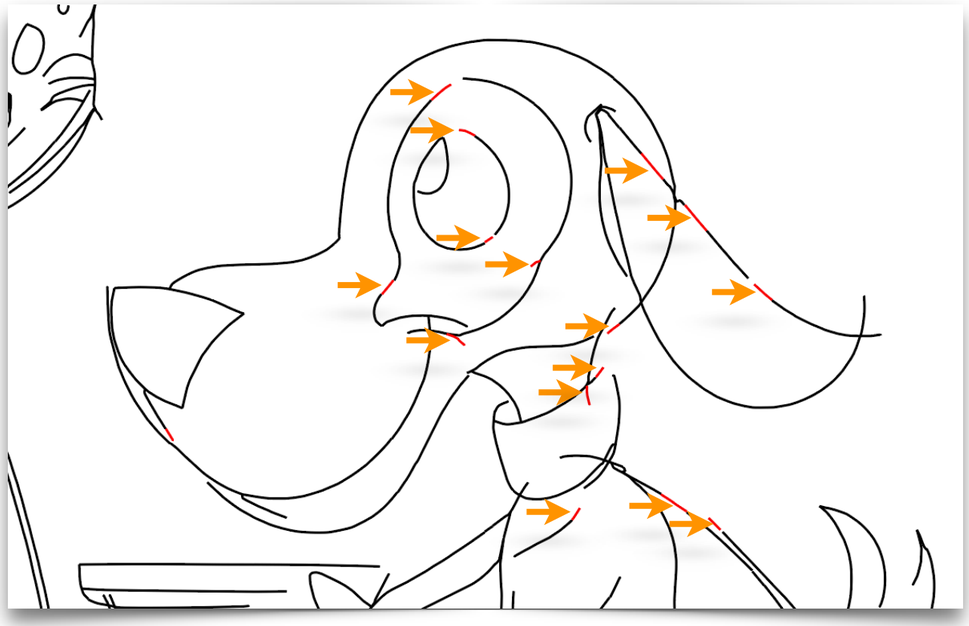
- **Vector quality**
  - Stroke length



Vector algorithmically results

Metrics

- **Vector quality**
  - Stroke length

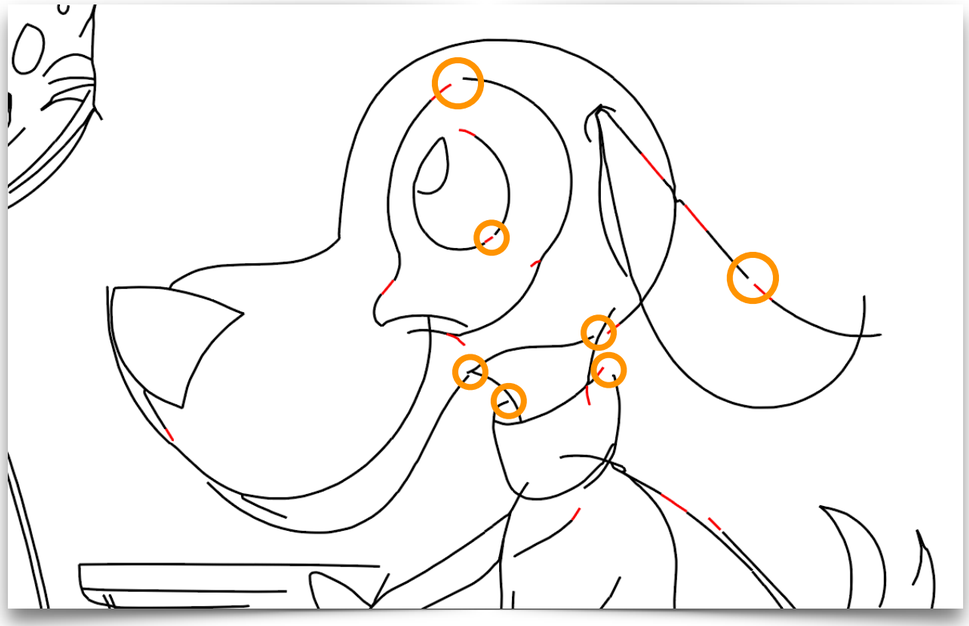


Vector algorithmically results

Metrics

- **Vector quality**
  - Stroke length
  - Junction quality

Vector algorithmically results



Benchmark

- Algorithms
- Parameters
  - Based on author's recommendation

Method	Input	Output
TopologyDriven [Noris et al. 2013]	raster	vector
FidelitySimplicity [Favreau et al. 2016]	raster	vector
DelaunayTriangulation [Parakkat et al. 2018]	raster	vector
PolyVector [Bessmeltsev and Solomon 2019]	raster	vector
StrokeAggregator [Liu et al. 2018]	**vector**	vector
MasteringSketching [Simo-Serra et al. 2018a]	raster	**raster**
RealTimeInking [Simo-Serra et al. 2018b]	raster	**raster**
TopologyDriven [Noris et al. 2013] → StrokeAggregator [Liu et al. 2018]	raster	vector
PolyVector [Bessmeltsev and Solomon 2019] → StrokeAggregator [Liu et al. 2018]	raster	vector

Benchmark

- Algorithms
- Parameters
  - Based on author's recommendation

A

Method	Input	Output
TopologyDriven [Noris et al. 2013]	raster	vector
FidelitySimplicity [Favreau et al. 2016]	raster	vector
DelaunayTriangulation [Parakkat et al. 2018]	raster	vector
PolyVector [Bessmeltsev and Solomon 2019]	raster	vector
StrokeAggregator [Liu et al. 2018]	**vector**	vector
MasteringSketching [Simo-Serra et al. 2018a]	raster	**raster**
RealTimeInking [Simo-Serra et al. 2018b]	raster	**raster**
TopologyDriven [Noris et al. 2013] → StrokeAggregator [Liu et al. 2018]	raster	vector
PolyVector [Bessmeltsev and Solomon 2019] → StrokeAggregator [Liu et al. 2018]	raster	vector

Benchmark

- Algorithms
- Parameters
  - Based on author's recommendation

A

B

Method	Input	Output
TopologyDriven [Noris et al. 2013]	raster	vector
FidelitySimplicity [Favreau et al. 2016]	raster	vector
DelaunayTriangulation [Parakkat et al. 2018]	raster	vector
PolyVector [Bessmeltsev and Solomon 2019]	raster	vector
StrokeAggregator [Liu et al. 2018]	**vector**	vector
MasteringSketching [Simo-Serra et al. 2018a]	raster	**raster**
RealTimeInking [Simo-Serra et al. 2018b]	raster	**raster**
TopologyDriven [Noris et al. 2013] → StrokeAggregator [Liu et al. 2018]	raster	vector
PolyVector [Bessmeltsev and Solomon 2019] → StrokeAggregator [Liu et al. 2018]	raster	vector

Benchmark

- Algorithms
- Parameters
  - Based on author's recommendation

	Method	Input	Output
A	TopologyDriven [Noris et al. 2013]	raster	vector
A	FidelitySimplicity [Favreau et al. 2016]	raster	vector
A	DelaunayTriangulation [Parakkat et al. 2018]	raster	vector
A	PolyVector [Bessmeltsev and Solomon 2019]	raster	vector
B	StrokeAggregator [Liu et al. 2018]	**vector**	vector
C	MasteringSketching [Simo-Serra et al. 2018a]	raster	**raster**
C	RealTimeInking [Simo-Serra et al. 2018b]	raster	**raster**
	TopologyDriven [Noris et al. 2013] → StrokeAggregator [Liu et al. 2018]	raster	vector
	PolyVector [Bessmeltsev and Solomon 2019] → StrokeAggregator [Liu et al. 2018]	raster	vector

Benchmark

- Algorithms
- Parameters
  - Based on author's recommendation

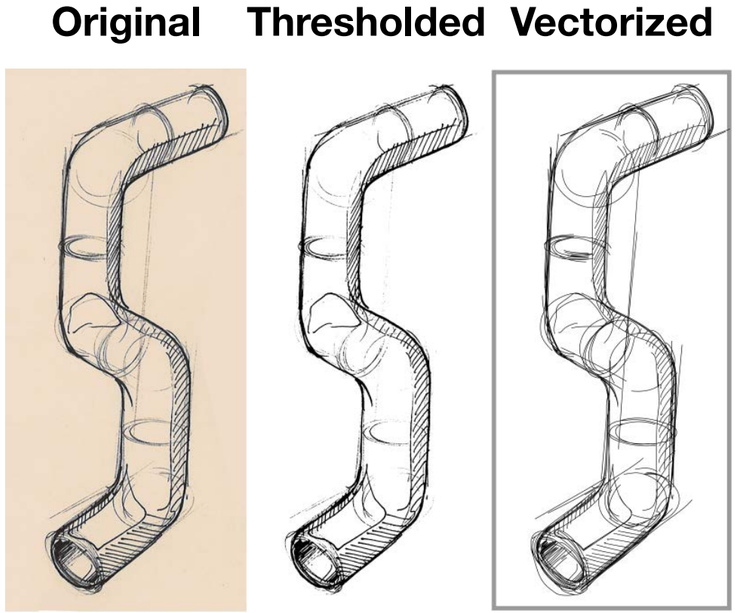
	Method	Input	Output
A	TopologyDriven [Noris et al. 2013]	raster	vector
	FidelitySimplicity [Favreau et al. 2016]	raster	vector
	DelaunayTriangulation [Parakkat et al. 2018]	raster	vector
	PolyVector [Bessmeltsev and Solomon 2019]	raster	vector
B	StrokeAggregator [Liu et al. 2018]	**vector**	vector
C	MasteringSketching [Simo-Serra et al. 2018a]	raster	**raster**
	RealTimeInking [Simo-Serra et al. 2018b]	raster	**raster**
D	TopologyDriven [Noris et al. 2013] → StrokeAggregator [Liu et al. 2018]	raster	vector
	PolyVector [Bessmeltsev and Solomon 2019] → StrokeAggregator [Liu et al. 2018]	raster	vector

Benchmark

- **Data preparation**

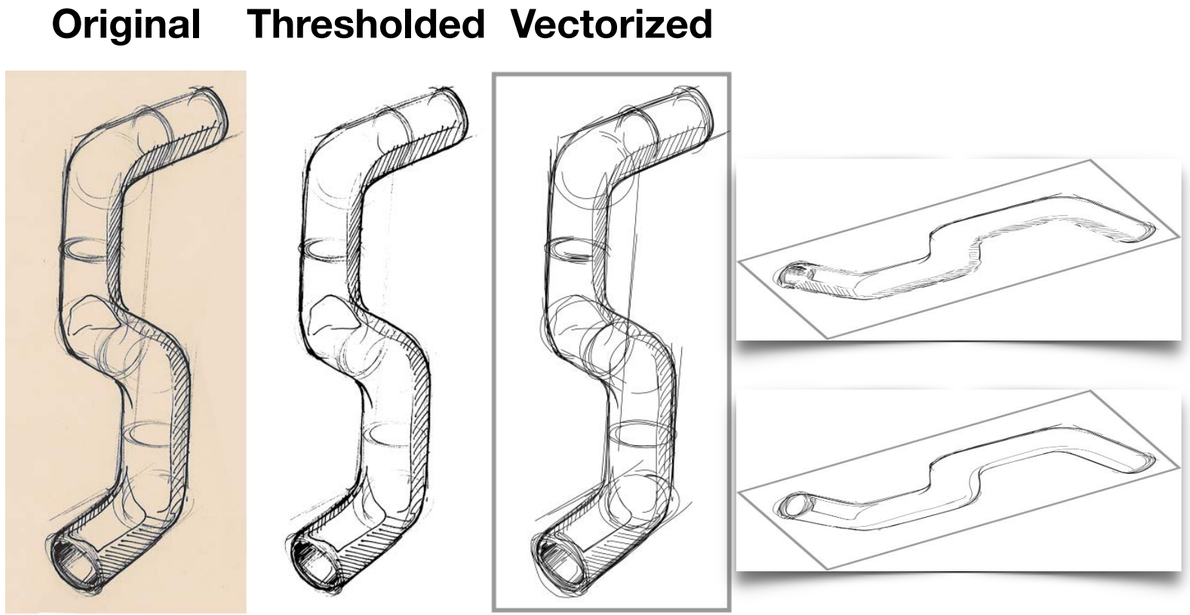
Benchmark

- **Data preparation**
  - Sketch format: original, thresholded, and vectorized



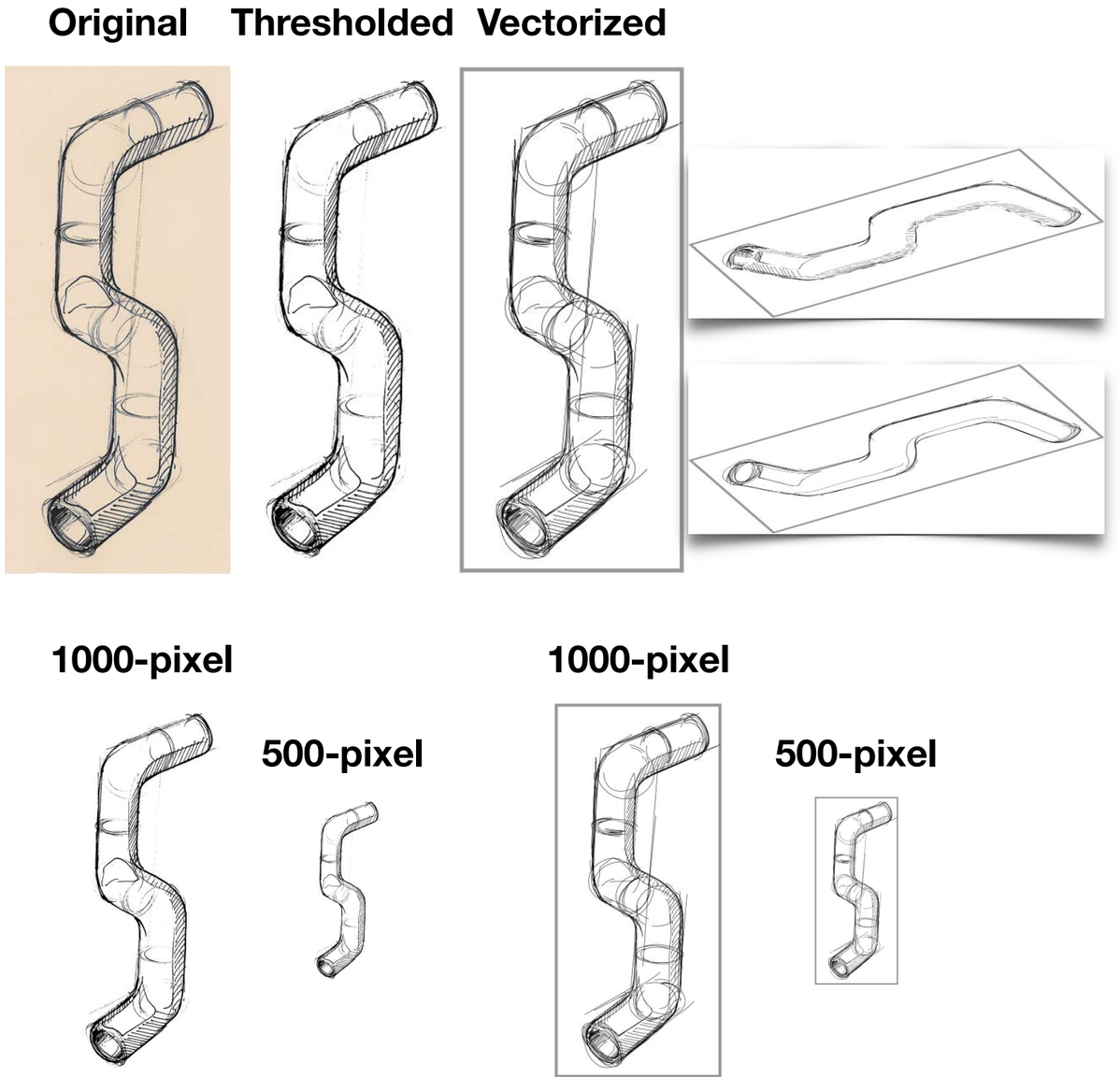
Benchmark

- **Data preparation**
  - Sketch format: original, thresholded, and vectorized
  - Layer separation



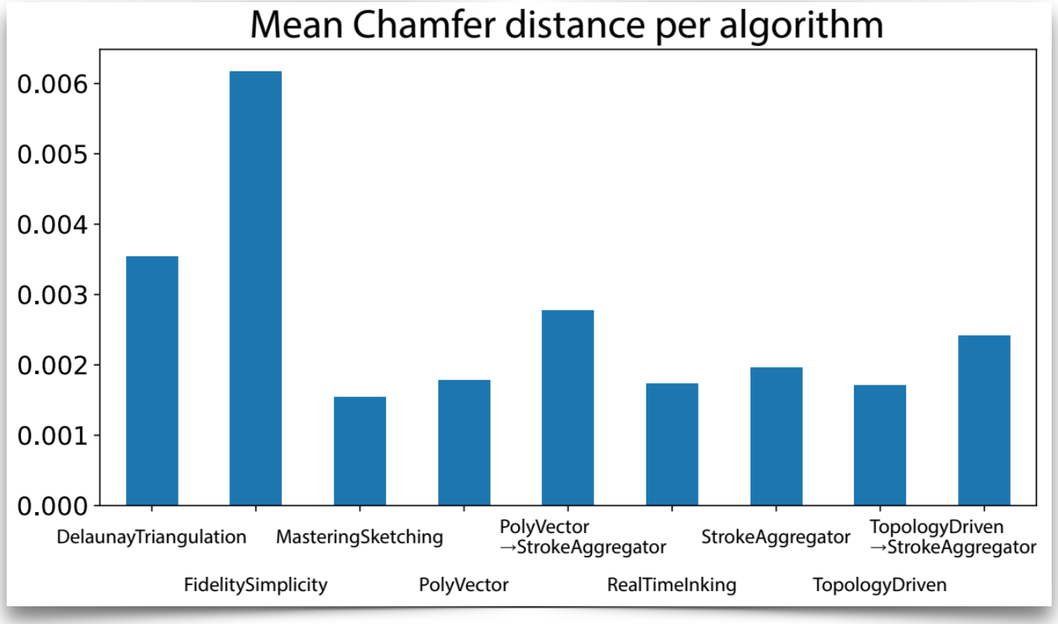
Benchmark

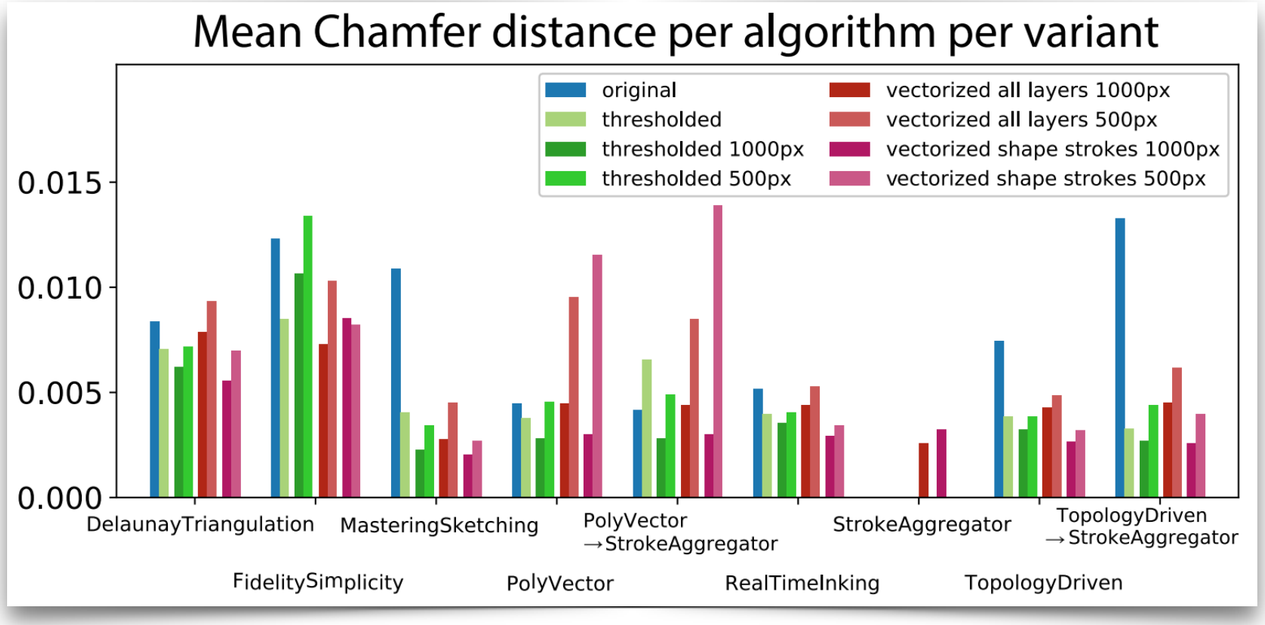
- **Data preparation**
  - Sketch format: original, thresholded, and vectorized
  - Layer separation
  - Resolution: original, 1000, and 500 long edge pixels



Benchmark

- How well do algorithmically cleaned rough sketches match ground truth?





Benchmark

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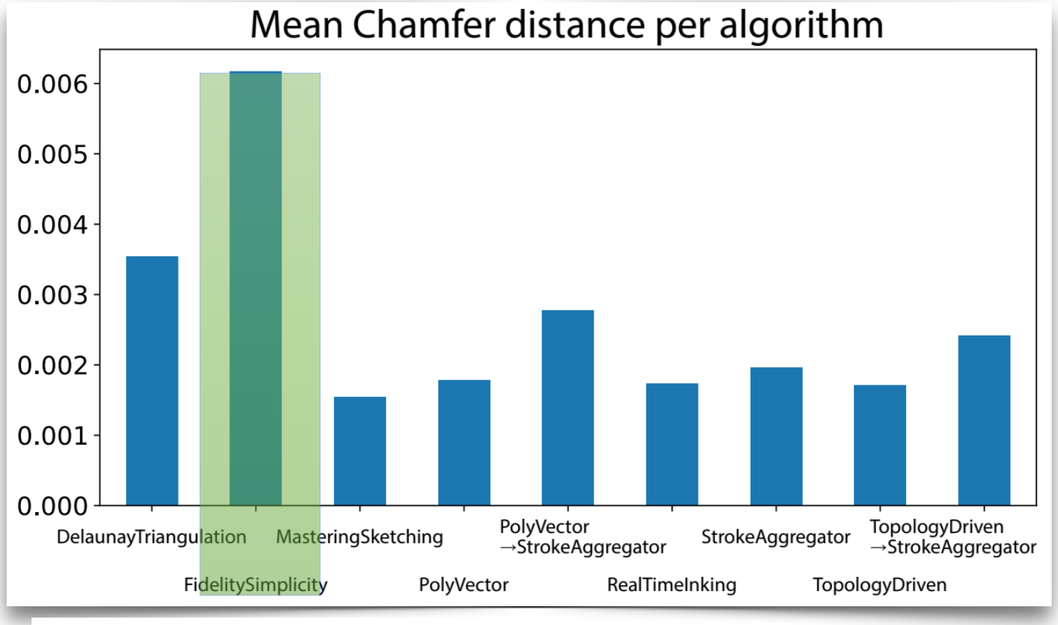
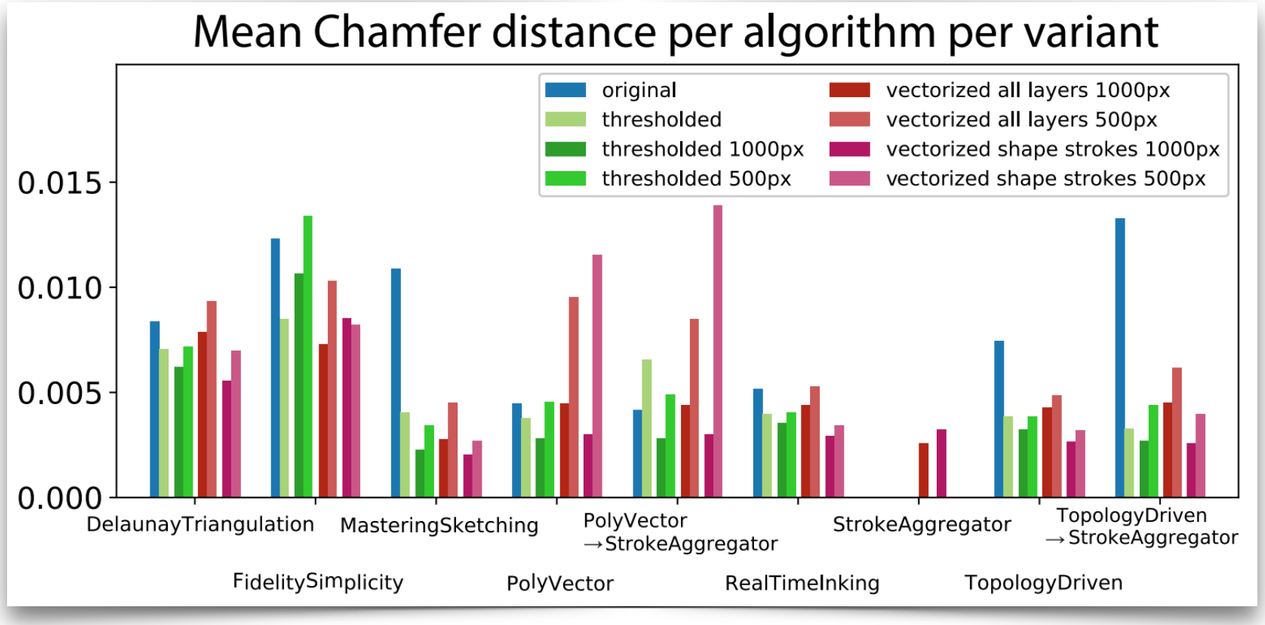


Fidelity vs Simplicity



Benchmark

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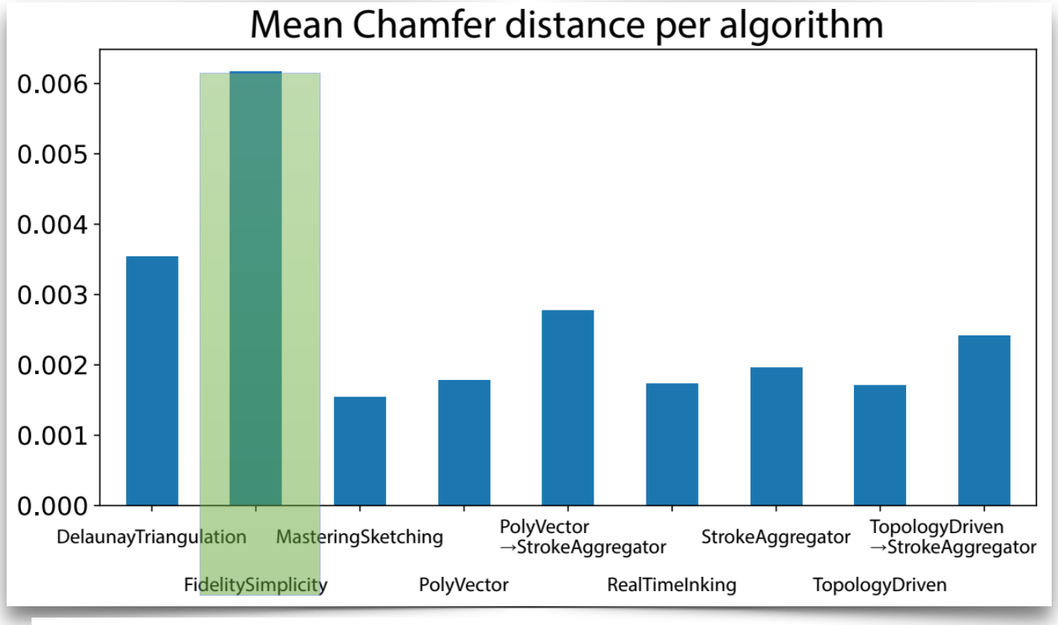
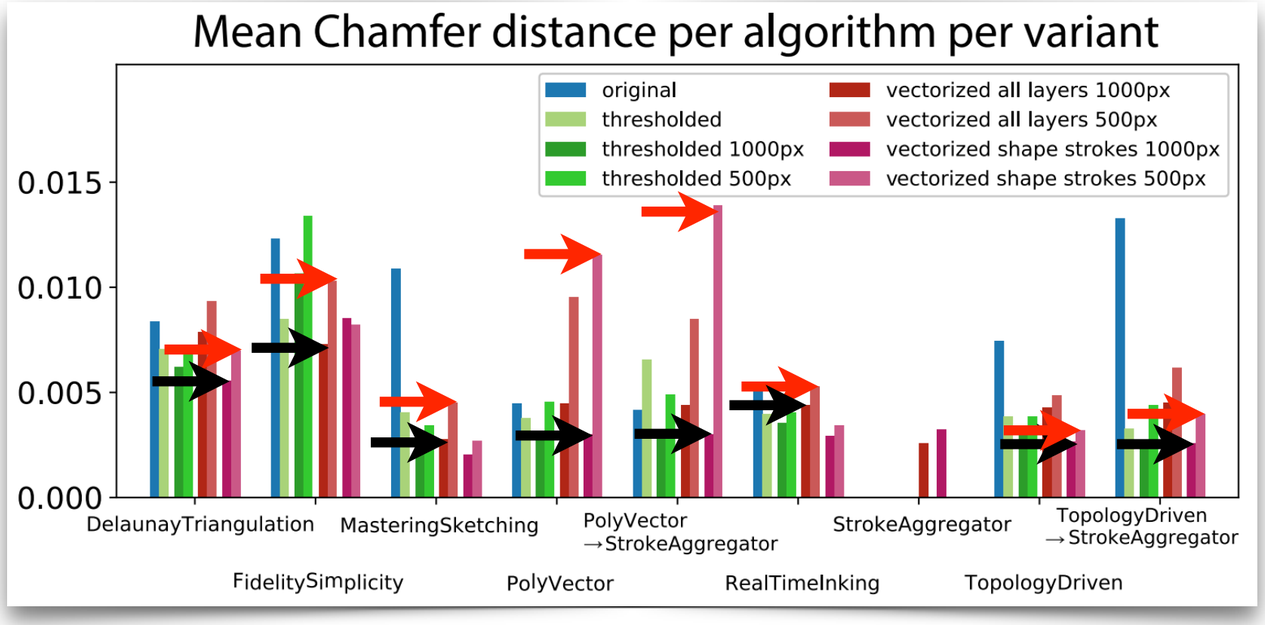


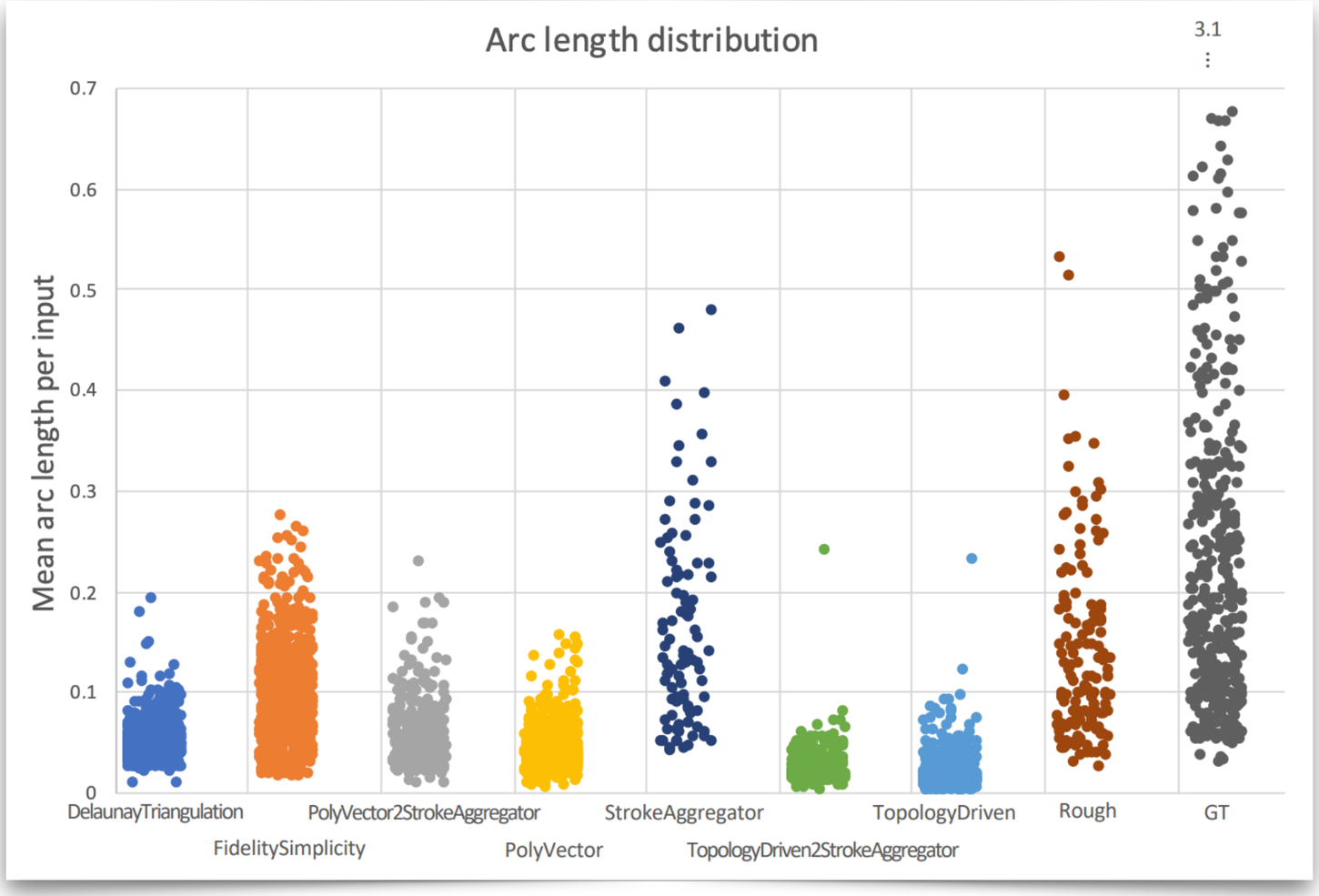
Fidelity vs Simplicity



Benchmark

- Vector quality

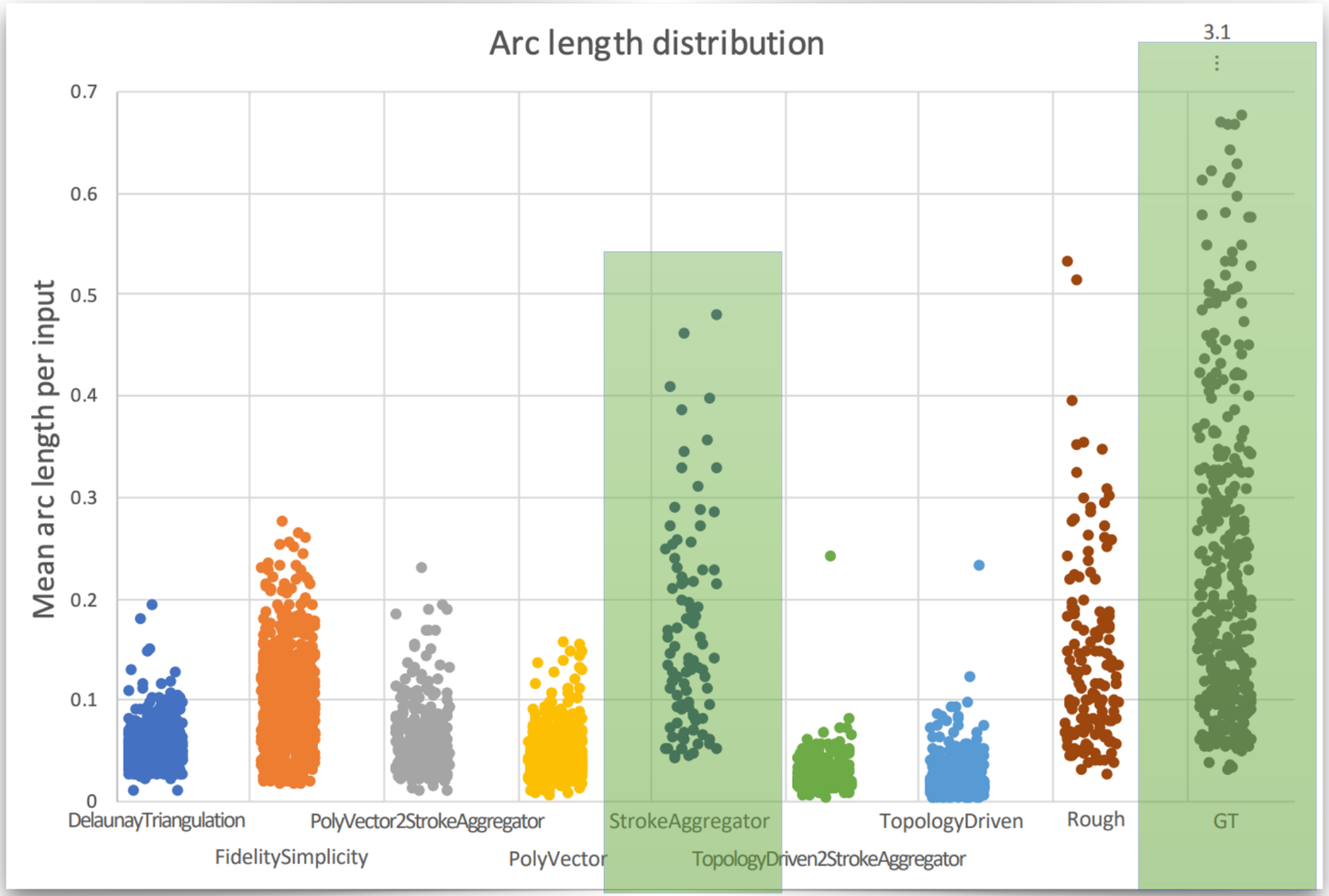
Stroke Length



Benchmark

- Vector quality

Stroke Length



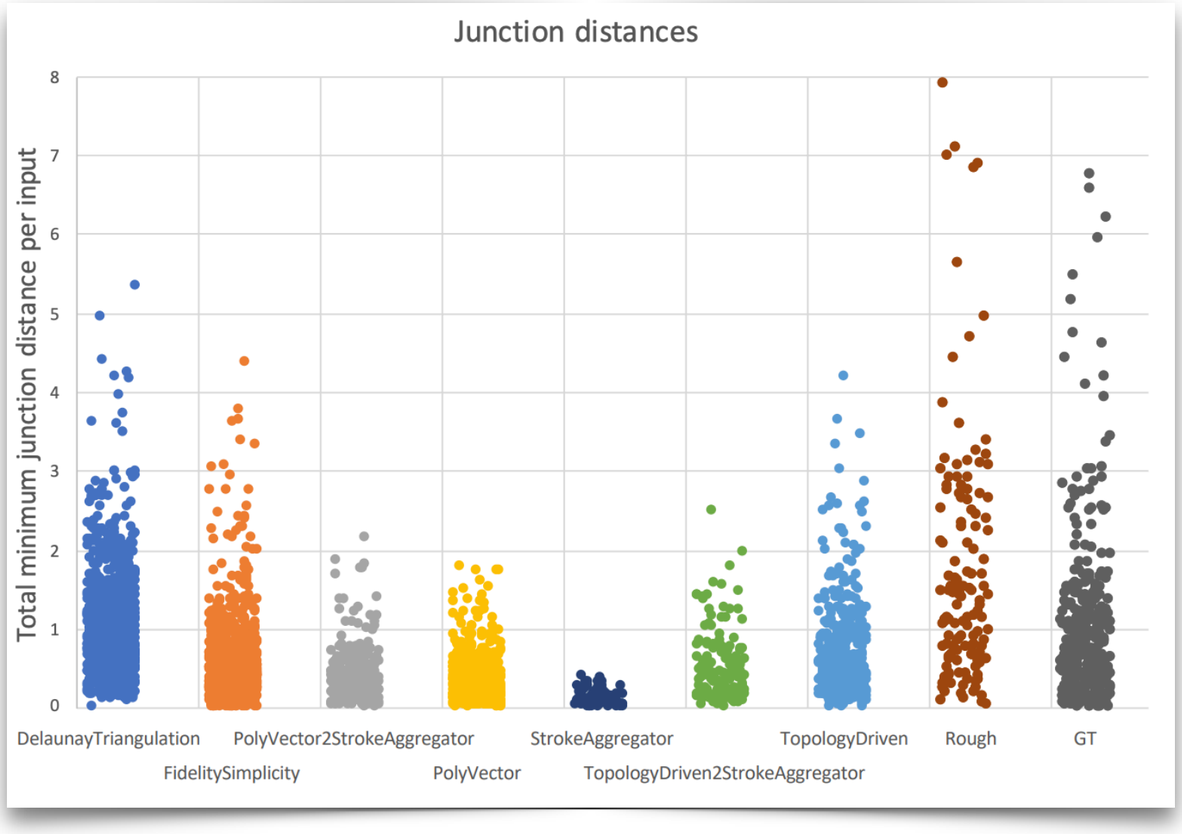
StrokeAggregator

Ground Truth

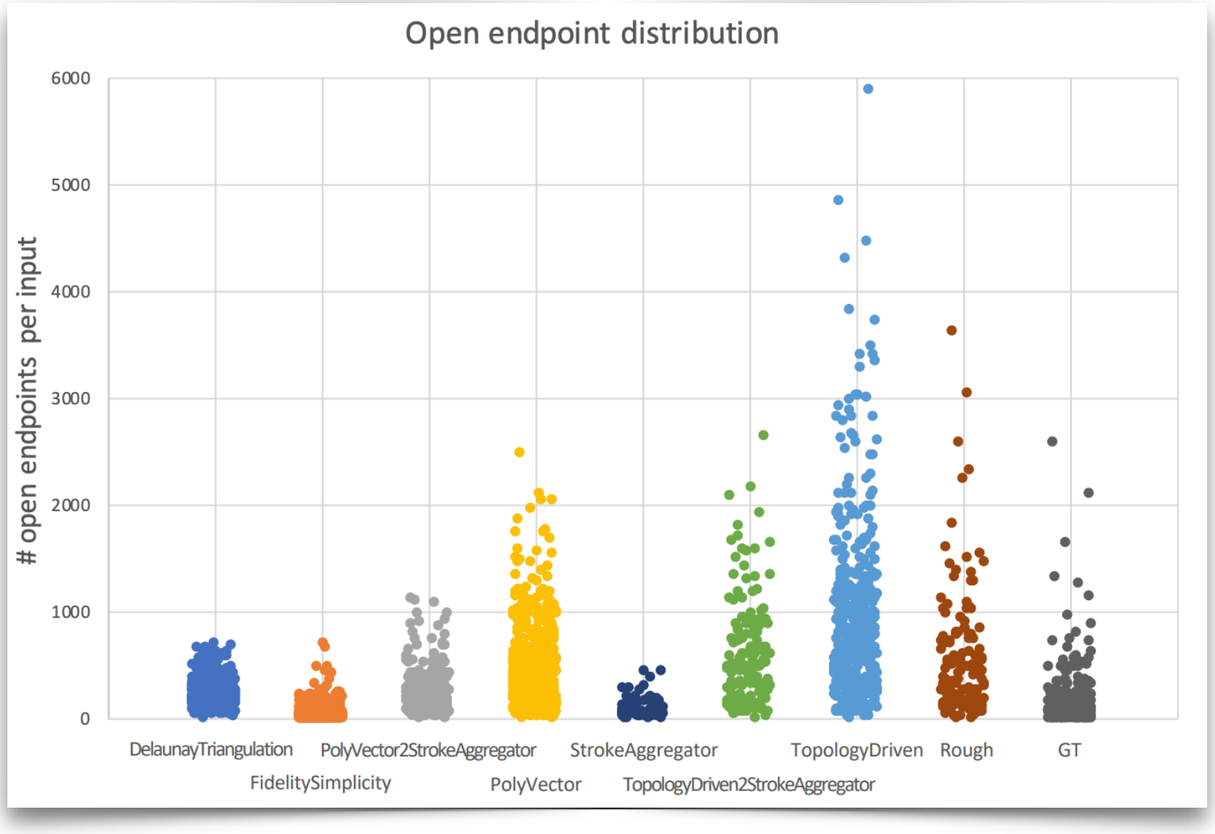
Benchmark

- Vector quality

Junction Distances



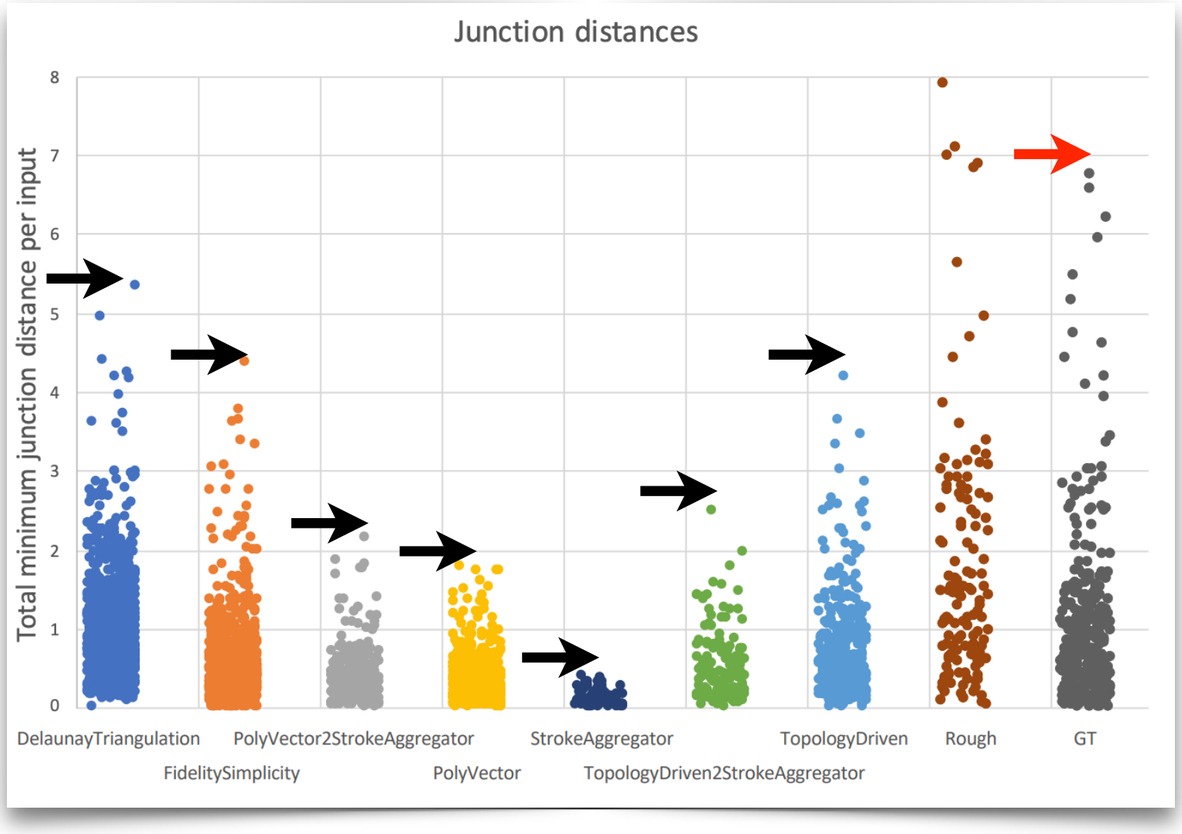
Open Endpoints



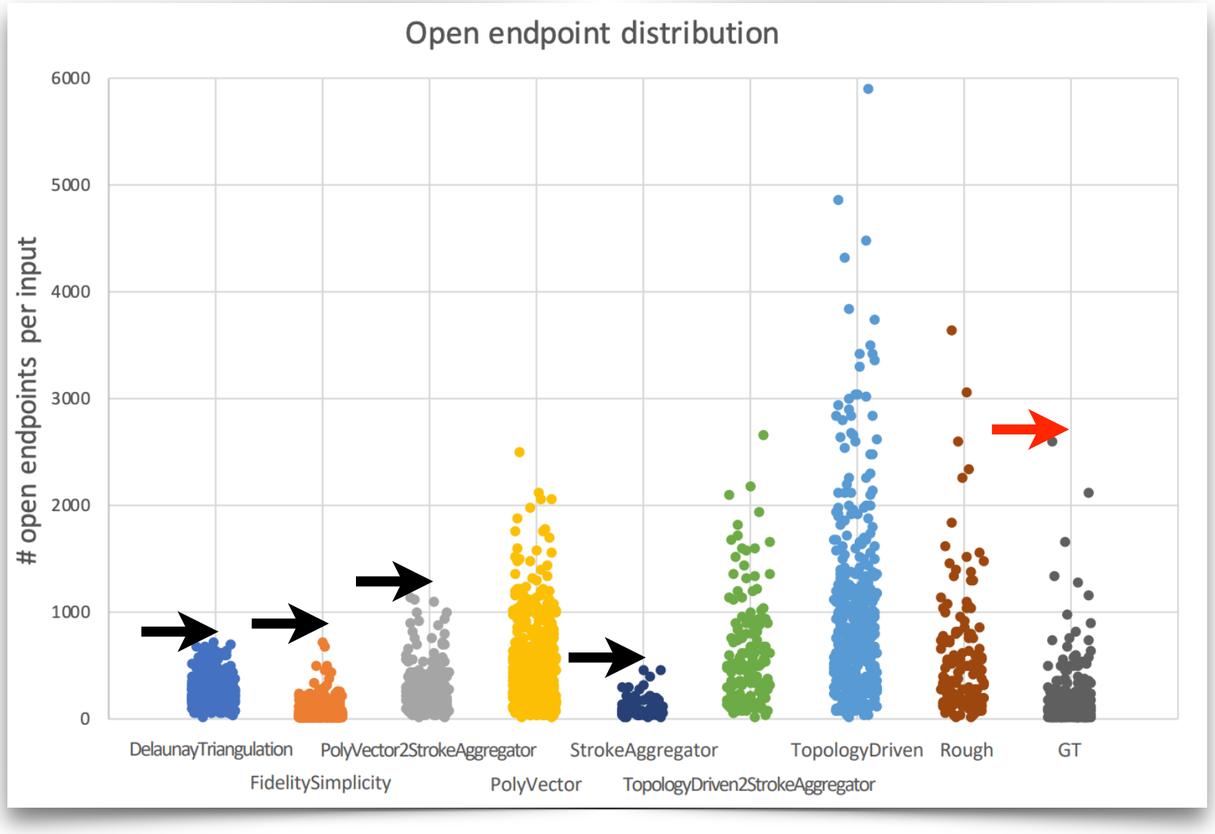
Benchmark

- Vector quality

Junction Distances

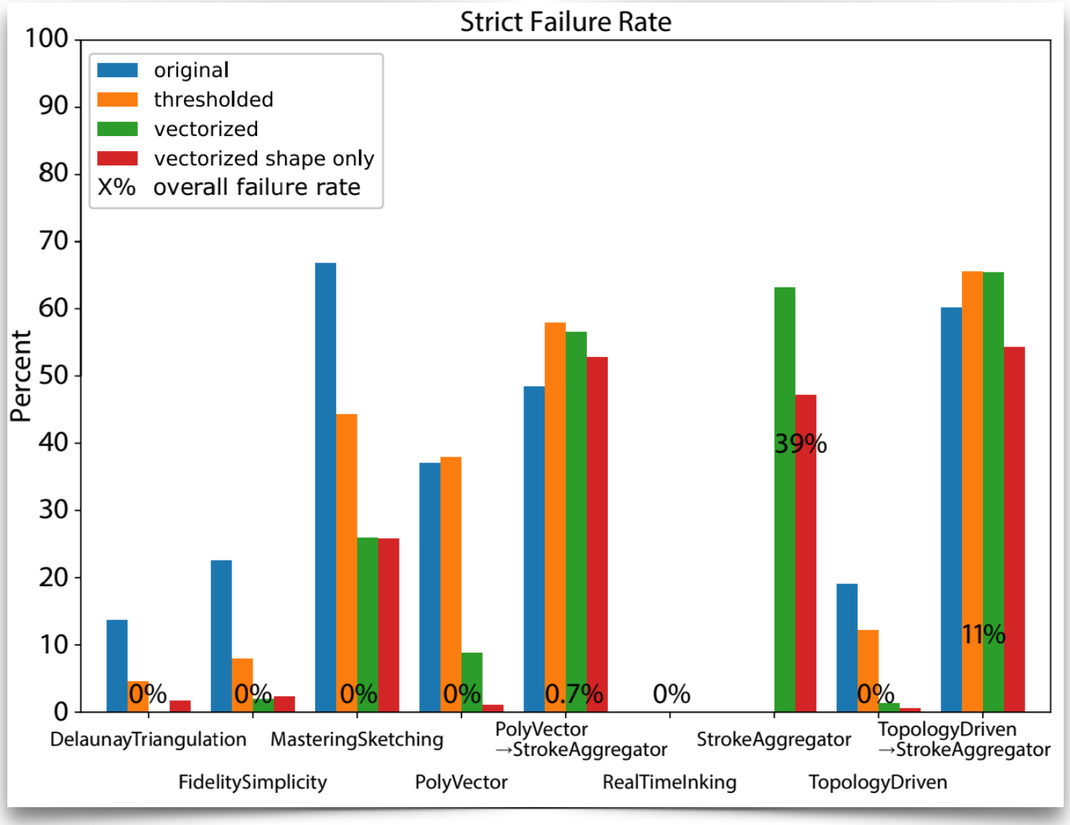


Open Endpoints

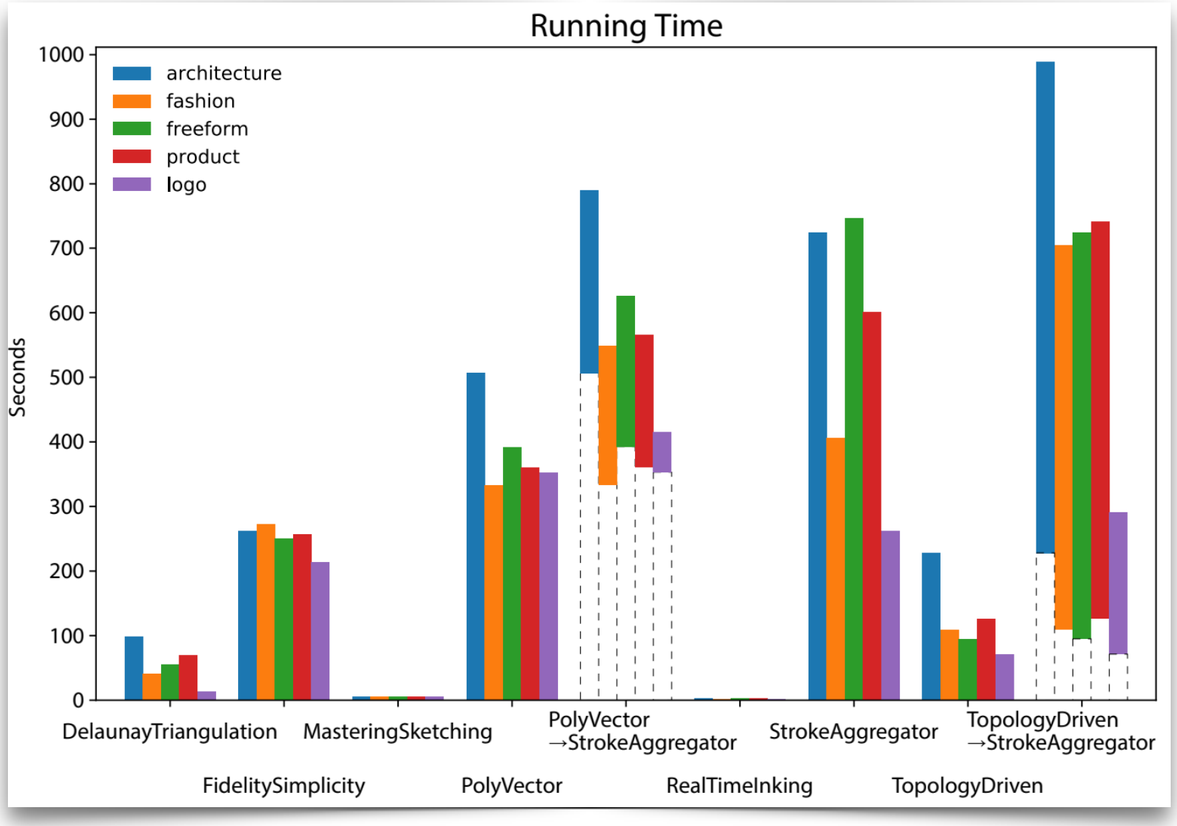


Benchmark

Failure Rate

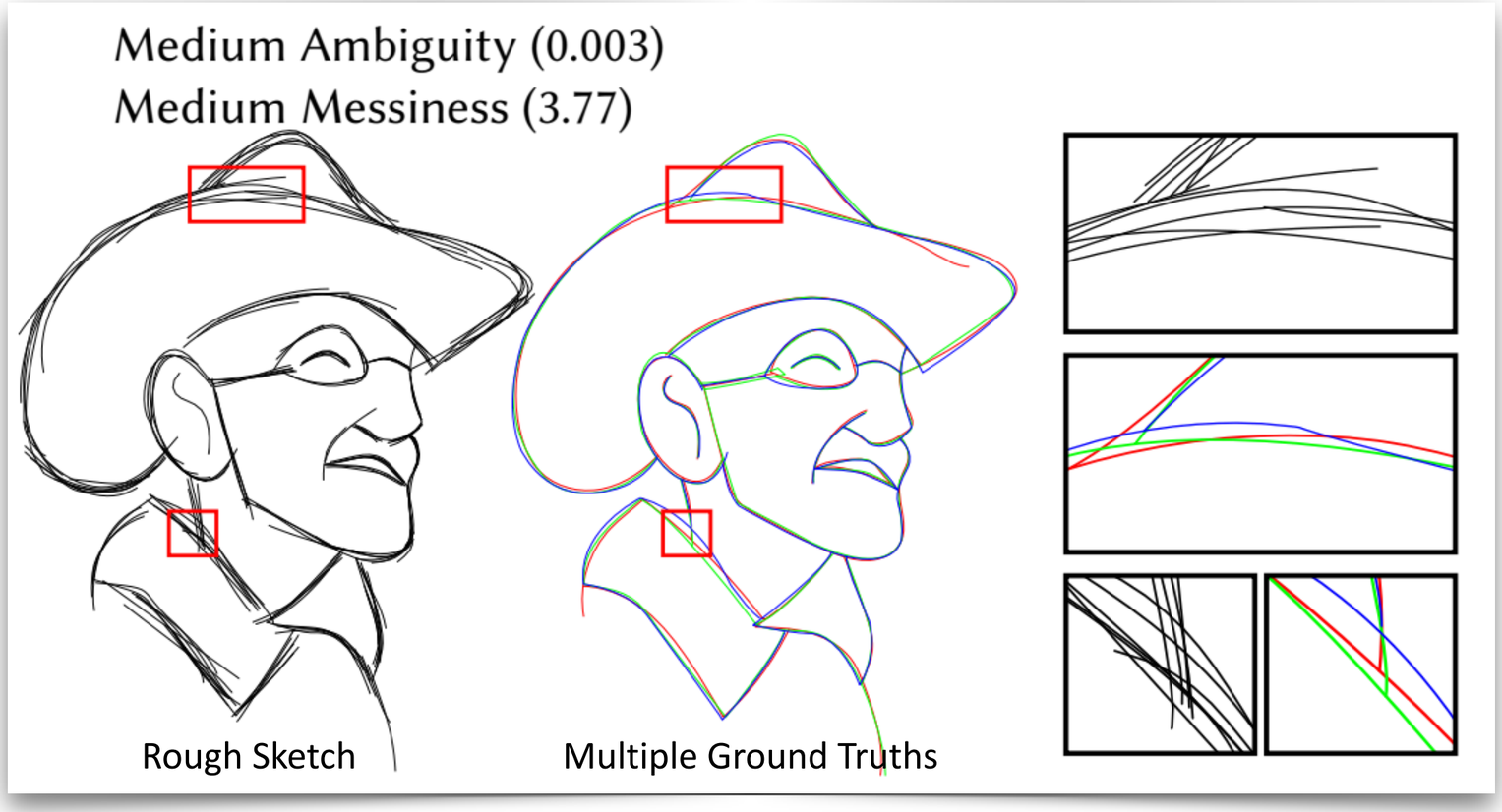


Running Time



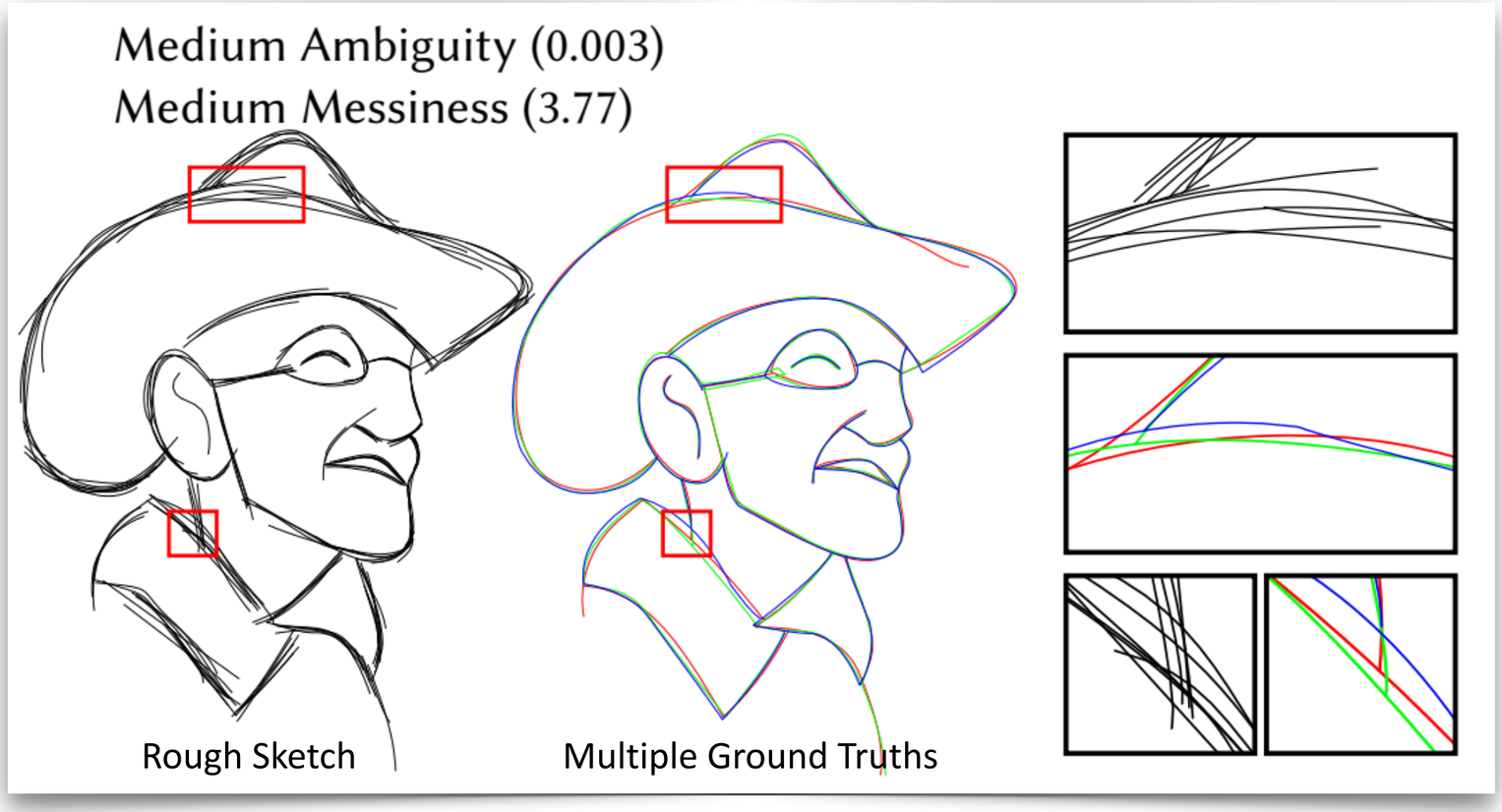
Benchmark

- Ambiguity



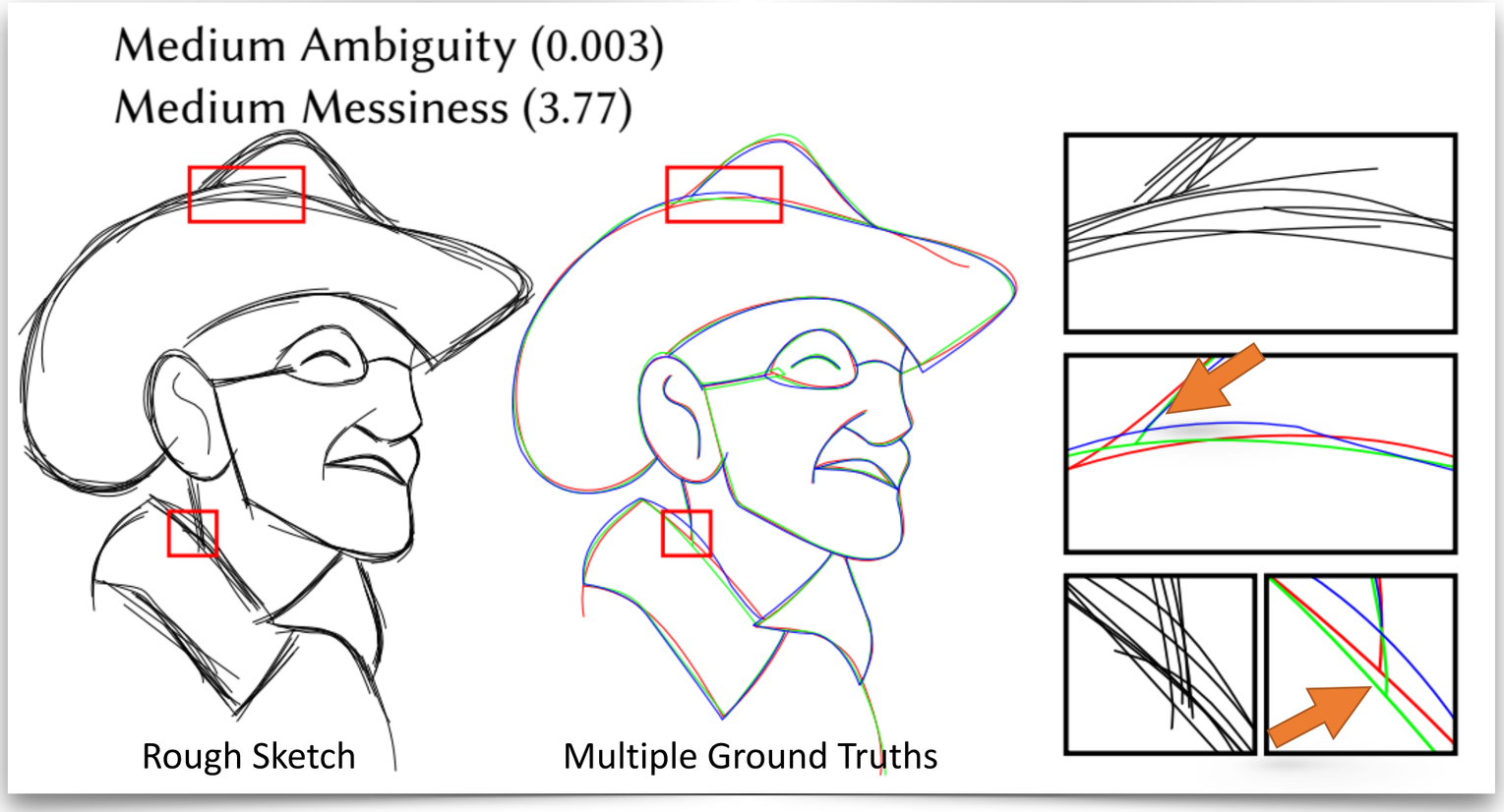
Benchmark

- Ambiguity
  - How much do humans agree on the cleaned sketch?



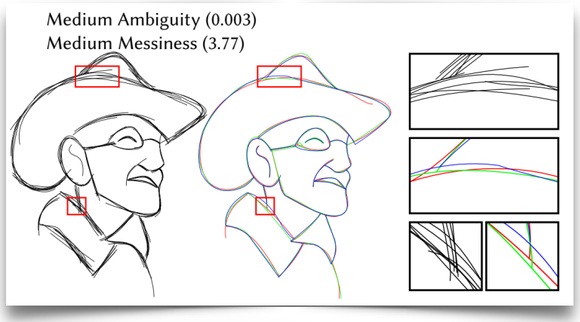
Benchmark

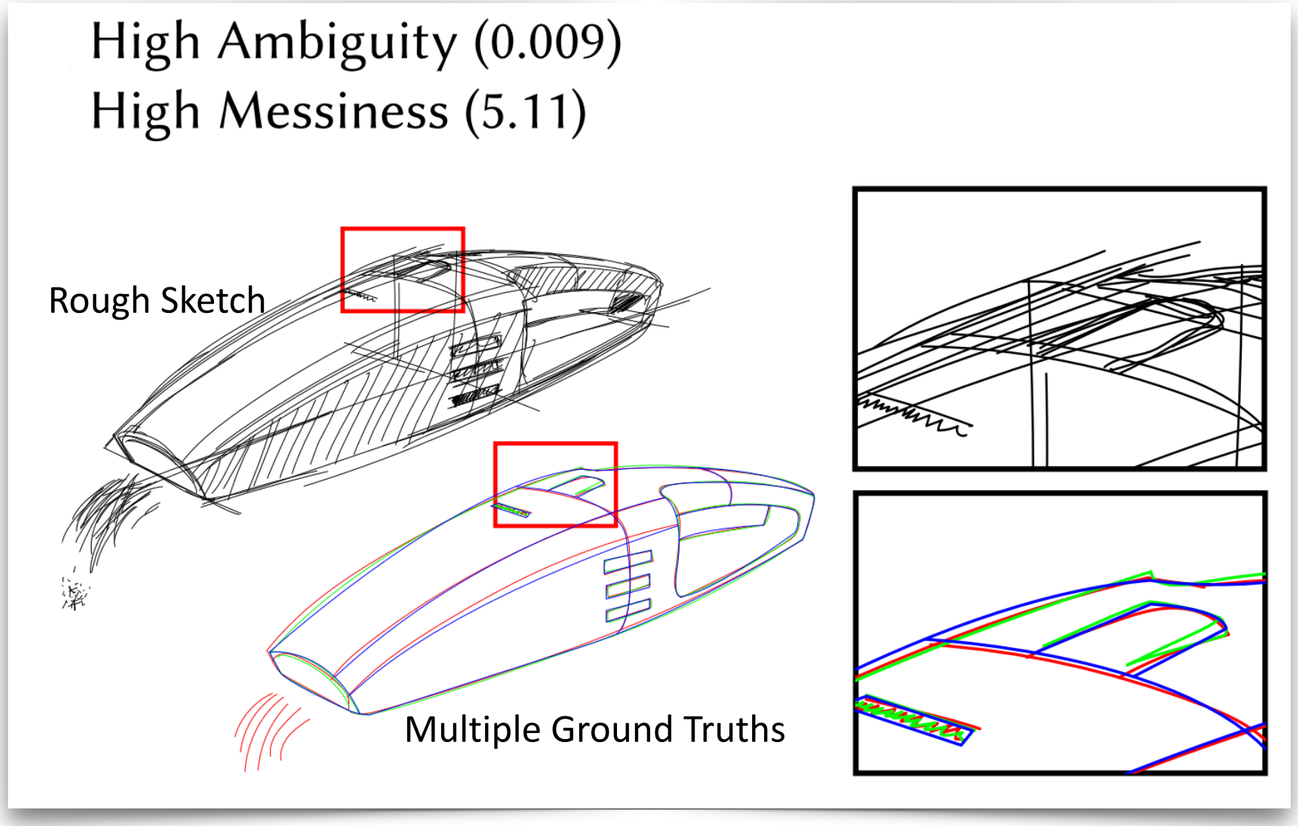
- Ambiguity
  - How much do humans agree on the cleaned sketch?
  - Similarity between the multiple ground truths



Benchmark

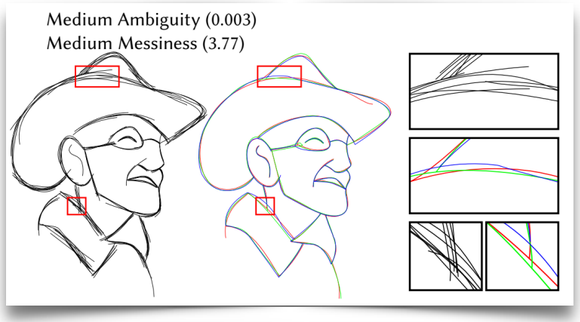
- Messiness

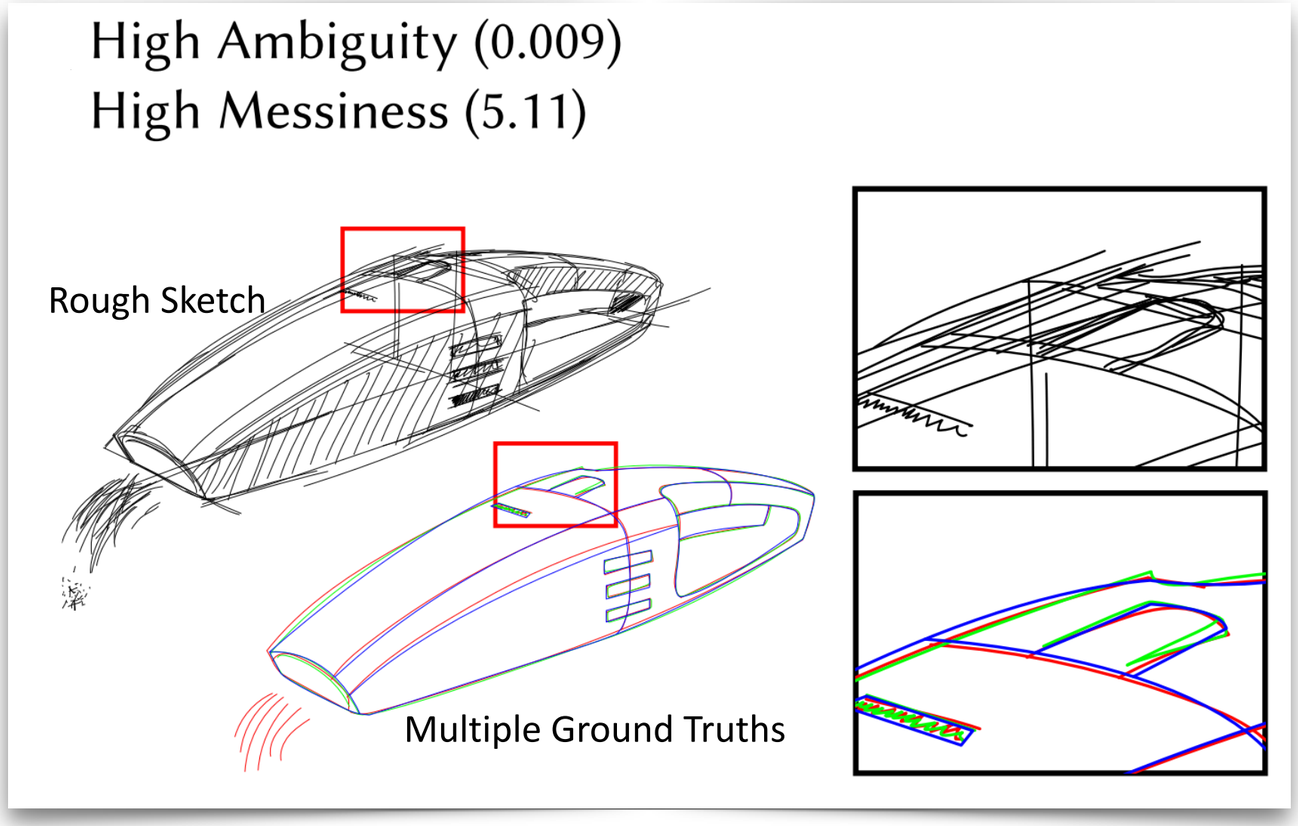




Benchmark

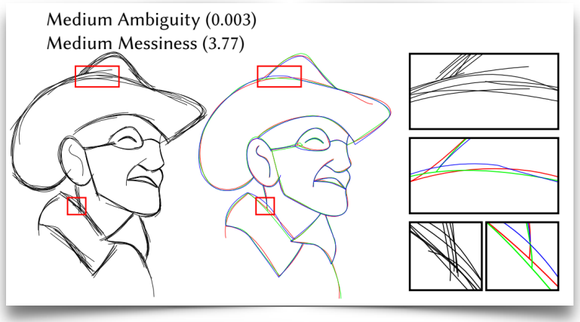
- Messiness
  - How much non-essential information does the input sketch contain?

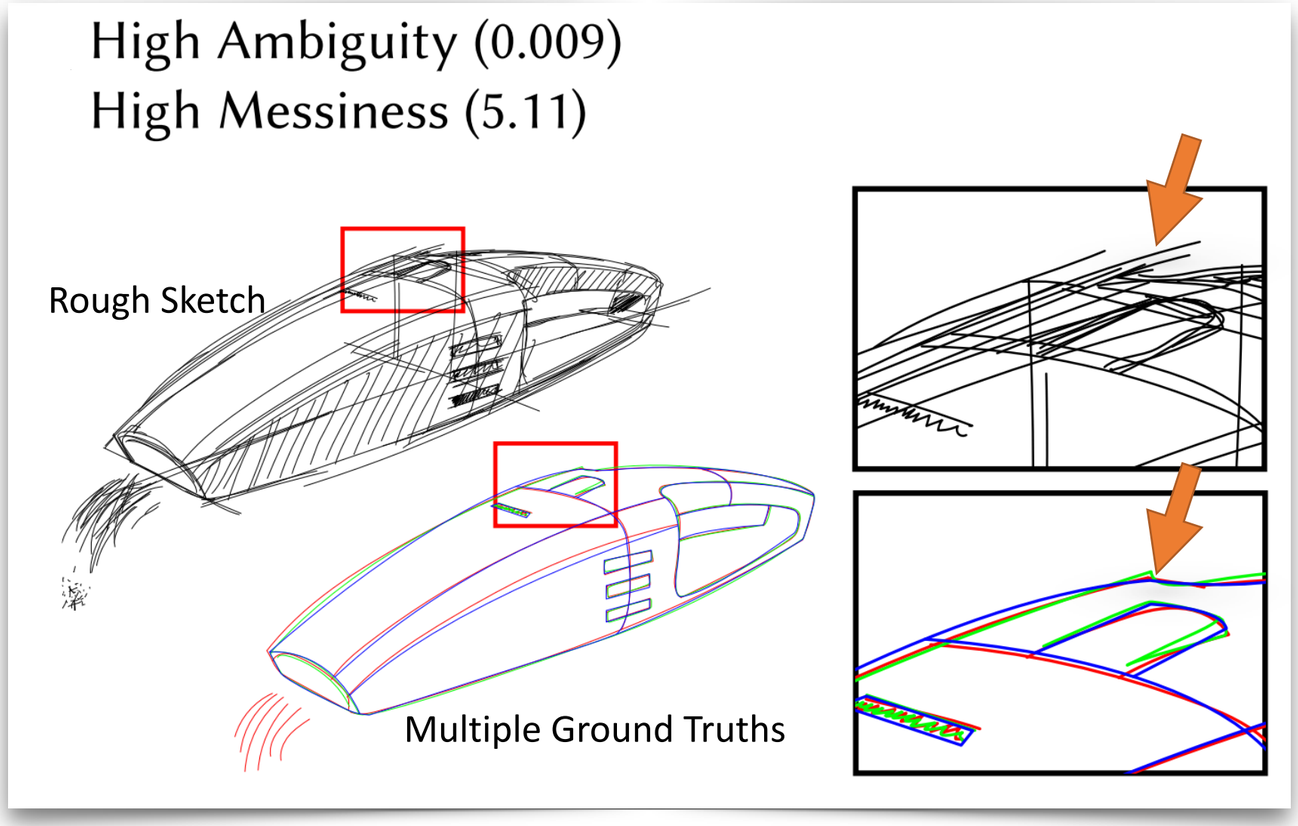




Benchmark

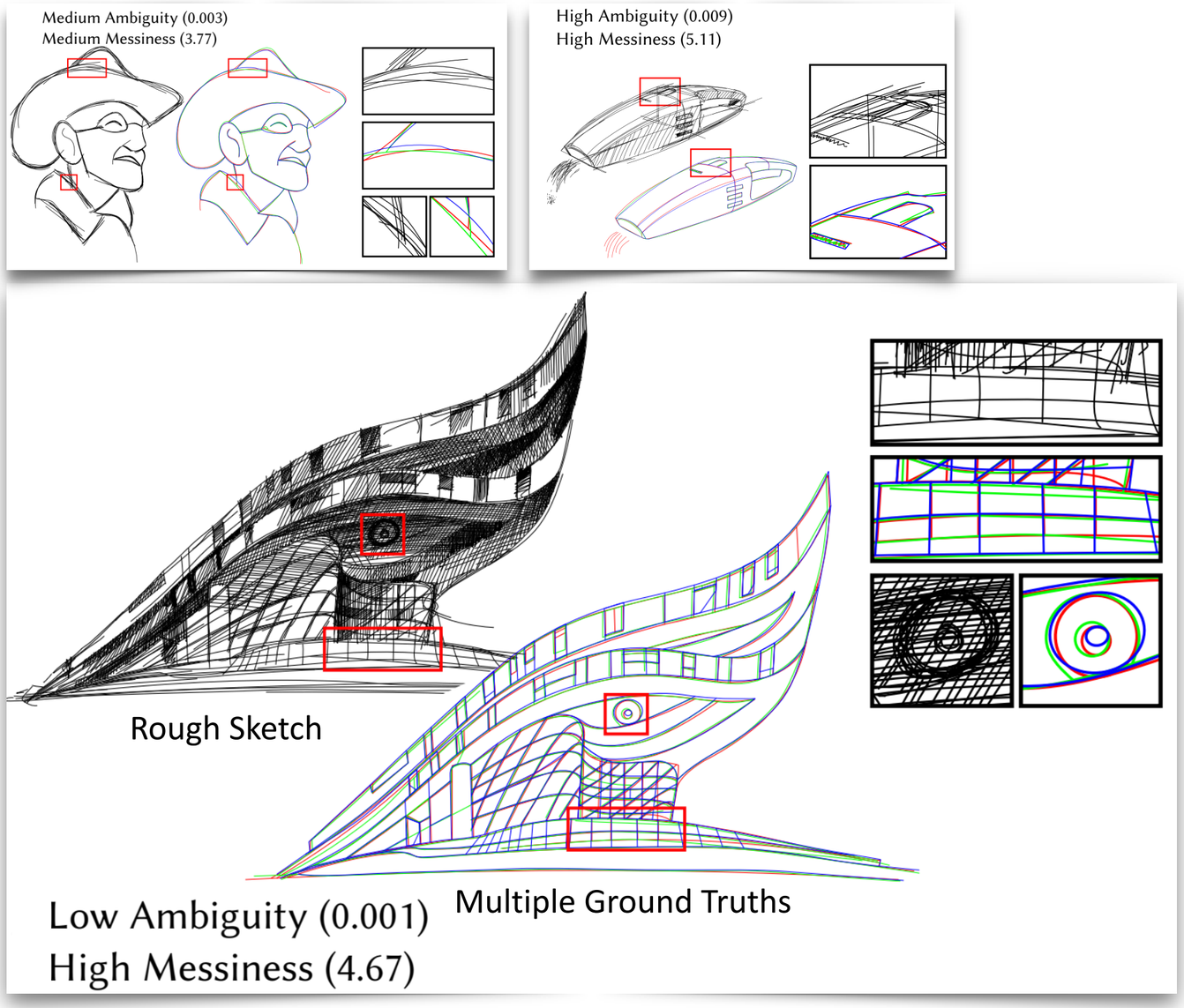
- Messiness
  - How much non-essential information does the input sketch contain?
  - The fraction of covered pixels removed during cleanup





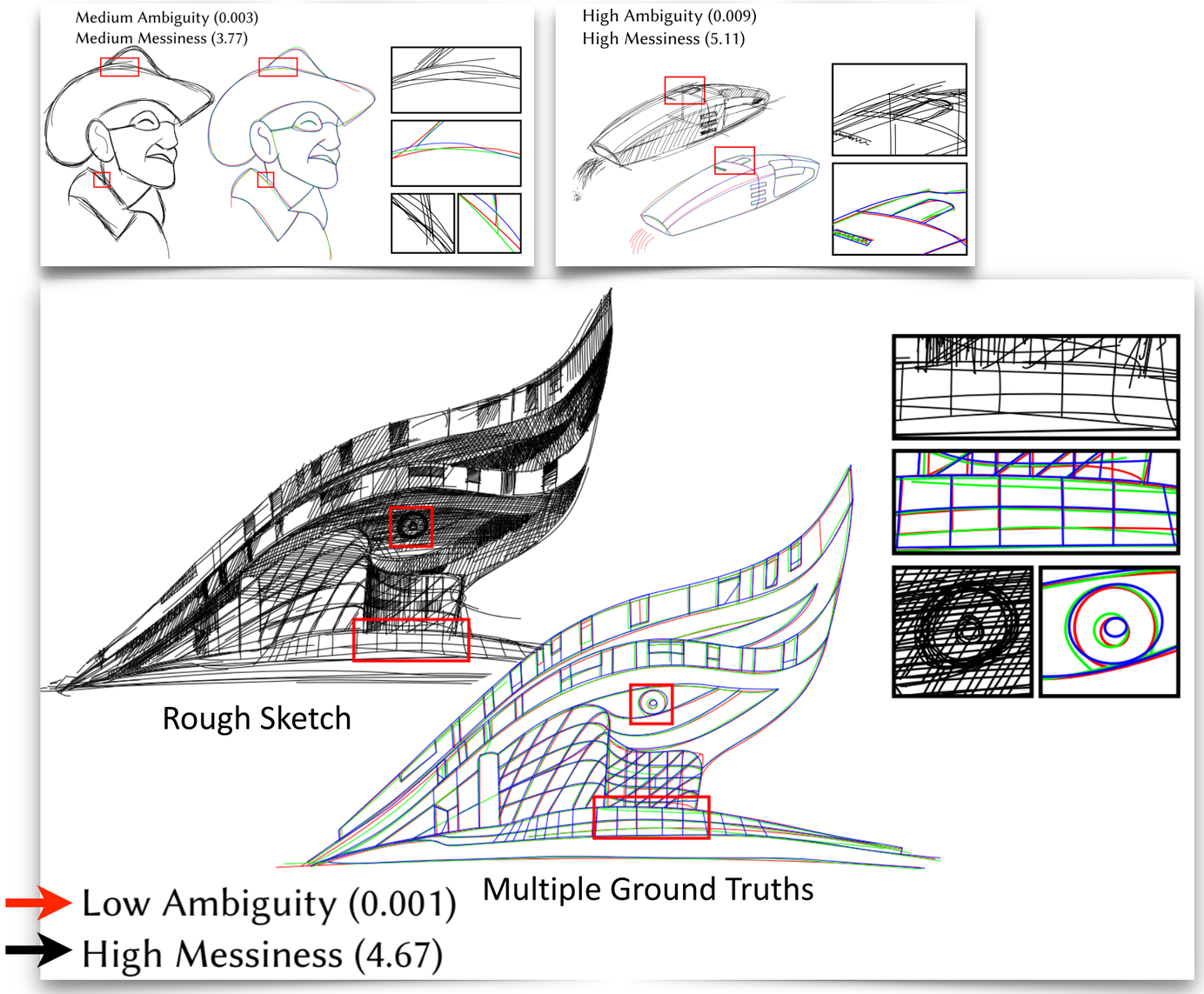
Benchmark

- Ambiguity vs. Messiness



Benchmark

- Ambiguity vs. Messiness



Algorithm characteristics

- Resolution dependence

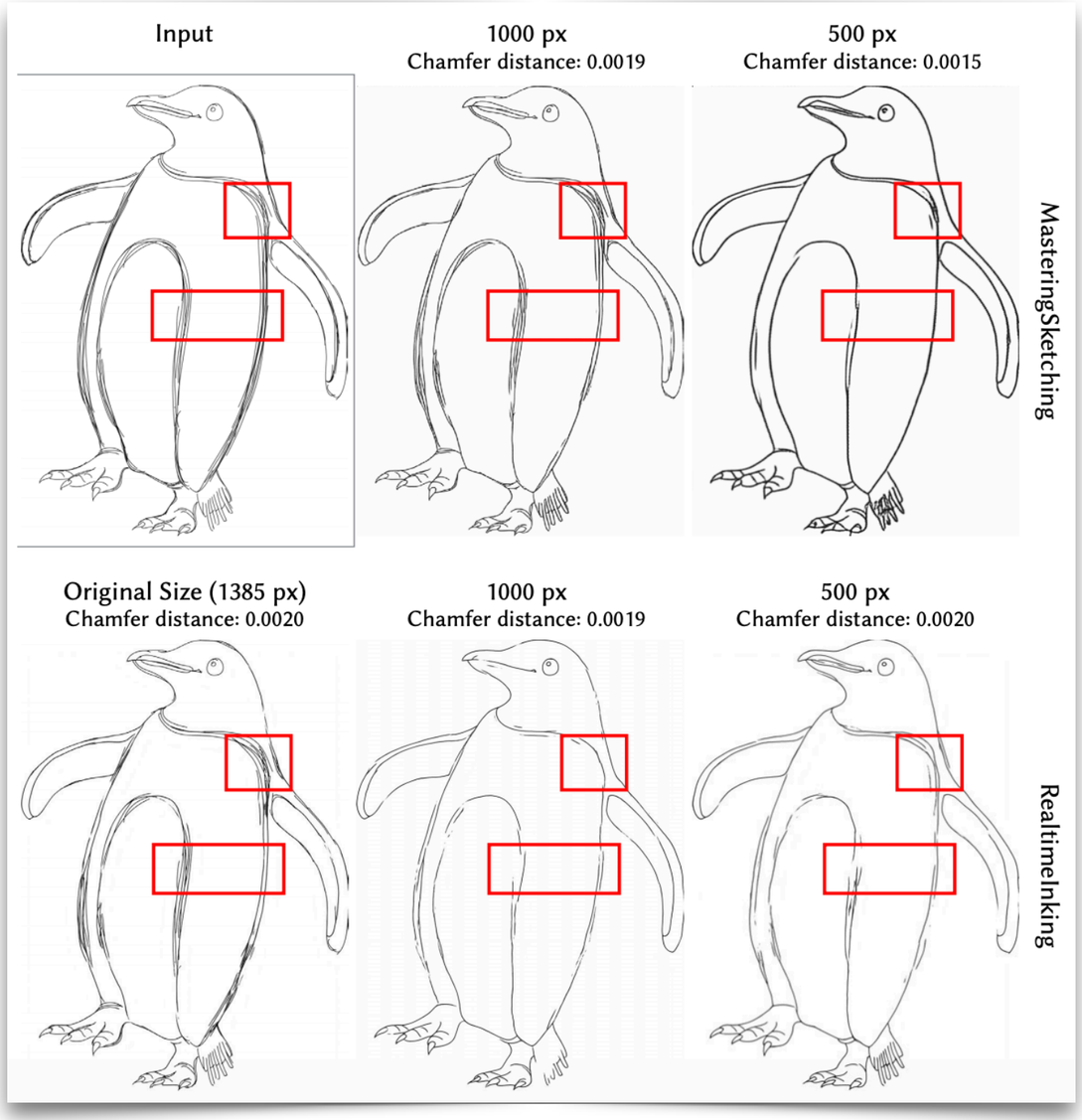


Image: ©Enrique Rosales

Algorithm characteristics

- Gap sensitivity

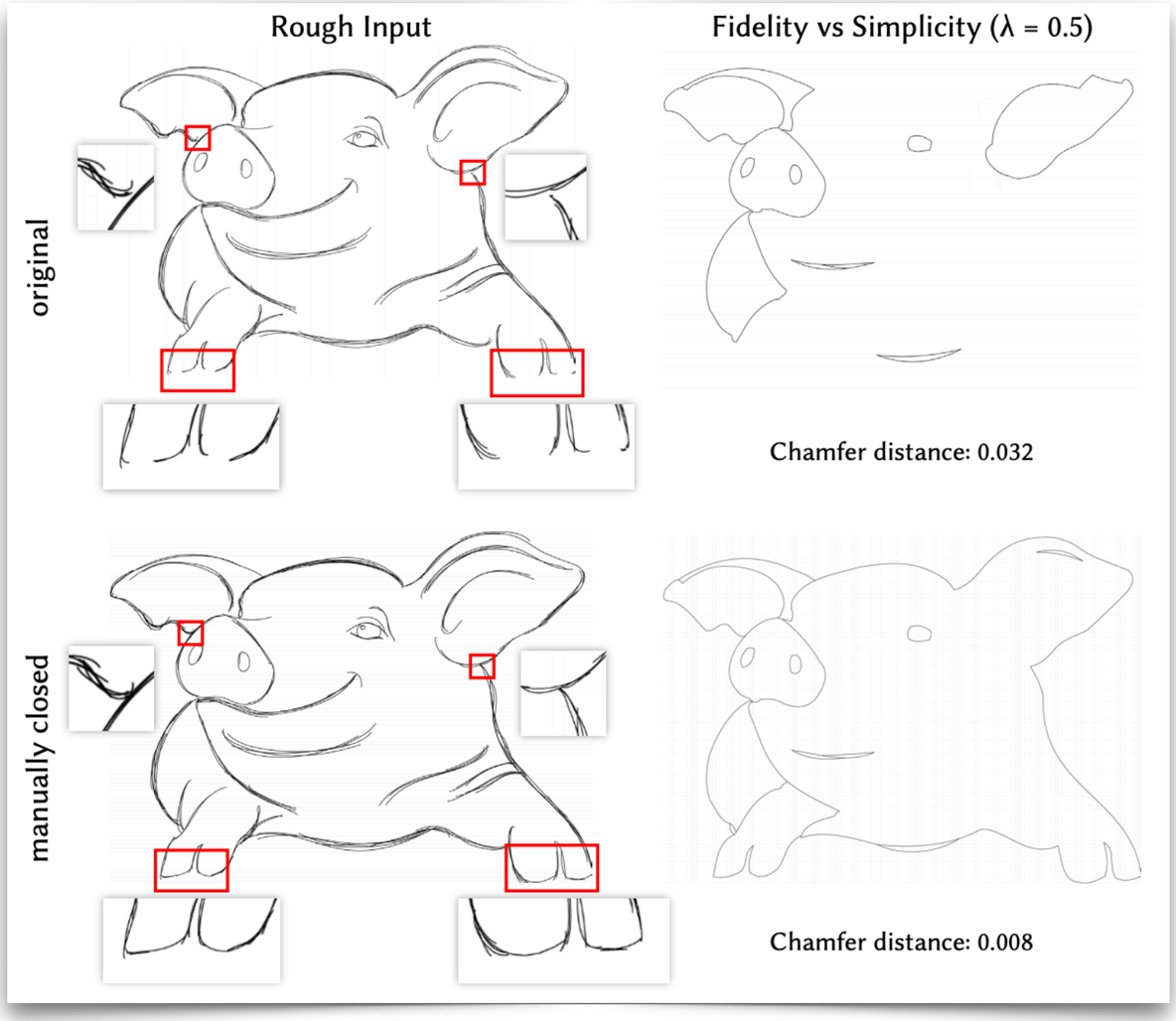
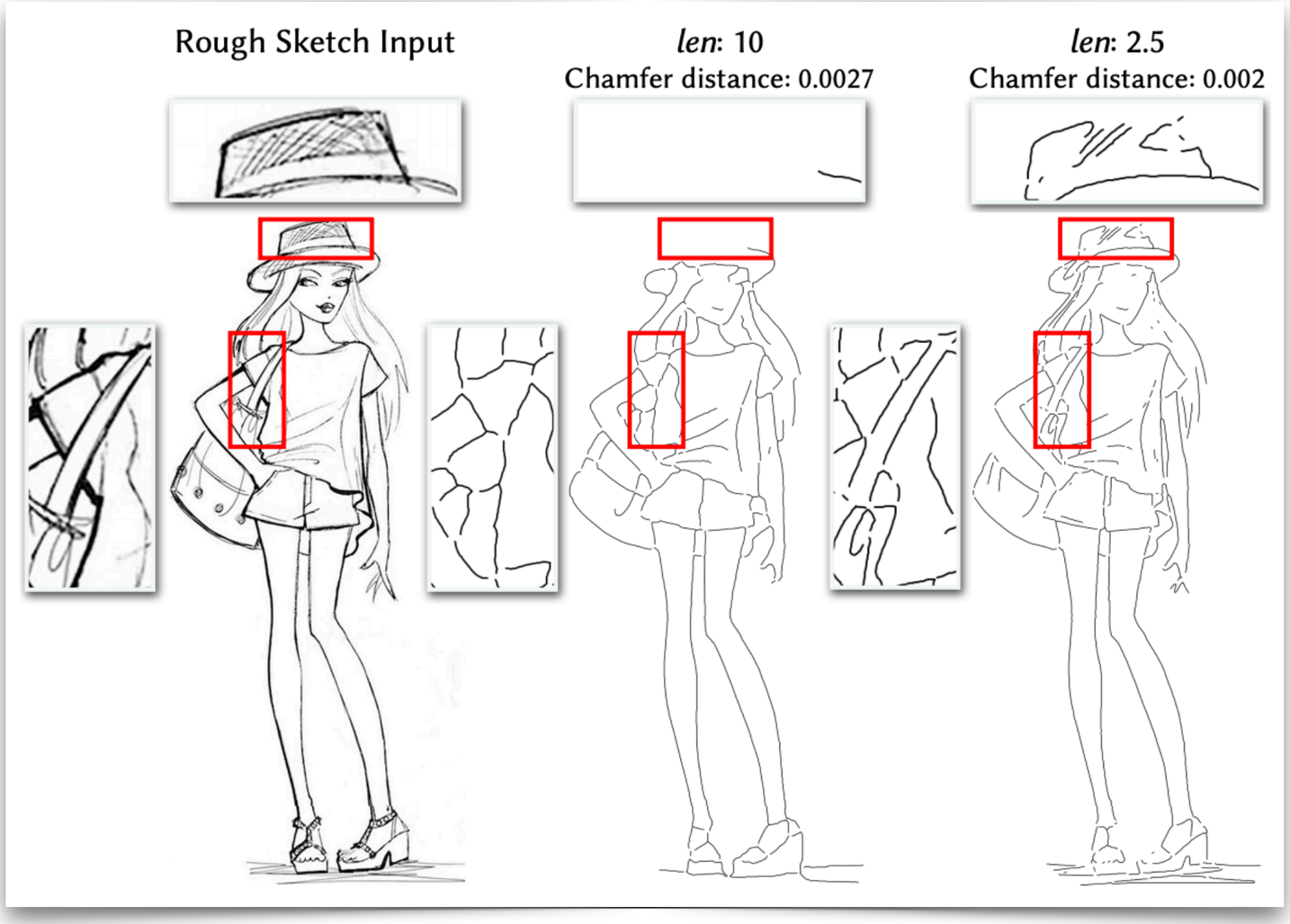


Image: ©Enrique Rosales

Algorithm characteristics

- Parameter sensitivity

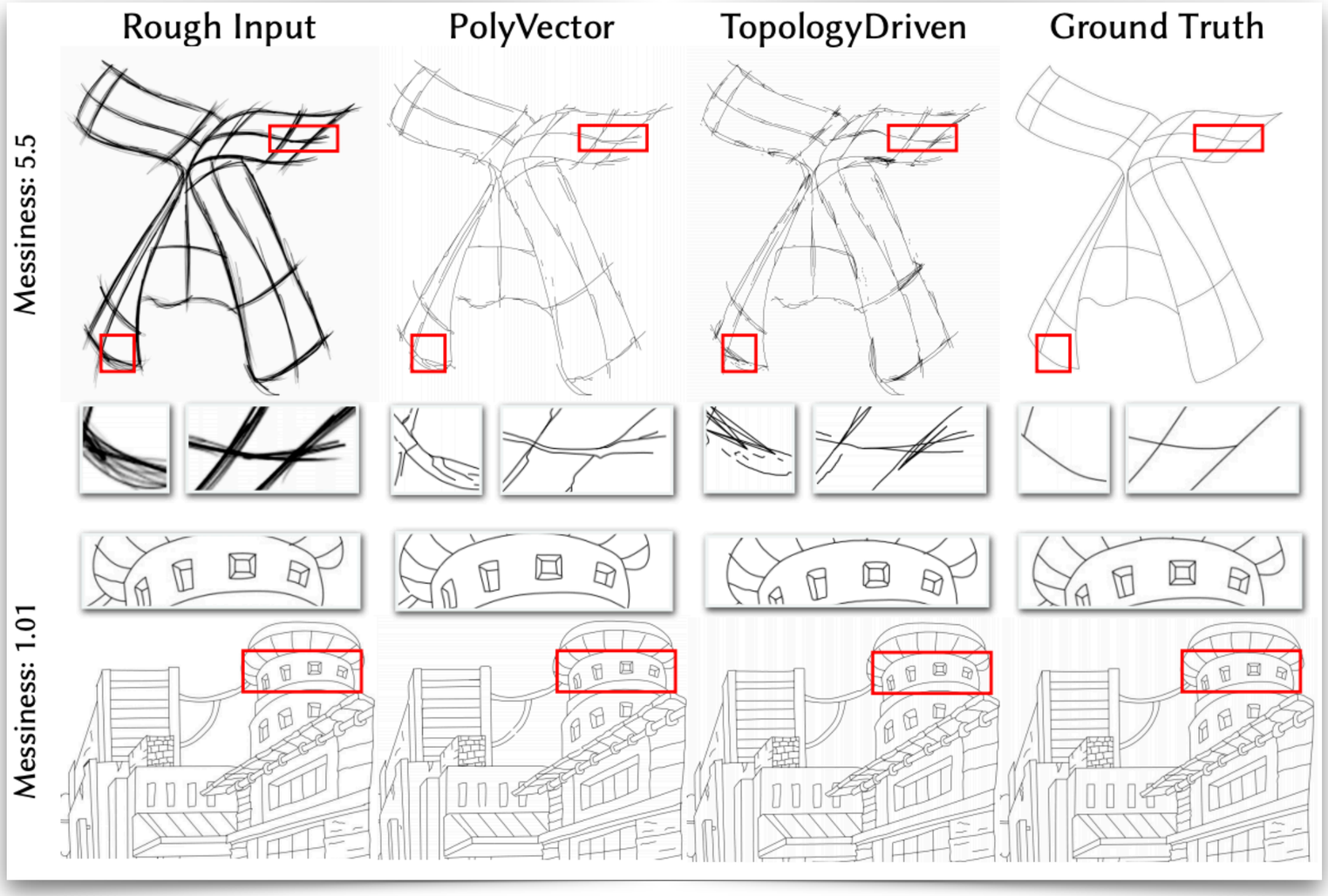
Delaunay Triangulation



Algorithm characteristics

- Messiness sensitivity

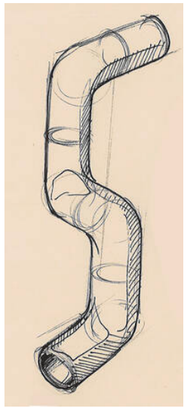
PolyVector & TopologyDriven



Open Problems

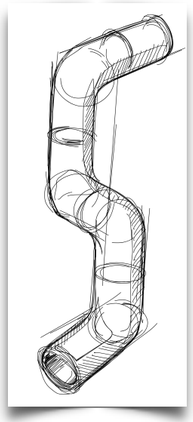
- Algorithm robustness

Rough

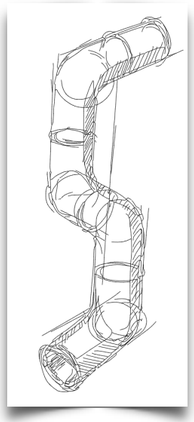


Failed

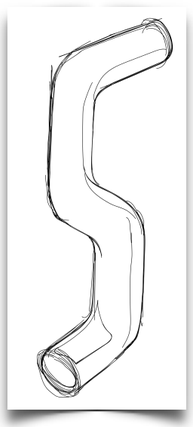
Vectorized - all stroke, 1000px



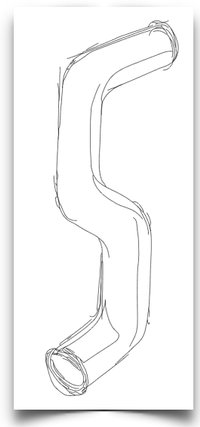
Algorithmic output



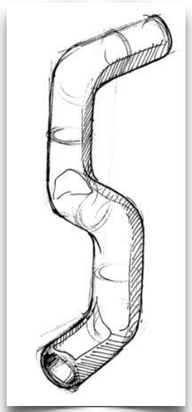
Vectorized - shape stroke, 1000px



Algorithmic output

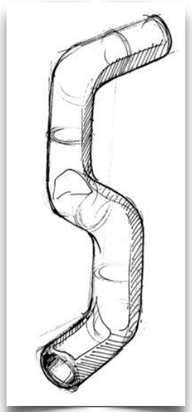


Thresholded

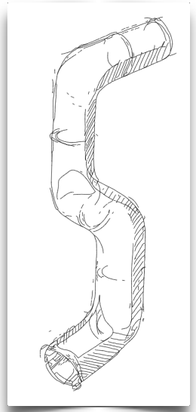


Failed

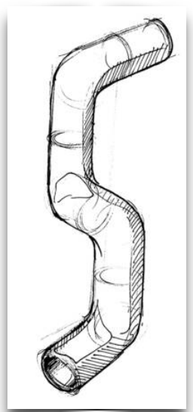
Thresholded - 1000px



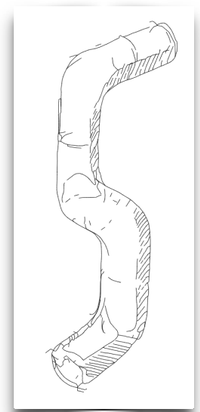
Algorithmic output



Thresholded - 500px



Algorithmic output

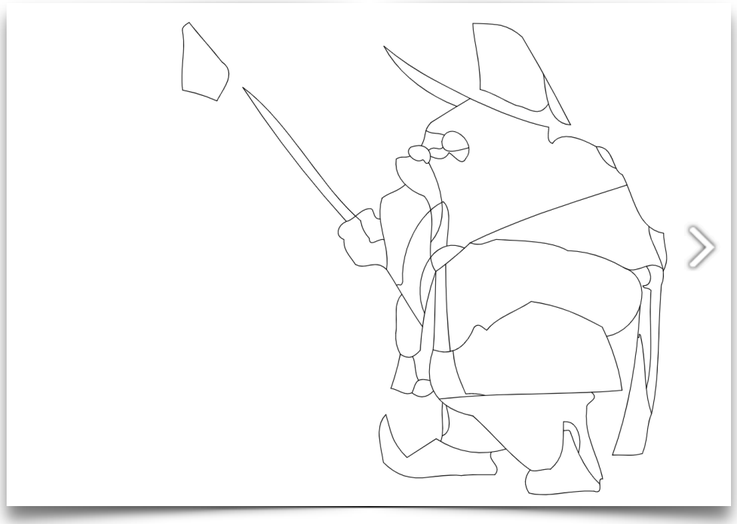


Open Problems

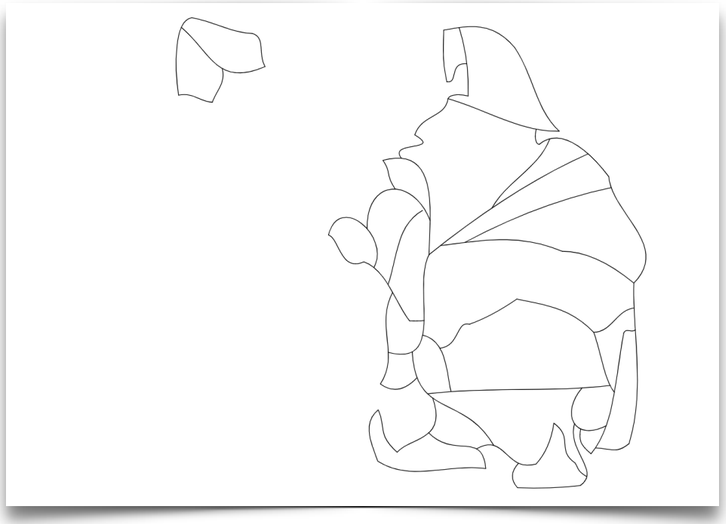
- Algorithm robustness
- Resolution dependence

Rough

Algorithmic result - 1000px

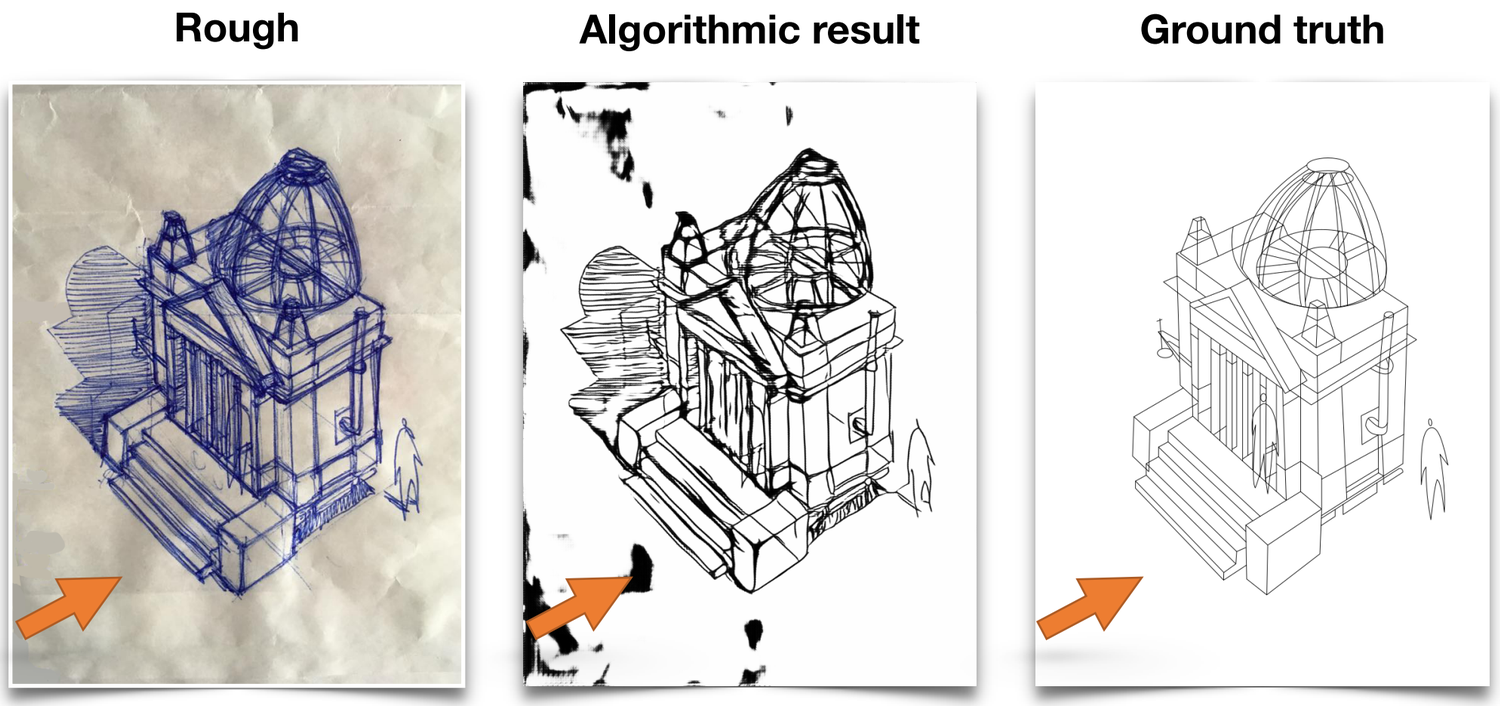


Algorithmic result - 500px



Open Problems

- Algorithm robustness
- Resolution dependence
- Physical artifacts removal



Open Problems

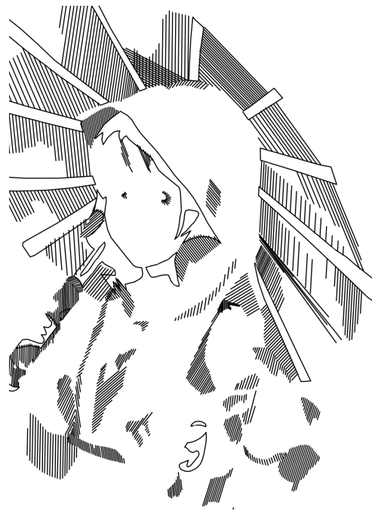
- Algorithm robustness
- Resolution dependence
- Physical artifacts removal
- Non-shape stroke separation

Rough

Algorithmic result

Ground Truth - shape stroke

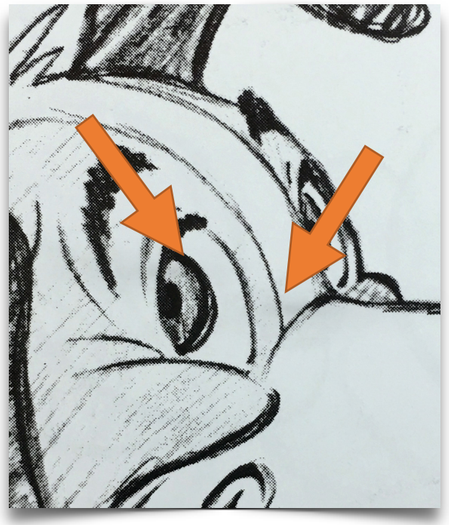
Ground Truth - shading & texture



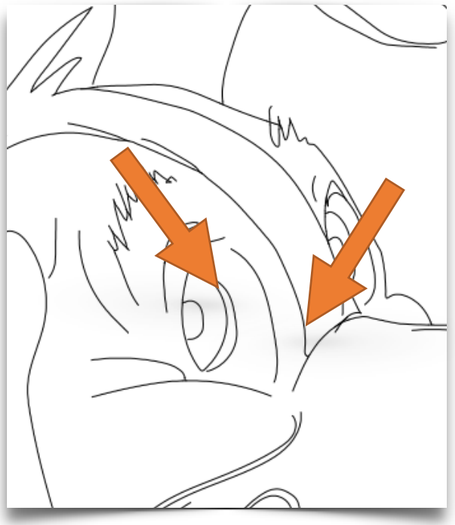
Open Problems

- Algorithm robustness
- Resolution dependence
- Physical artifacts removal
- Non-shape stroke separation
- Stroke thickness and color preservation

Rough



Algorithmic result



Idea ground truth

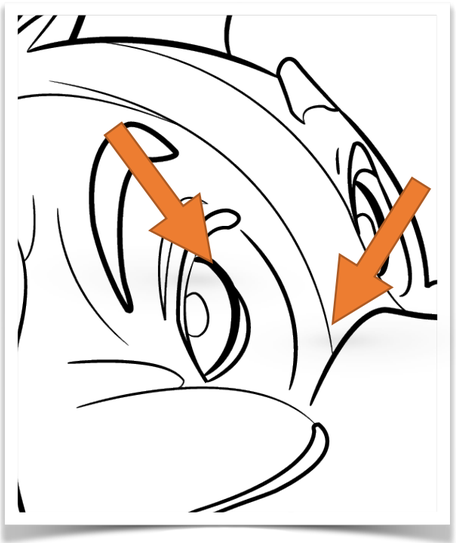


Image: ©Preston Blair

Limitations and Future Work

- Simple metrics

Limitations and Future Work

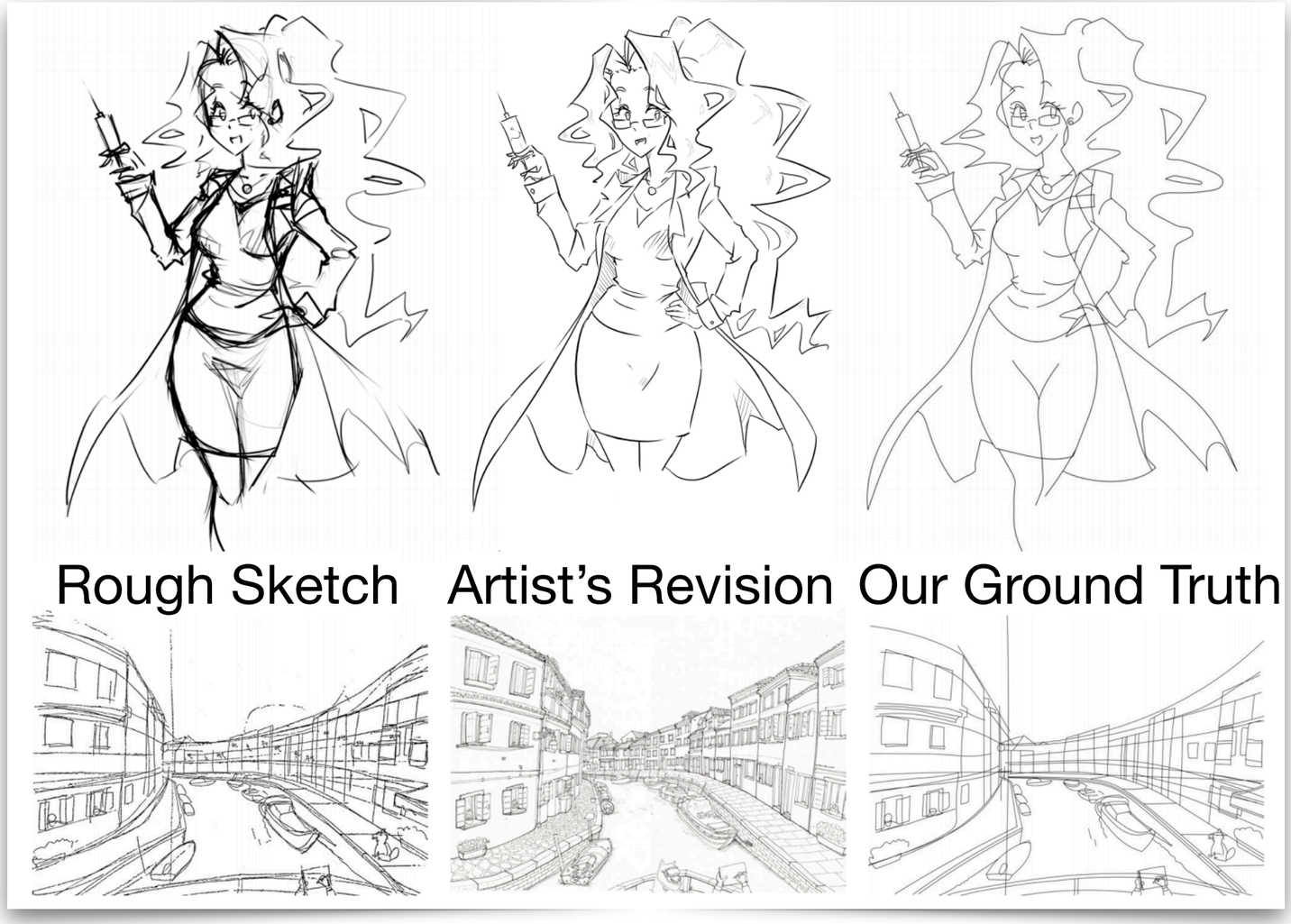
- Simple metrics
- Imperfect topology of vector ground truth

Limitations and Future Work

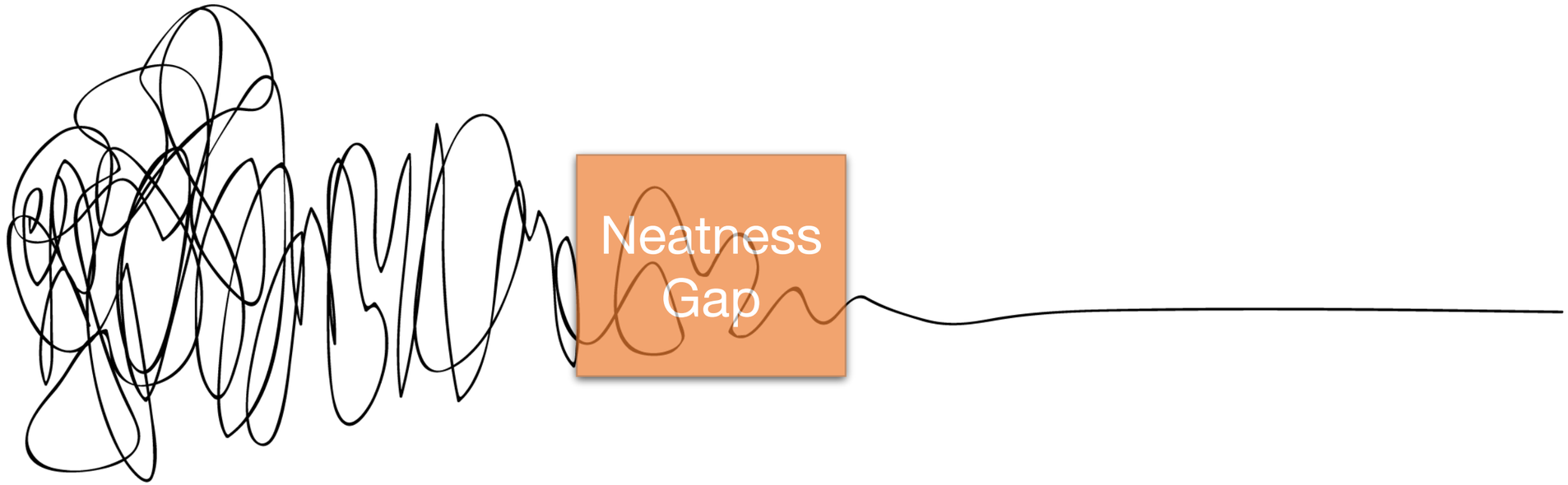
- Simple metrics
- Imperfect topology of vector ground truth
- Small dataset

Limitations and Future Work

- Simple metrics
- Imperfect topology of vector ground truth
- Small dataset
- Narrowly defined problem



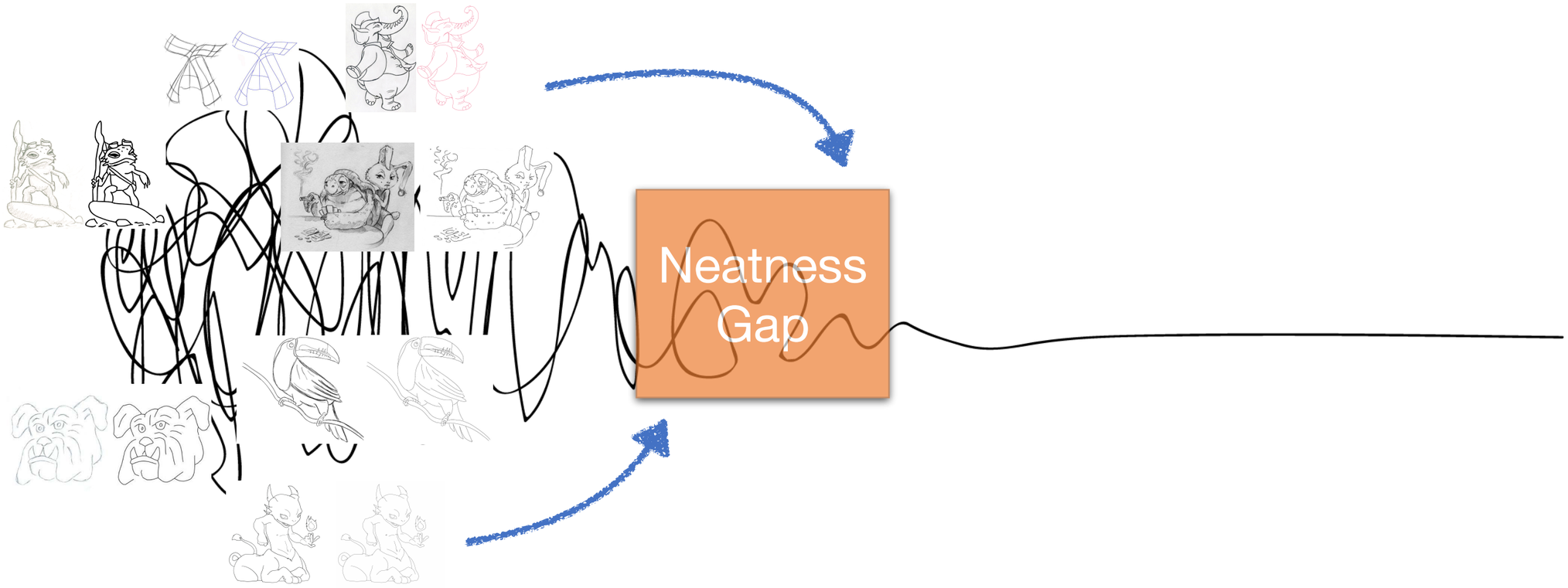
Future Work



The design squiggle: Damien Newman (CC-BY-ND 3.0)

Future Work

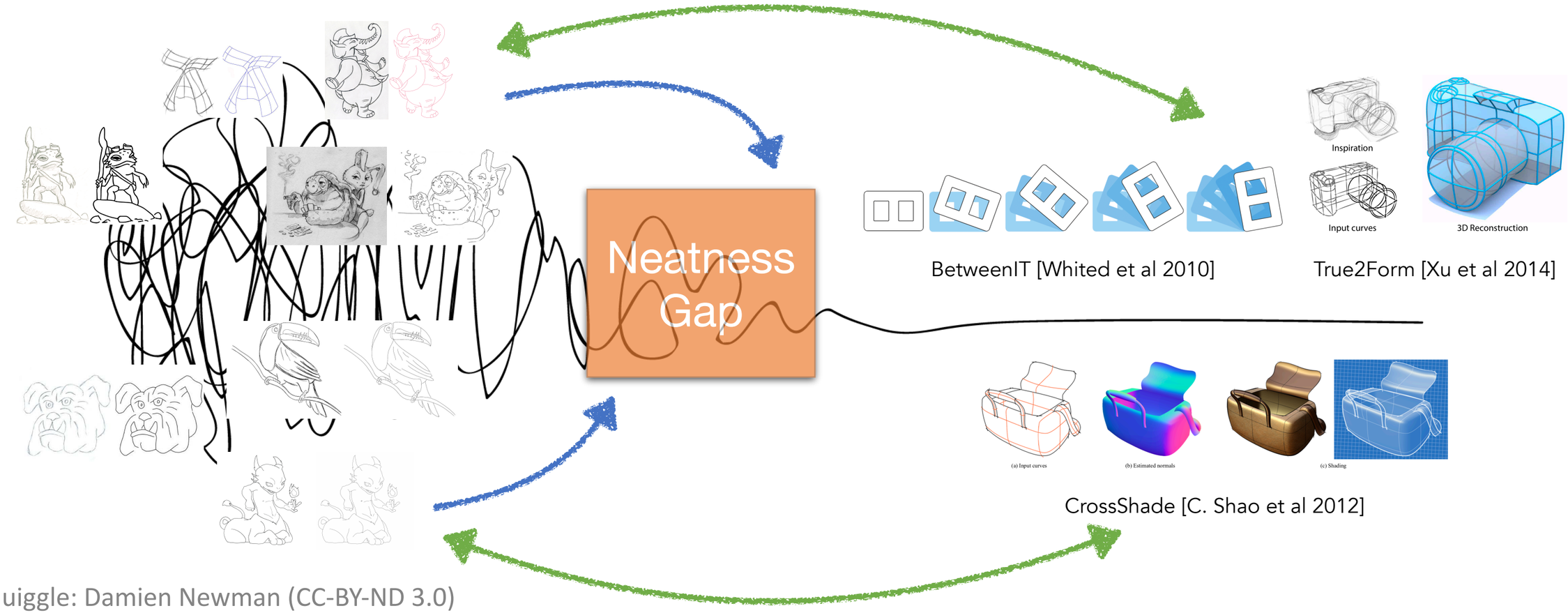
- Different algorithms can have different goals



The design squiggle: Damien Newman (CC-BY-ND 3.0)

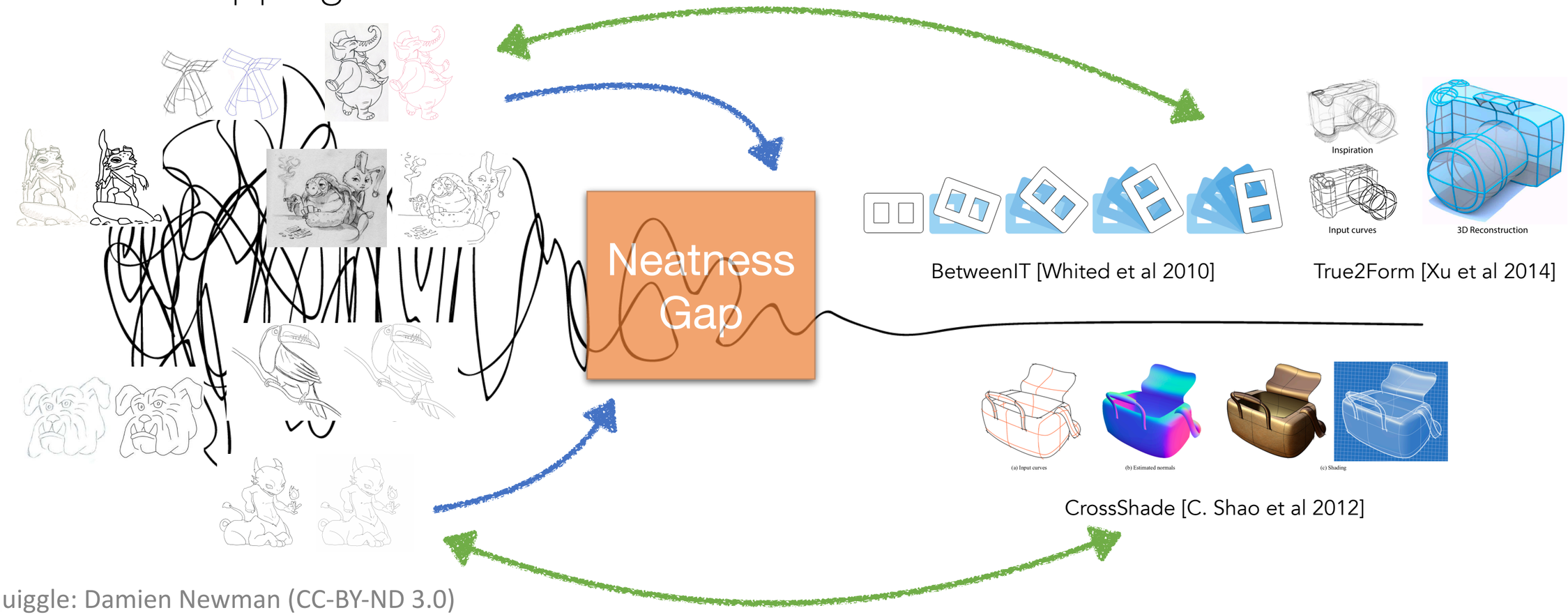
Future Work

- Different algorithms can have different goals
- End-to-End Evaluation



Future Work

- Different algorithms can have different goals
- End-to-End Evaluation
- Junction Snapping



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Thank You for Listening

Browse, download, and run our benchmark on your algorithm:

https://cragl.cs.gmu.edu/sketchbench/