Flow Visualization using Illustrative Line Styles

Maarten H. Everts, Henk Bekker,
Jos B.T.M. Roerdink, and Tobias Isenberg

university of groningen

Introduction: streamlines

Simulations of flow of fluids and gases

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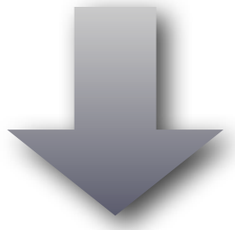
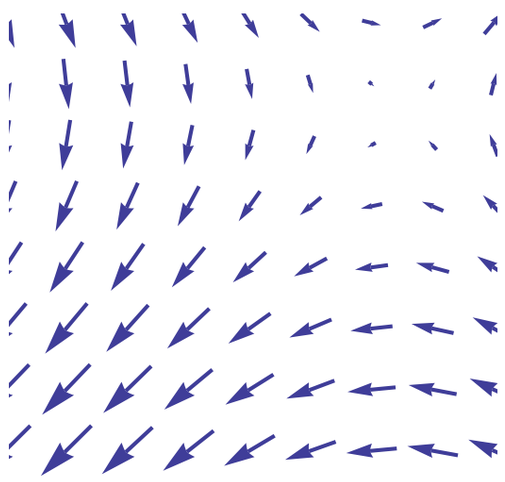
Simulations of flow of fluids and gases

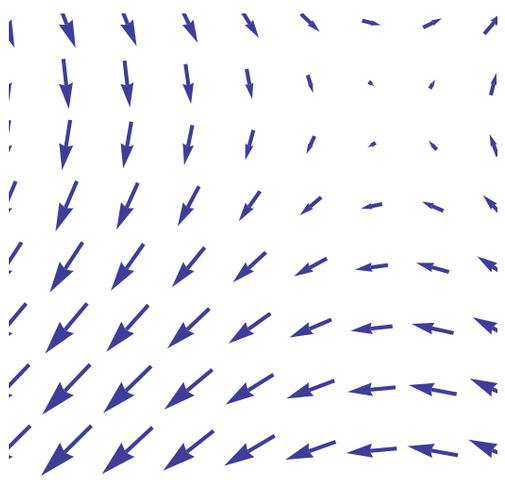


Large 3D vector fields



Introduction: streamlines

Simulations of flow of fluids and gases



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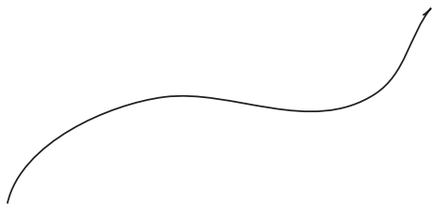

Streamlines

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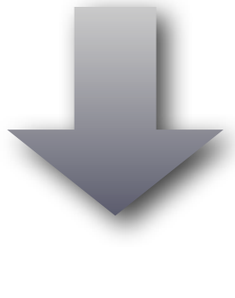

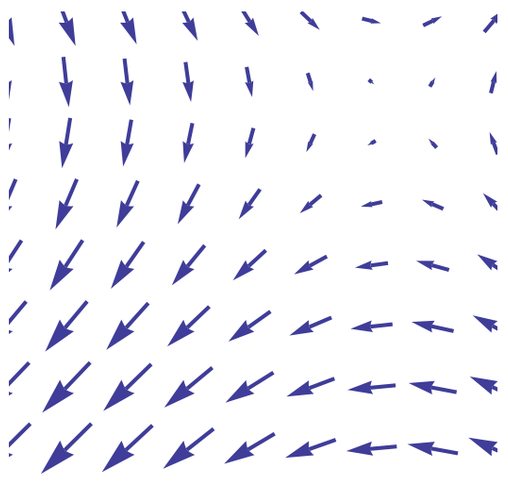

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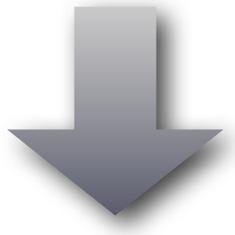

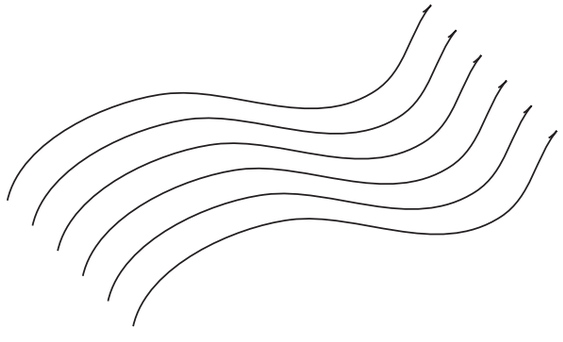

Streamlines

Introduction: our contribution

- A flexible line style model for visualizing streamlines.
- Supports interactive manipulation.
- A fast GPU implementation.
- Inspired by illustrations.

Introduction: depth-dependent halos

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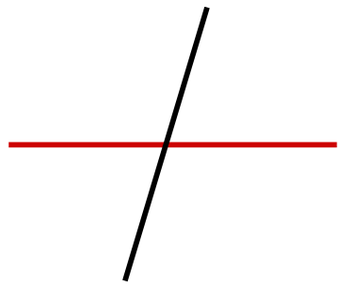
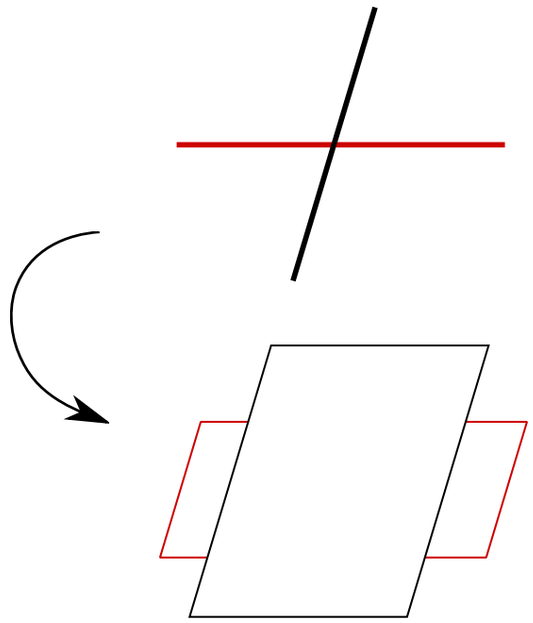


Introduction: depth-dependent halos



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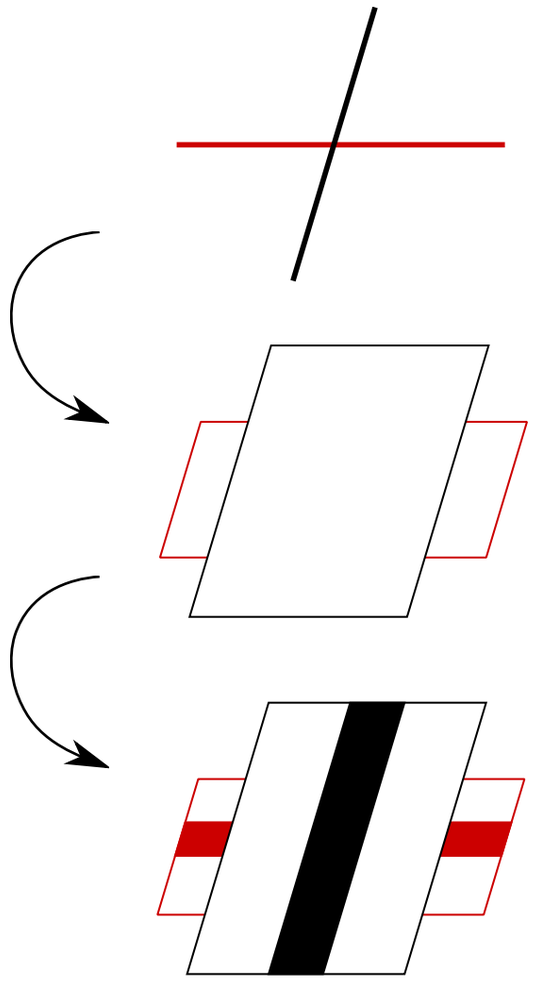

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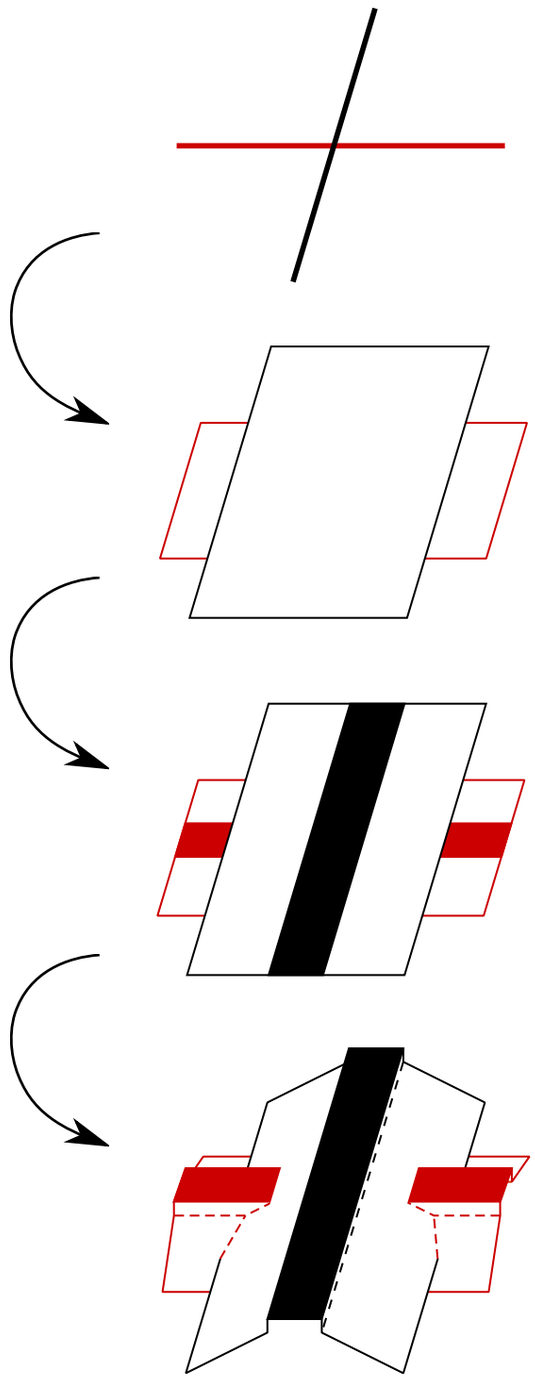

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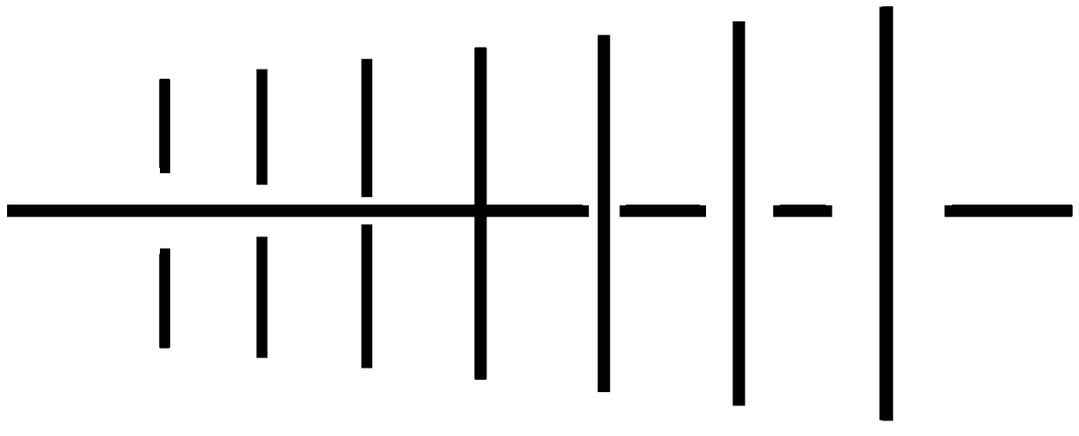
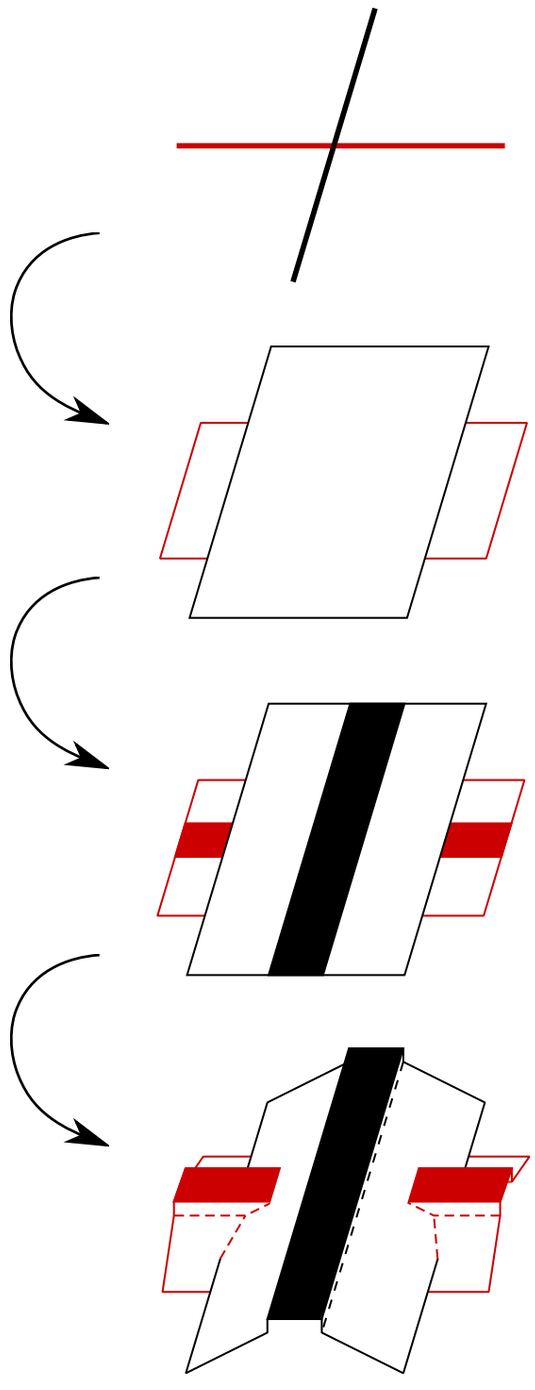


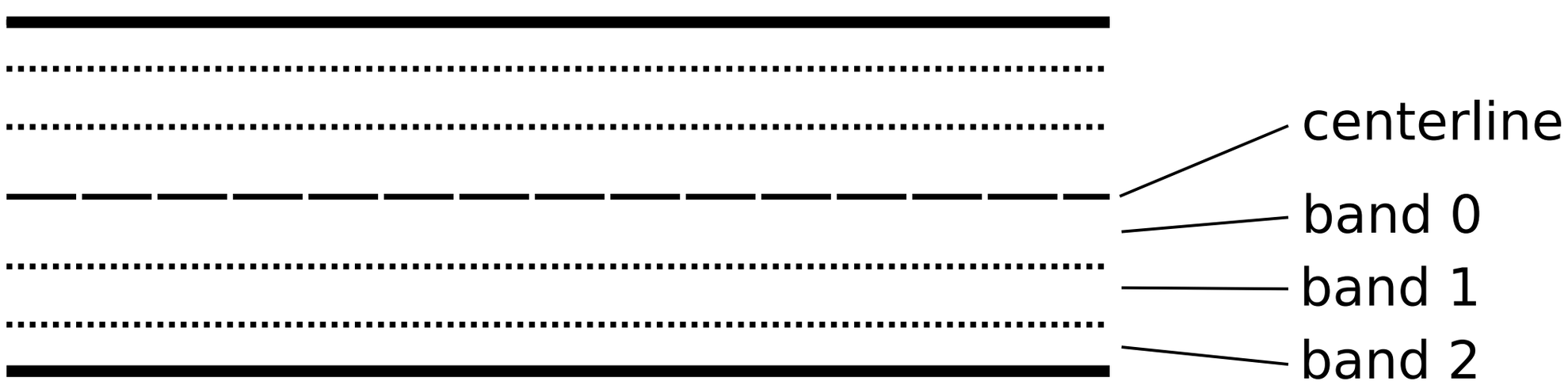


Line style model

Subdivision of line strips into bands

Provide the granularity

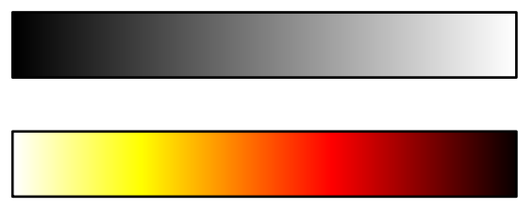
Visual properties (color, width, and distance offset) can be manipulated independently.



Local attribute mapping

Mapping of local flow attributes (temperature, velocity, etc.) to visual properties:

- Band color (i.e., color maps)



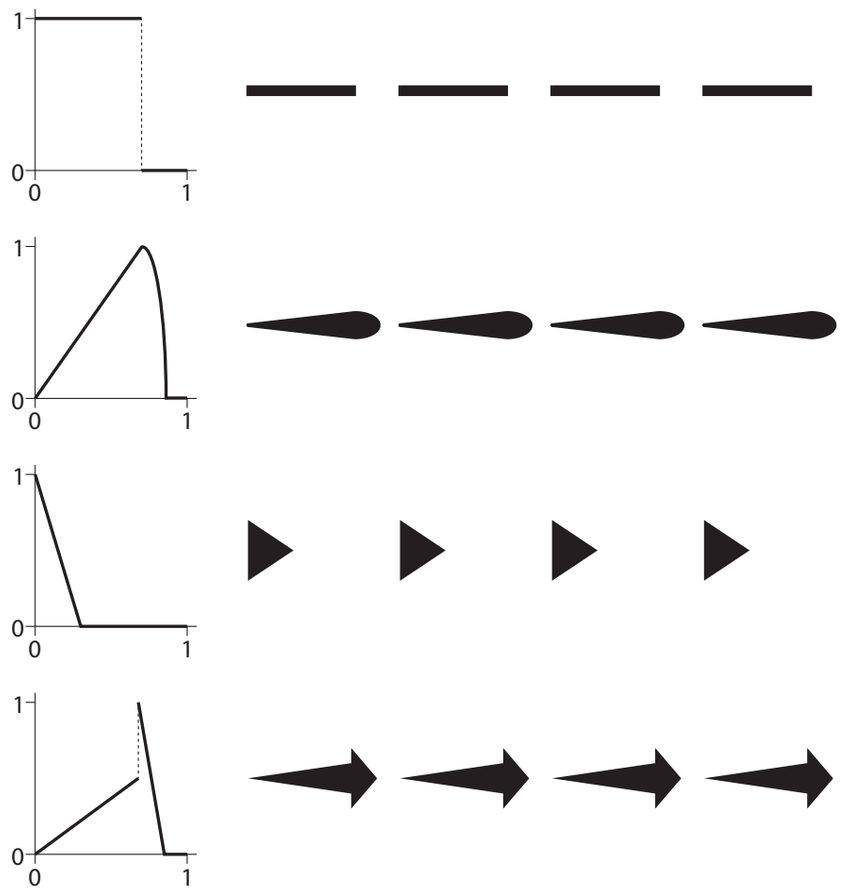
- Band width

Flexible band shapes

For repeating shape patterns:

- Shape mapping functions
- Line shape attribute

$$s_x = \frac{x}{l} \bmod 1$$



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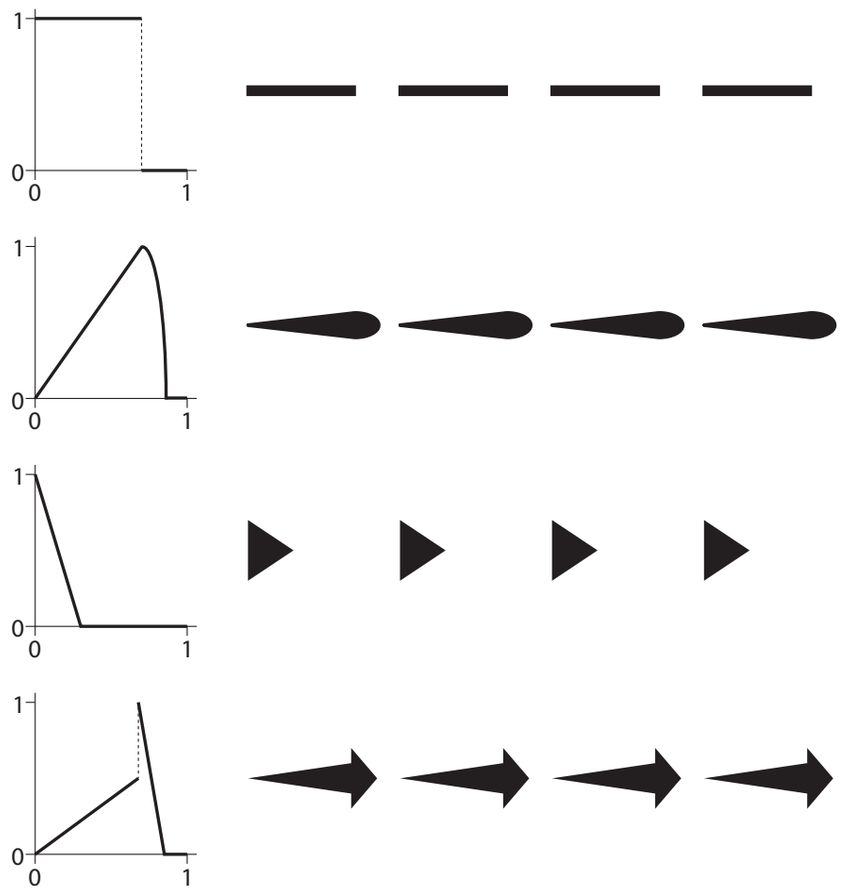
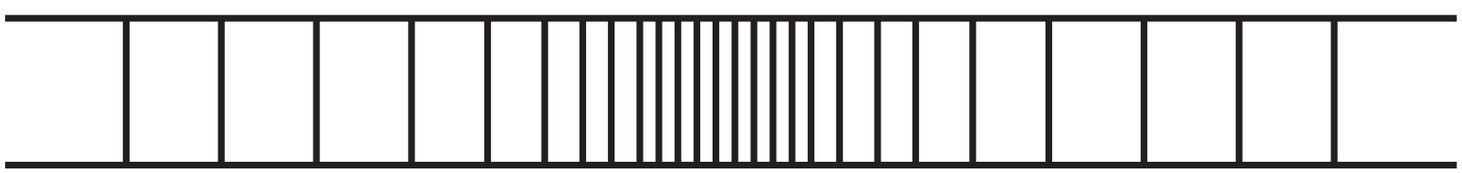
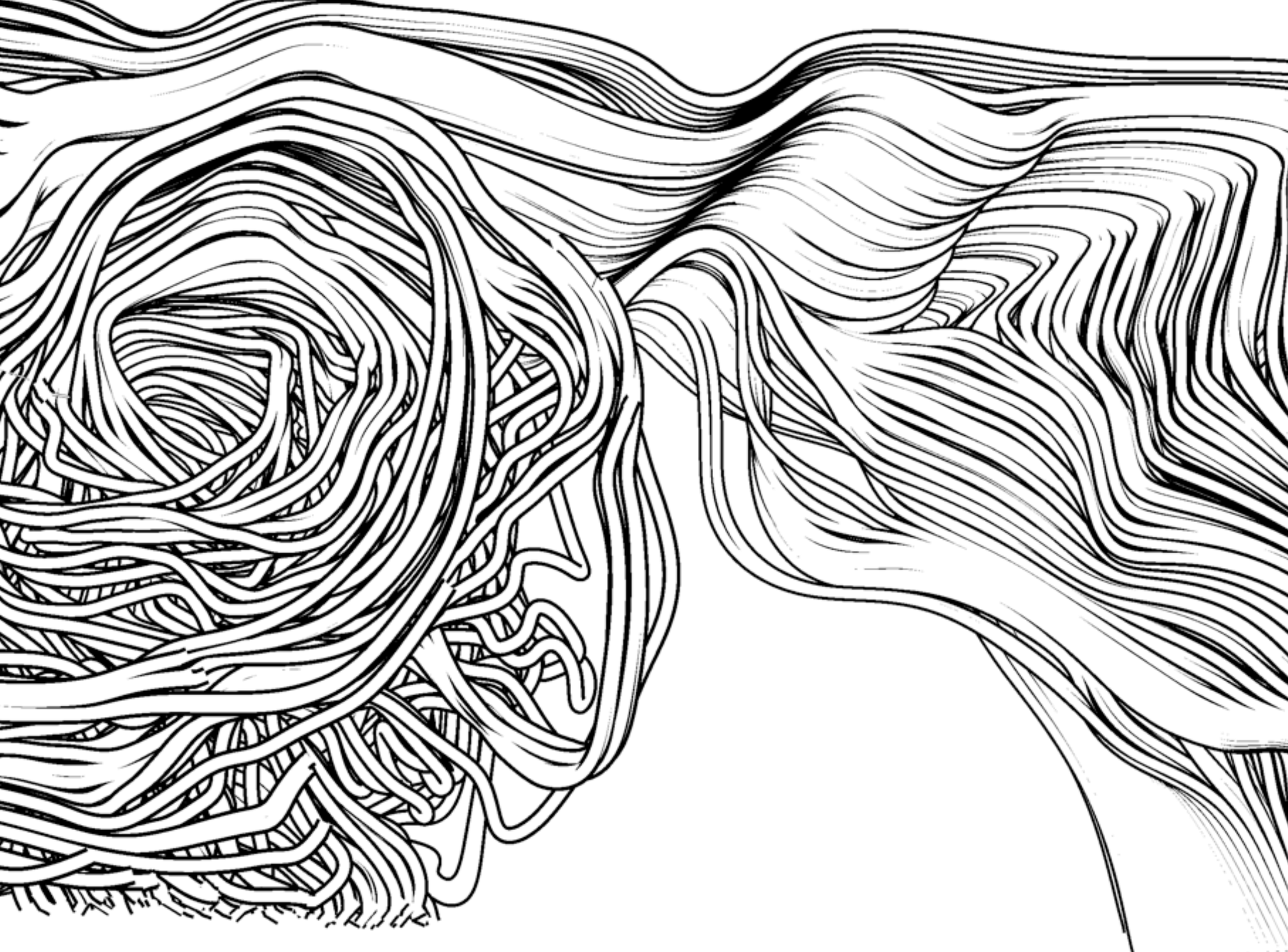


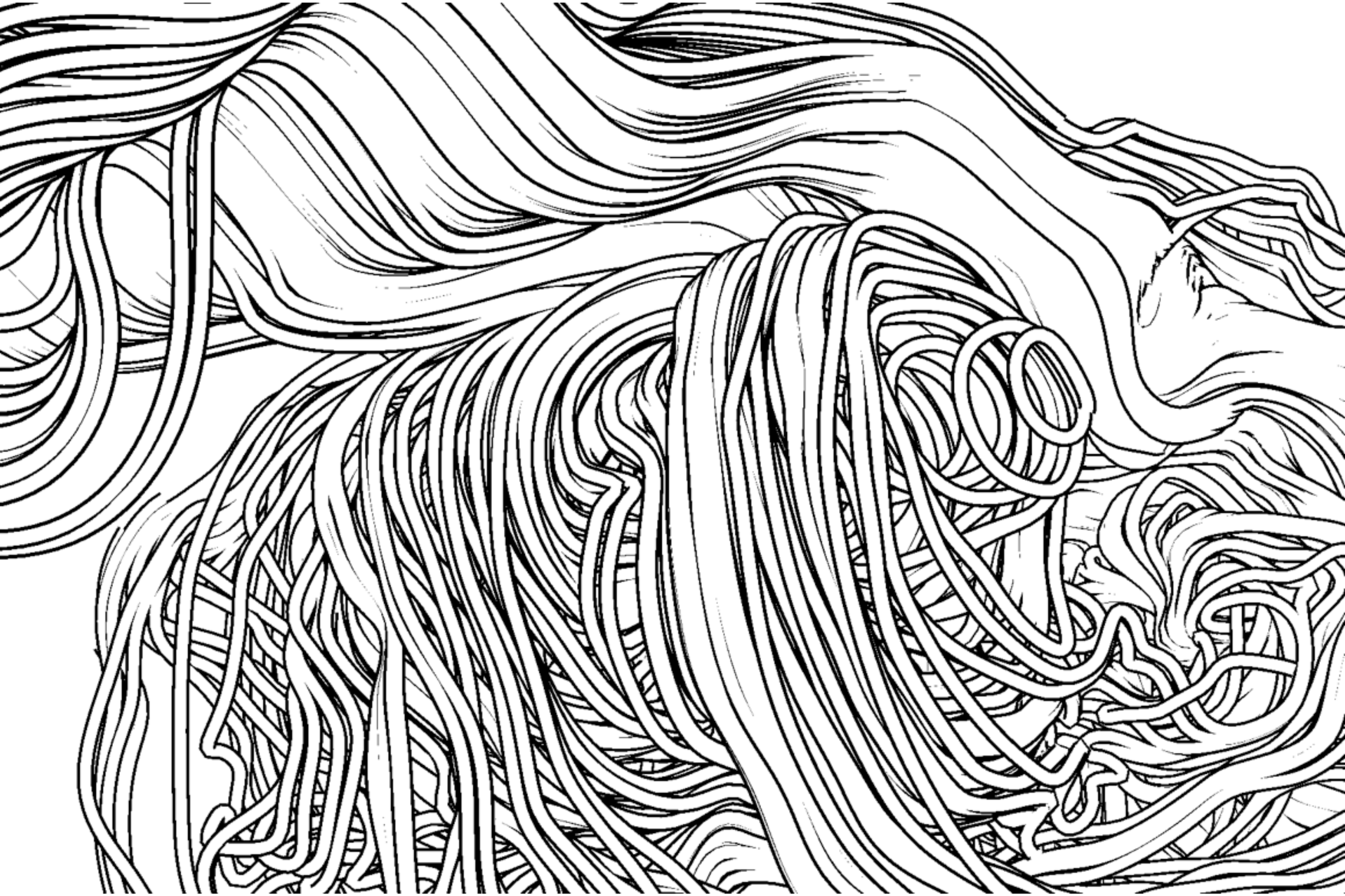
Integration time as attribute:

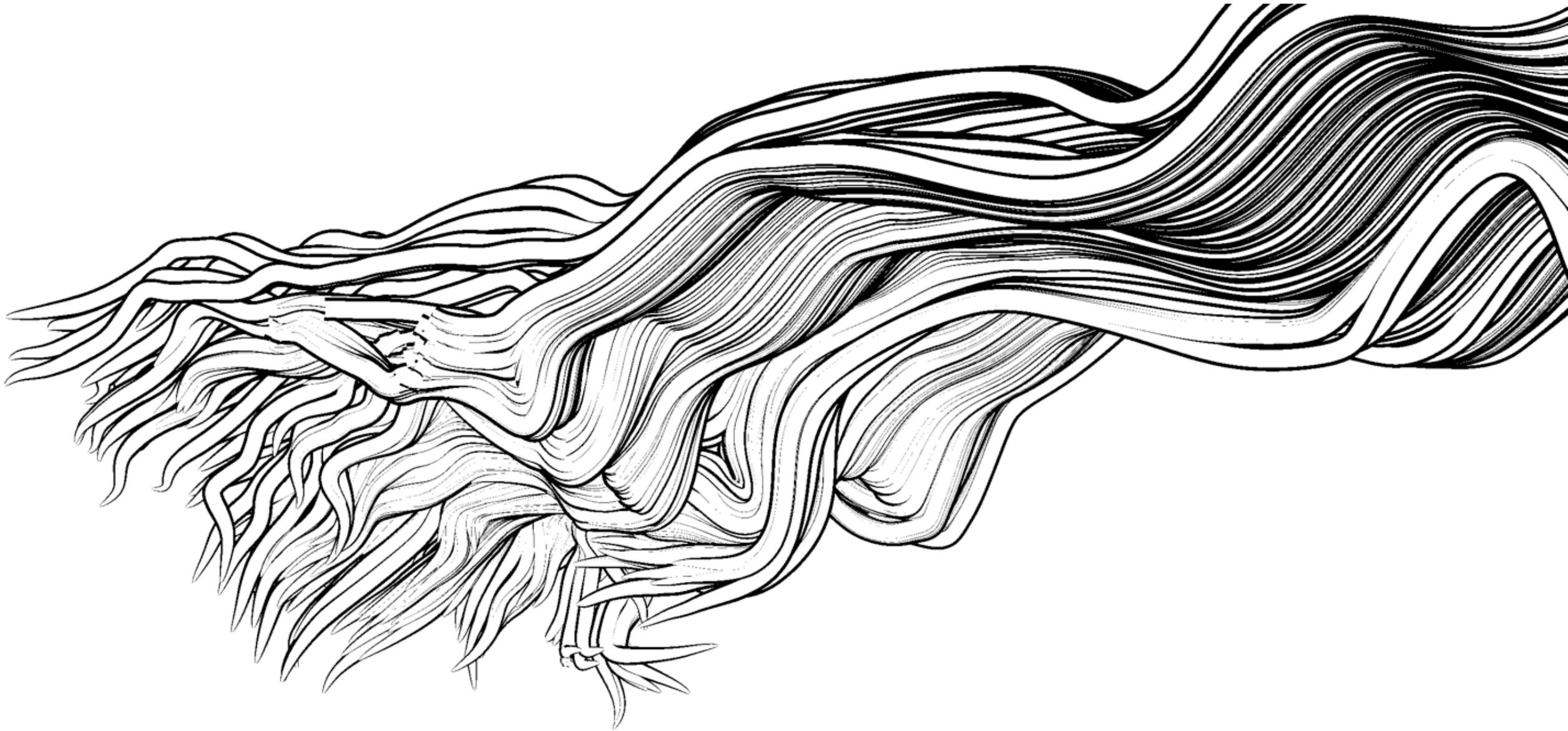
- Velocity encoded as shape frequency

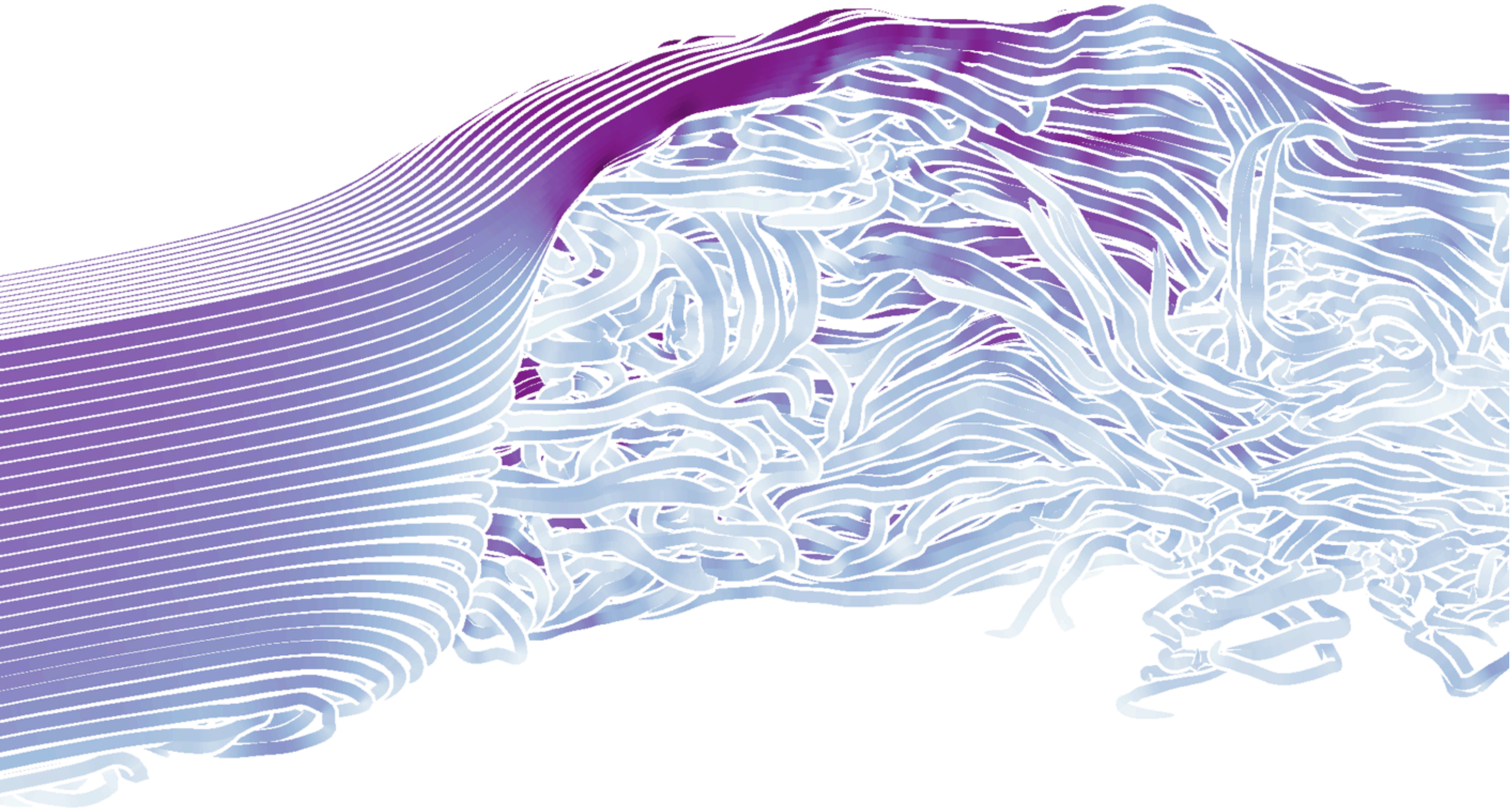


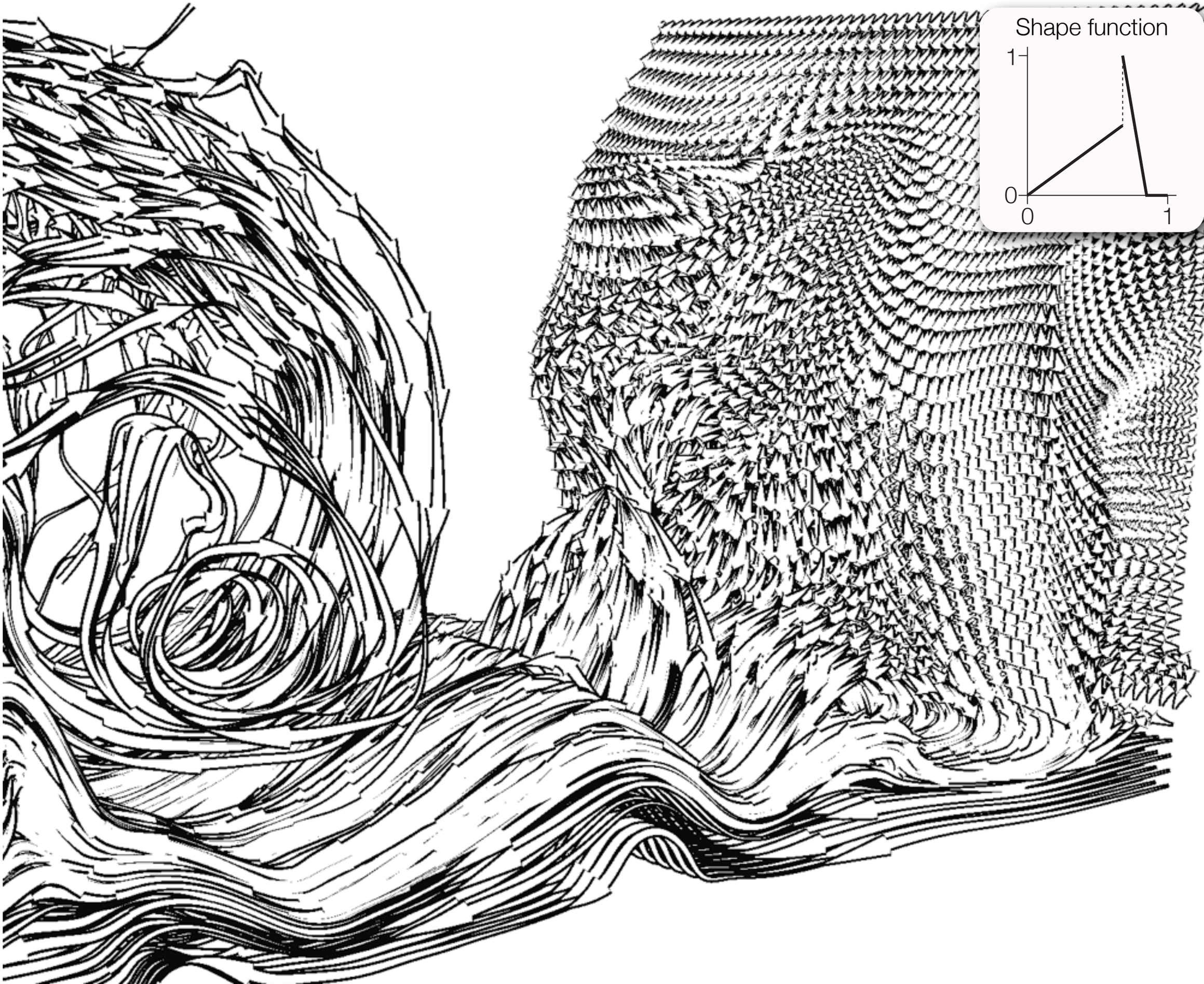
Results







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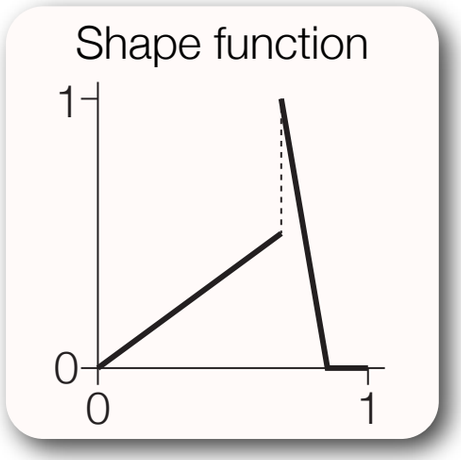
0
0
1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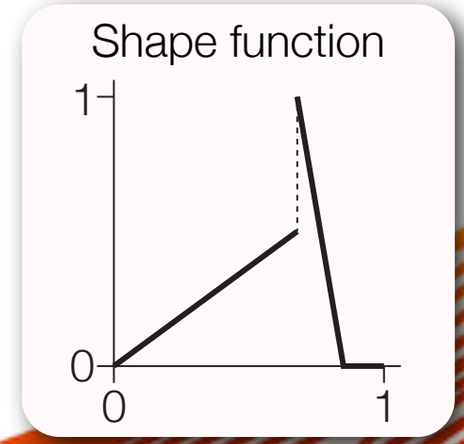
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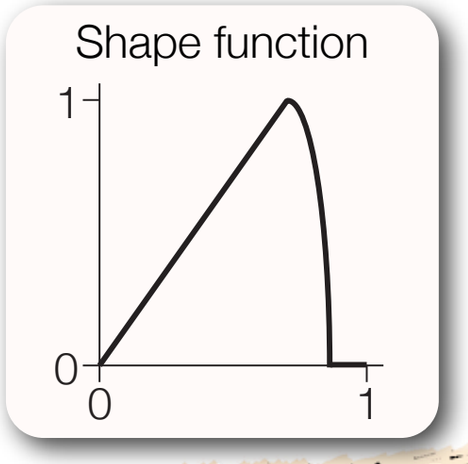
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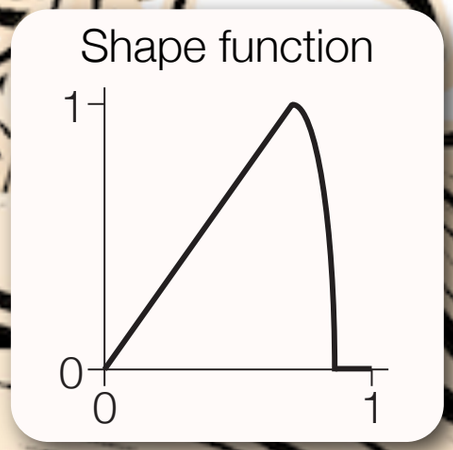
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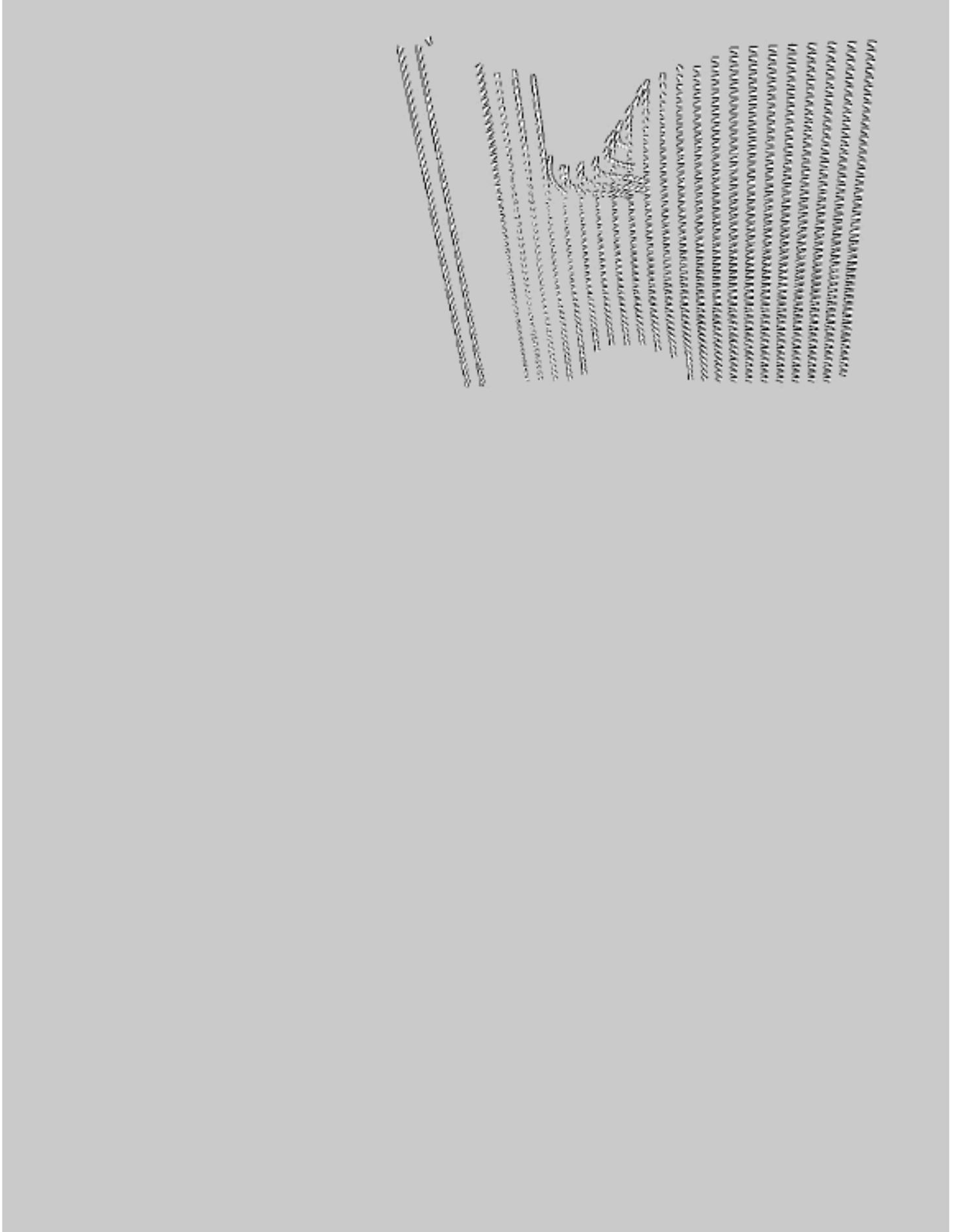
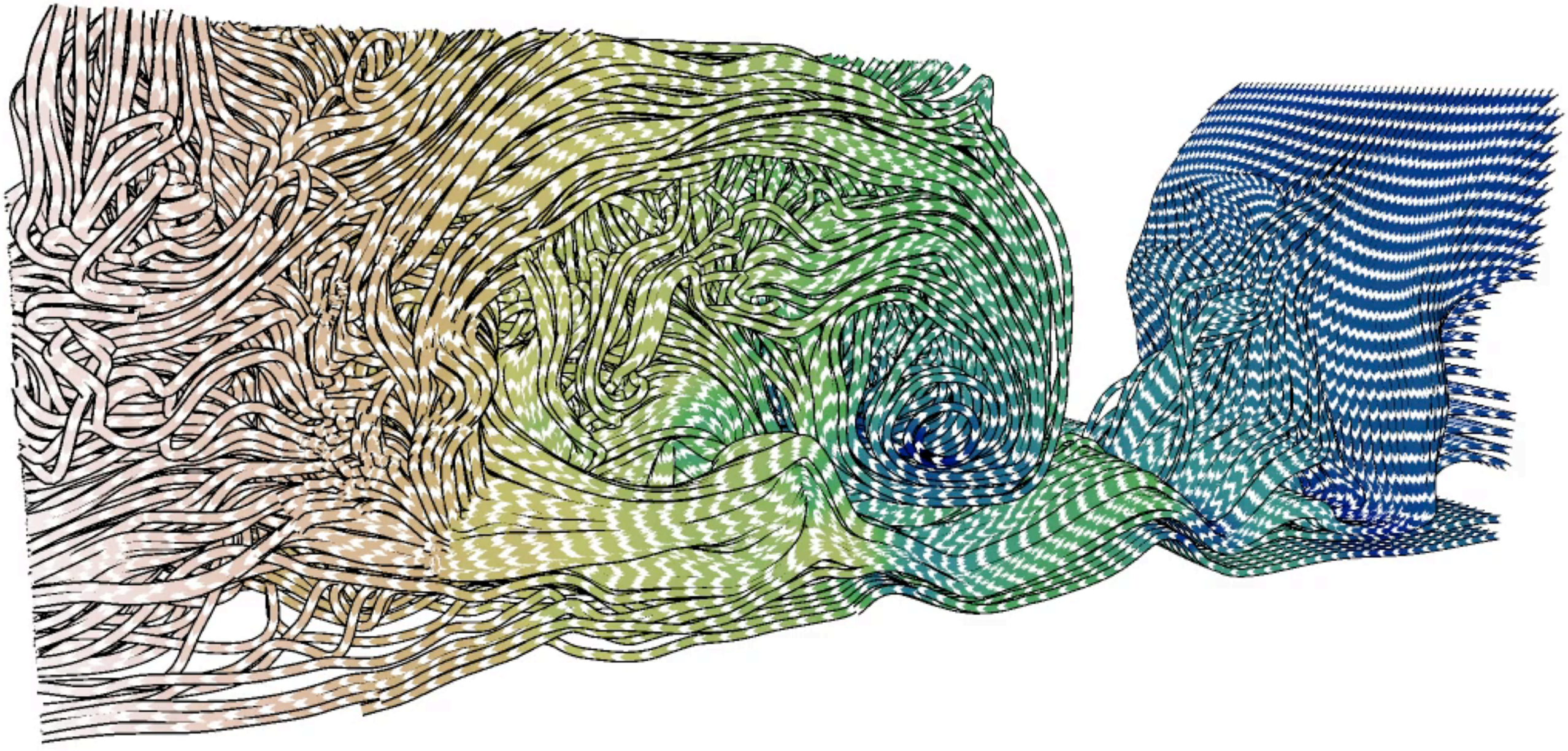
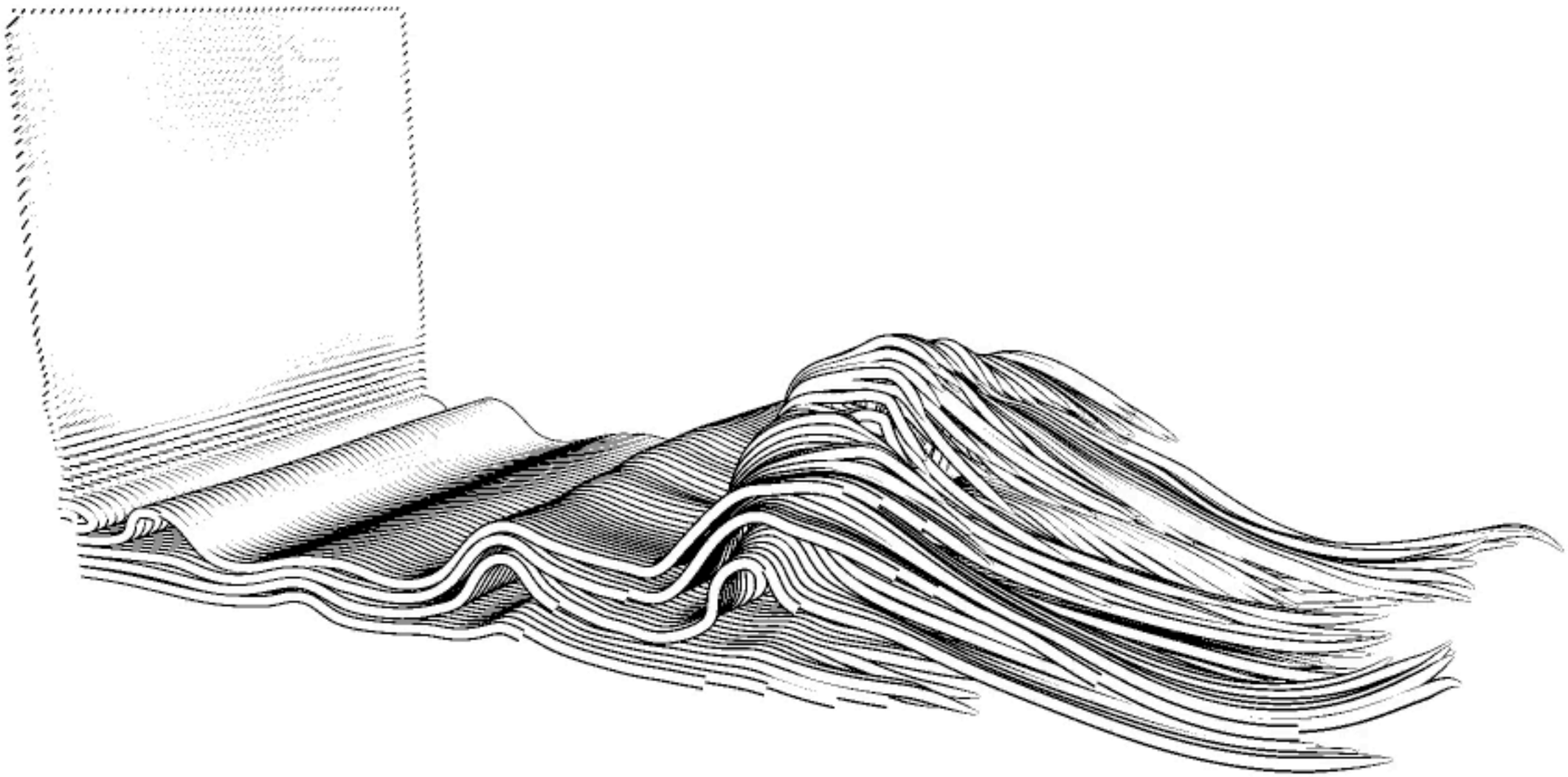
Bonus: animation



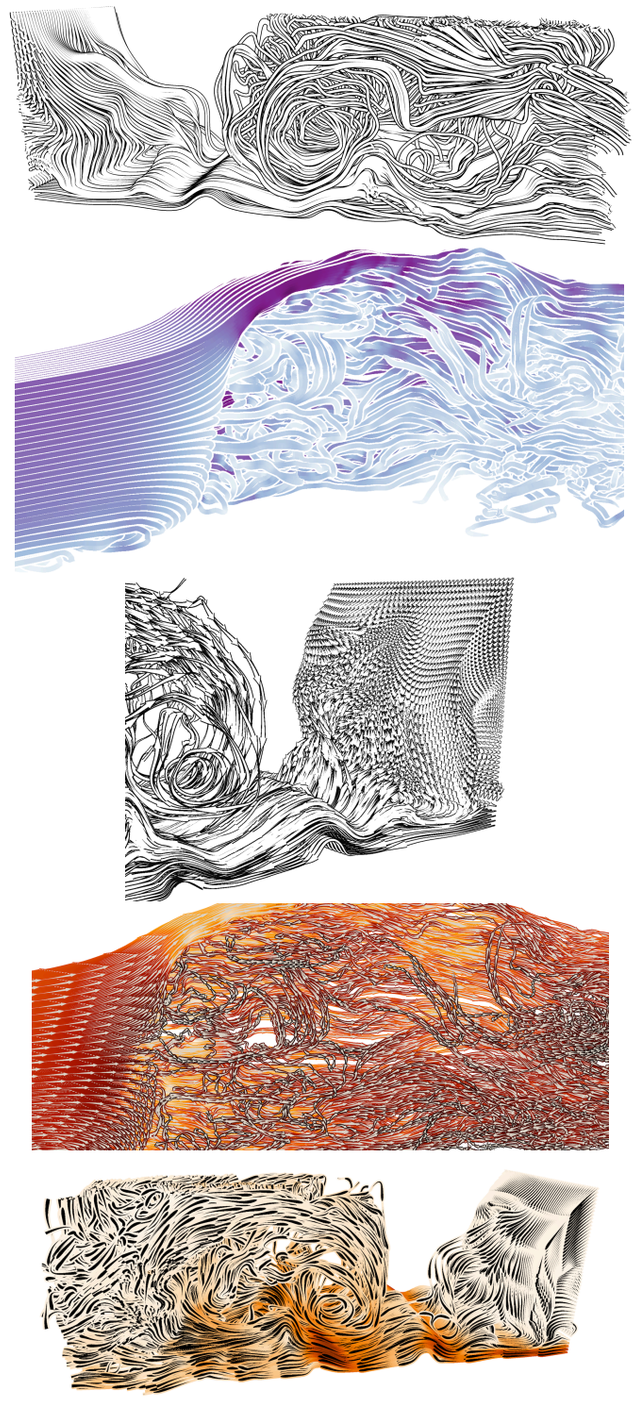




Discussion

- Fast and flexible GPU implementation.
- Interactive manipulation of line style parameters.
- Positive feedback in an informal evaluation with a fluid mechanics expert.

Conclusion

- Introduction of a flexible illustrative line style model for visualizing flow streamlines

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