Flower Factory: A Component-based Approach for Rapid Flower Modeling

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Presentation overview

- Introduction
- Method details
- Experimental results
- Conclusion and future work

Motivation

- Flowers are frequently utilized in CG applications, such as video games, film production and VR/AR scenes.
- It is quite tactical and time-consuming for designers to generate a realistic flower using the 3D modeling software.

Real flower

Virtual flowers

Related work

Ijiri et al. 2014

- X-ray
- Above 14 mins

Yan et al. 2014

- Image
- Semi-automatic

Zhang et al. 2014

- Point cloud
- Petal database

Zheng et al. 2017

- Point cloud
- 20-30 mins

Challenges

- How to create realistic flowers?
- How to reduce the computational cost or complicated interactions?
- Is it possible to be integrated in lightweight applications?

- In this paper, we propose **a component-based approach** for rapid flower modeling.

Contributions

- Our comprehensive component-based framework can be controlled by a set of parameters. It greatly reduces the computational cost.
- The components can be assembled in different ways to create various types of flowers. Also, we present straightforward strategies to handle the collisions of petals.
- We design a number of rules and provide a predefine mask to adjust the color distribution on the petal surface.

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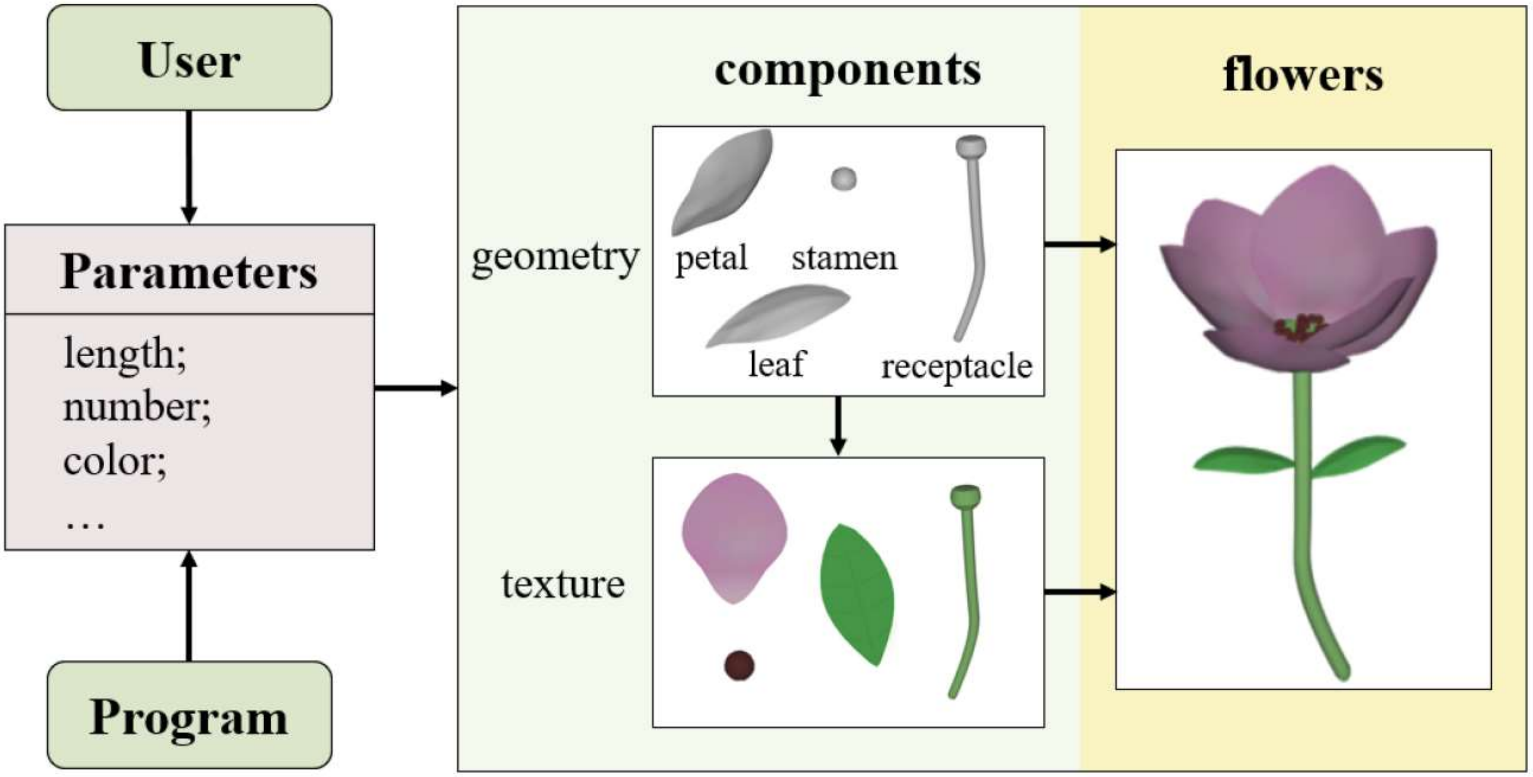
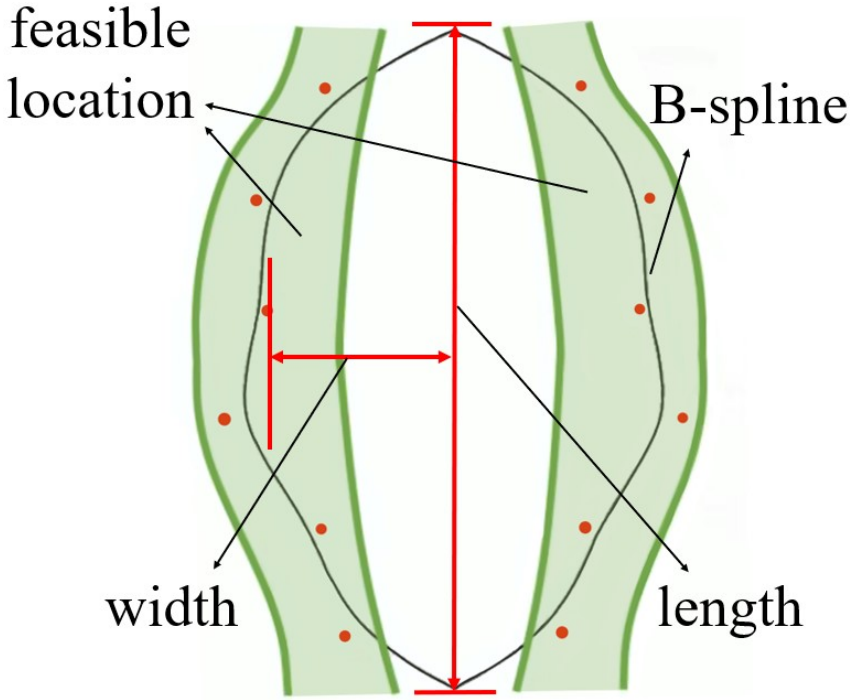
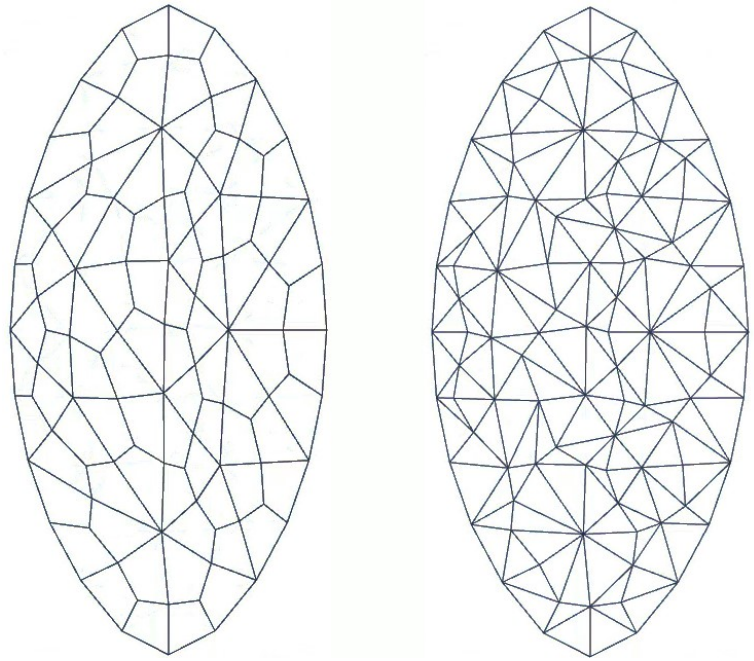
Framework


User
Parameters
length;
number;
color;
…
Program
components
flowers
geometry
petal
stamen
leaf
receptacle
texture

Geometry generation

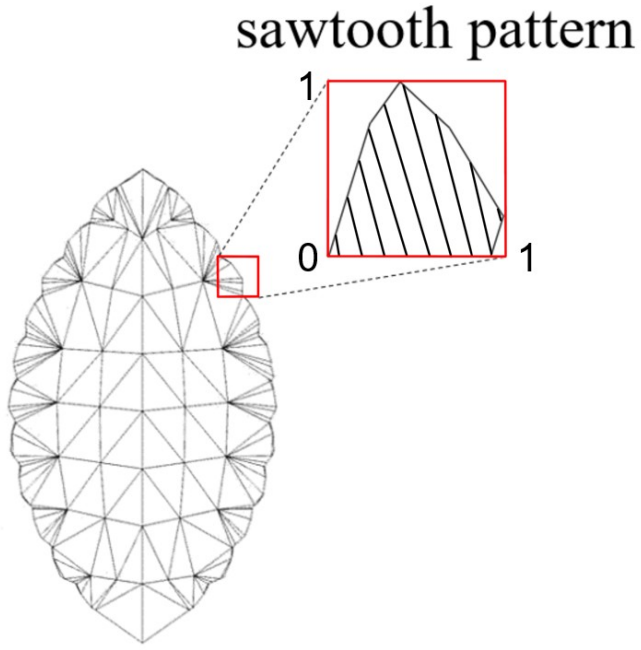
- **Floral components**
  - The floral components consist of petals, leaves, receptacles and stamens.
  - Petals and leaves are created using two boundary curves on 2D planes.

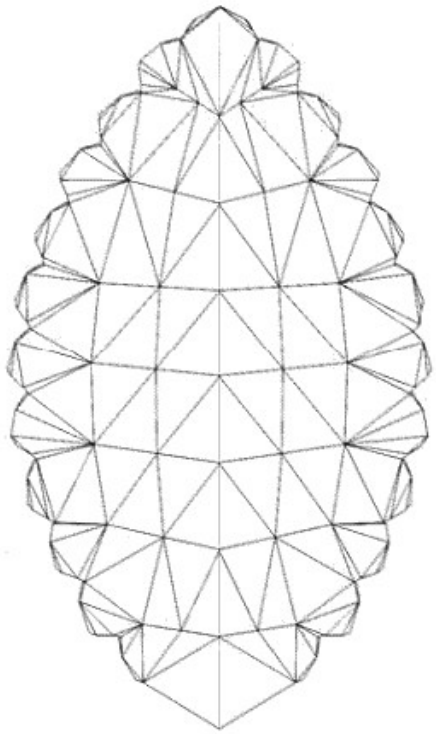


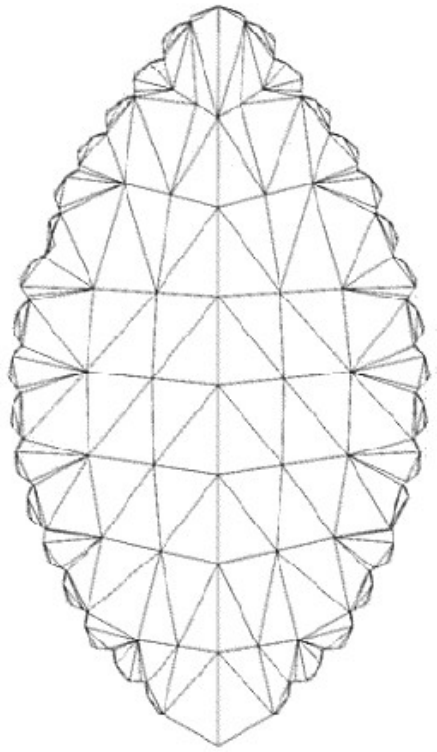


Geometry generation

- **Floral components**
  - We add sawtooth to the boundaries of leaves.
  - A set of patterns are defined for sawtooth.

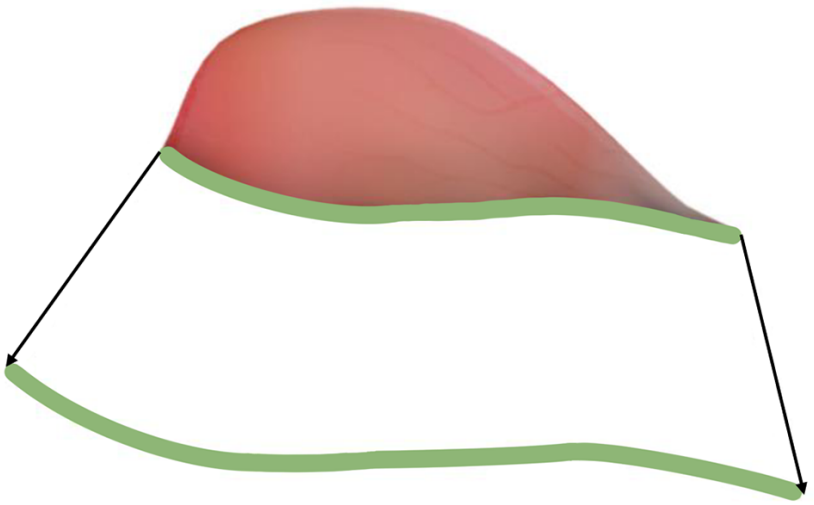


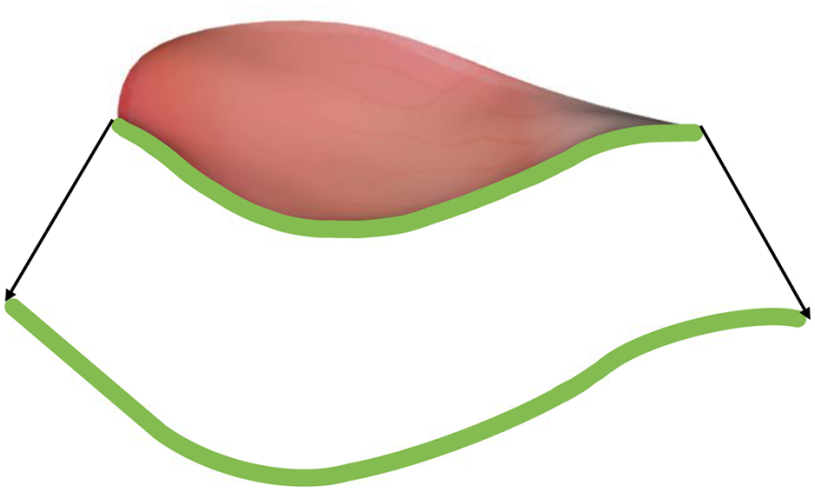




Geometry generation

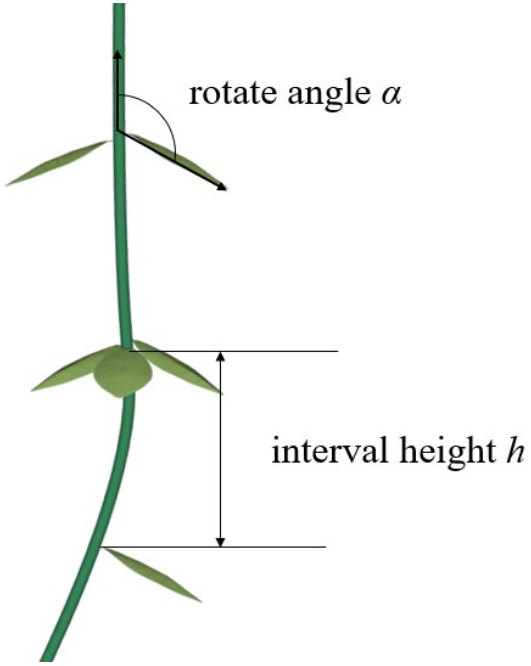
- **Floral components**
  - Since the models are created on 2D plane, we employ linear blend skinning (LBS) to produce the 3D geometry.
  - To change the shape, we make the central vein to fit a 3D curve.

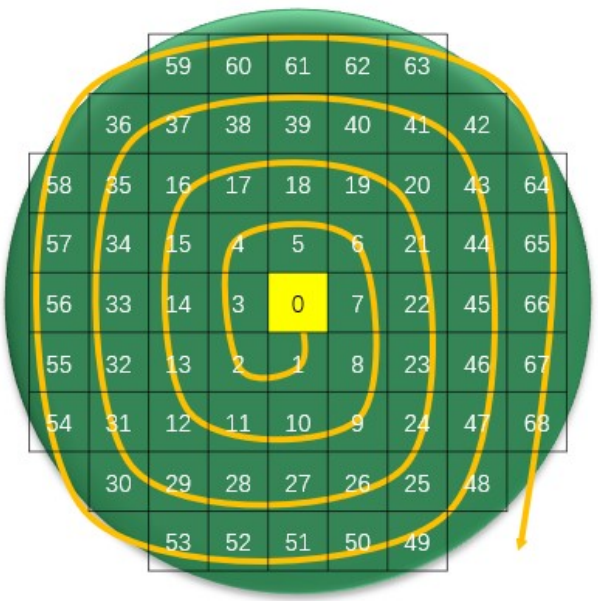


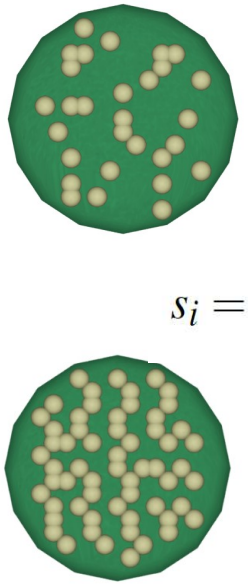


Geometry generation

- **Components assembly**
  - A complete flower model can be constructed after each component is created.
  - User can specify the parameters of the components.



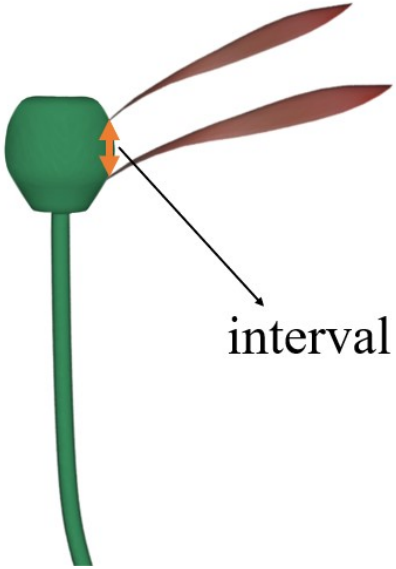




$$s_i = \lfloor \frac{i \times m}{n} \rfloor$$

Geometry generation

- **Components assembly**
  - To handle the collisions and overlaps between different layers, a small interval is added between adjacent layers.
  - In the same layer, an interval is also added between adjacent petals.



Geometry generation

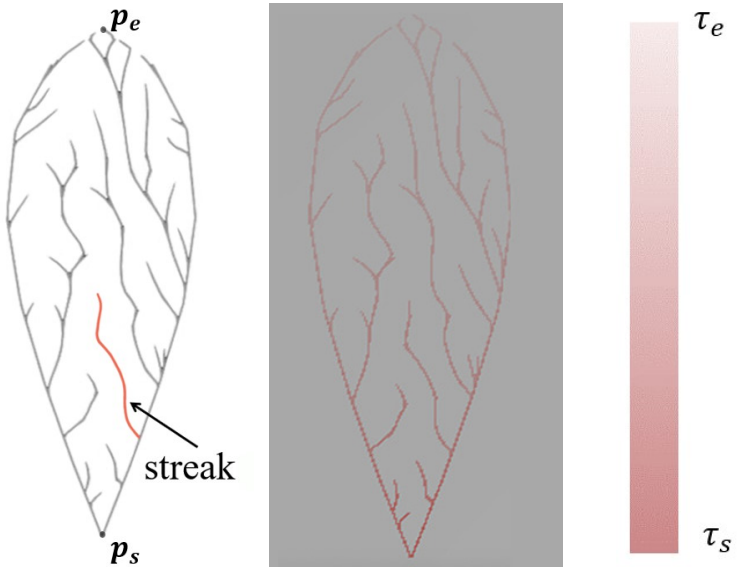
- **Components assembly**
  - The opening state is dominated by an input angle β.

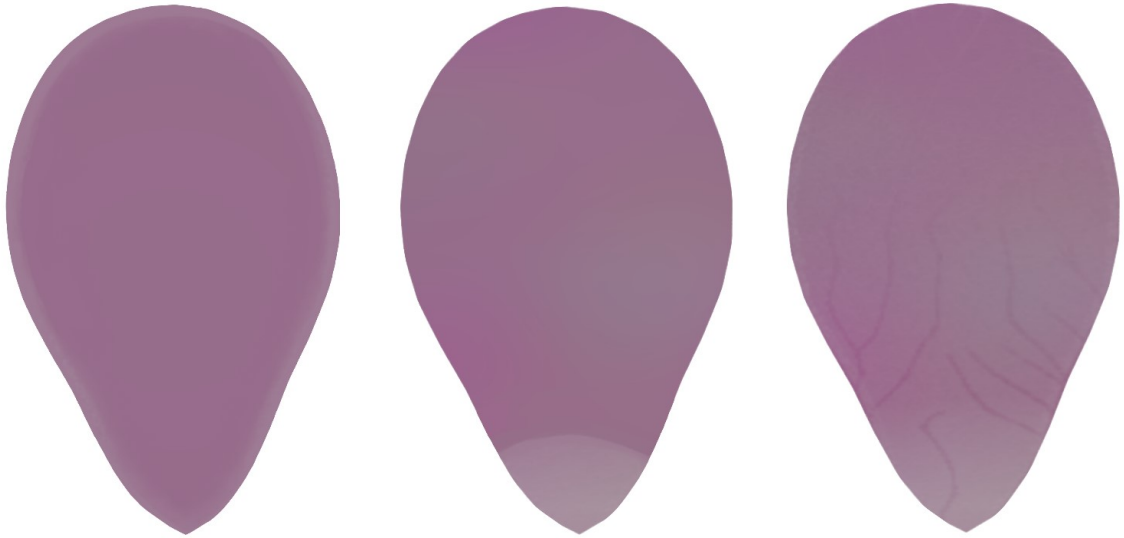
Geometry generation

- **Blooming animation**
  - The blooming animation is generated using linear interpolation of the corresponding points of the closed flower P_a and the opening flower P_b.

Textures generation

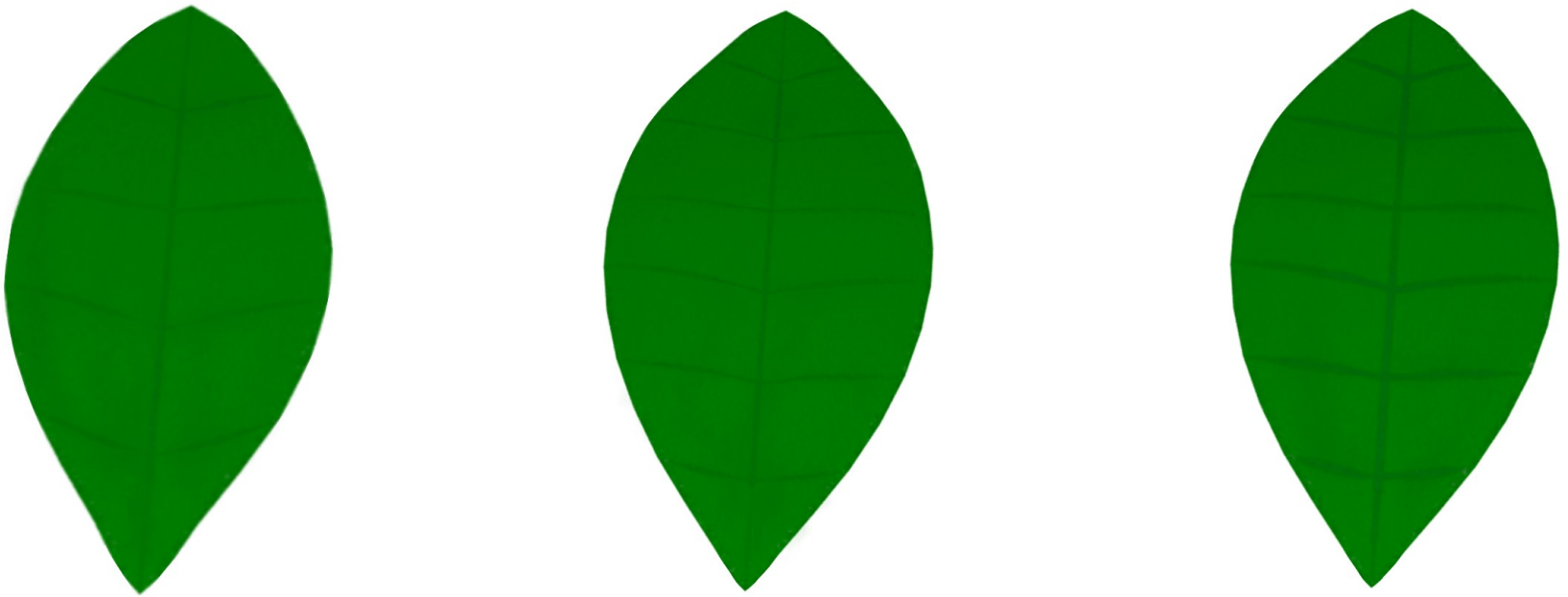
- **Textures for petals**
  - We define a set of rules for the texture generation.
  - To create the streaks, we define a mask for the petal component.
  - We utilize a heuristic method to simulate the diffusion of the pigments on the petal.





Textures generation

- **Textures for leaves**
  - We specify the pattern of leaf veins, and users can set the number of branches and the width of veins.



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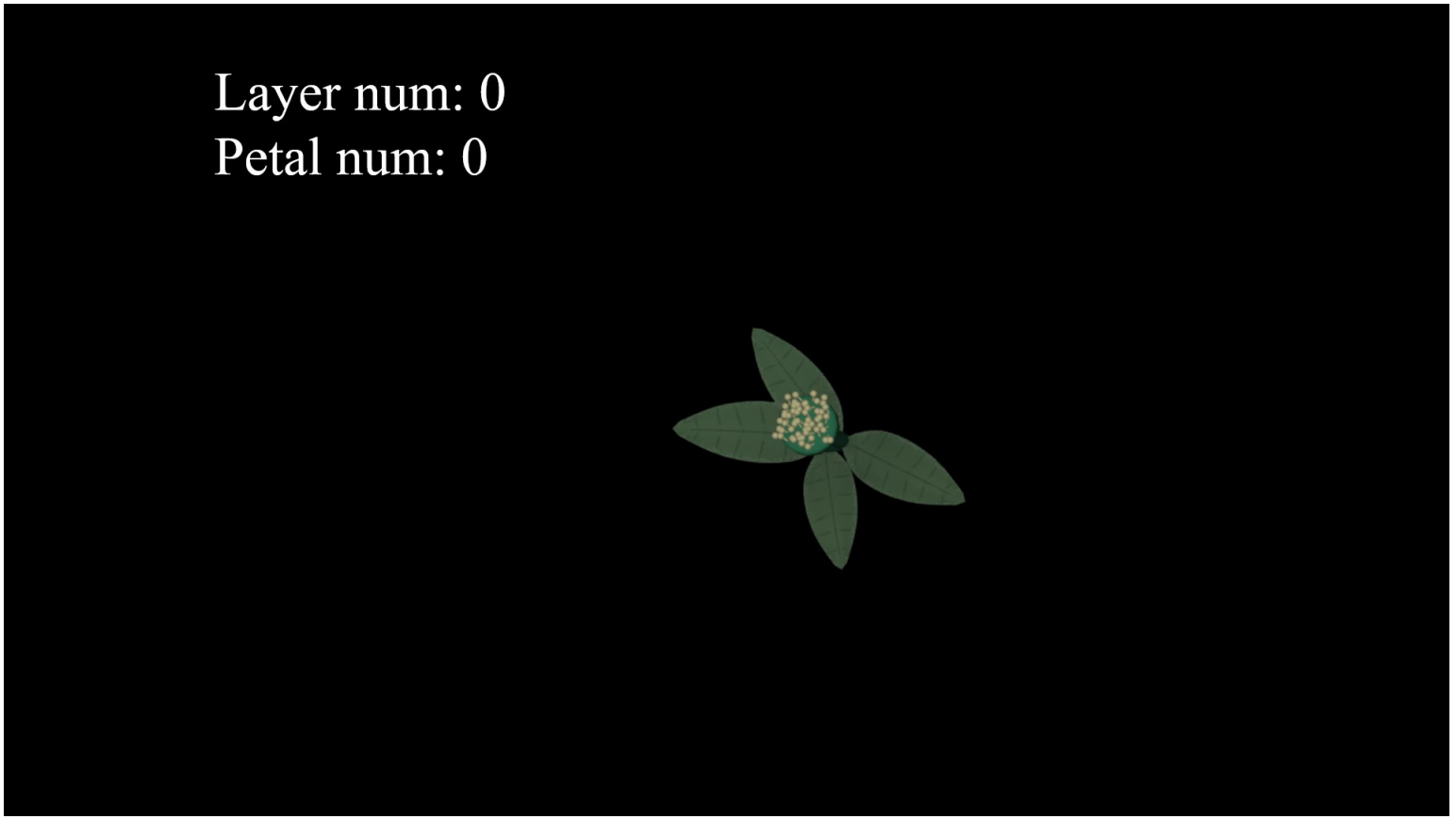
The effectiveness of the parameters

The effectiveness of the parameters



The effectiveness of the parameters

The effectiveness of the parameters

Comparison

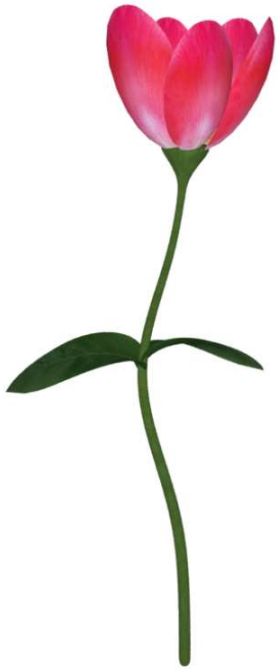
Zheng et al. 2017

Method	#Petals	#Frames	Total time
Zheng et al.	14	73	11min55s
Ours	25	50	4.21s

Ours

Comparison

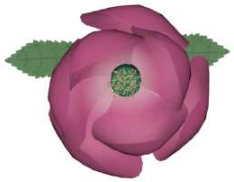
Tool	Time				Total time
	Geometry	Texture	Parameters	Computation	
Our system	/	/	3.4min	4.2s	3.5min
Houdini	2.8h	1.4h	/	/	4.2h
Our system	/	/	2.9min	3.7s	3min
Houdini	2.4h	1.5h	/	/□	3.9h



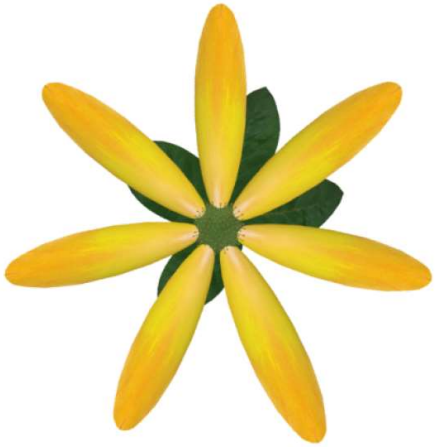
Houdini

Ours

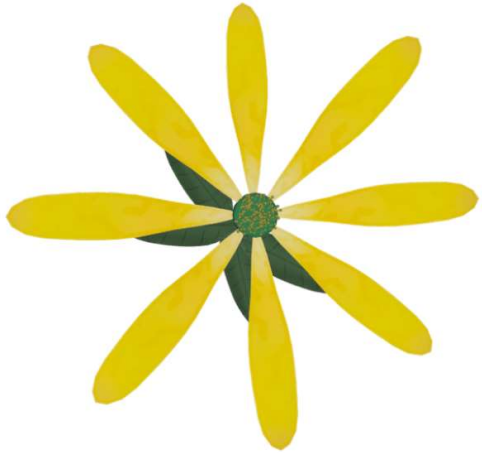
Houdini



Ours



Houdini



Ours

User study

- **Consistency**
  - Intraclass Correlation Coefficient (ICC) is employed to evaluate the consistency of the questionnaire.
  - We calculated ICC for the user study, and the average measurement is 0.932.

Attribute	Average score (0-10)
Easy to learn	7.87
Easy to use	8.06
Rationality of parameters	8.31
Diversity of flowers	7.62
Visual aesthetics	6.75
Fidelity of results	6.68

Limitations

- First, our approach cannot generate inflorescence.
- Second, our system does not employ any biological knowledge for the modeling.
- Third, our system cannot produce flowers directly from photos.

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Conclusion and future work

- In this paper, we propose a component-based framework for rapid modeling of flowers. Our technique is capable of producing a variety of flowers quickly.

- **Future work**
  - An image-based interface is helpful for the flower generation.
  - Biologically-based rules may enhance the geometry and texture generation.
  - We consider to add more functions into our system such as inflorescence.

Acknowledgment

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Thank You!

Q&A: Any question can be sent to the authors!

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