NeuraLeaf: Neural Parametric Leaf Models with Shape and Deformation Distanglement

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Introduction

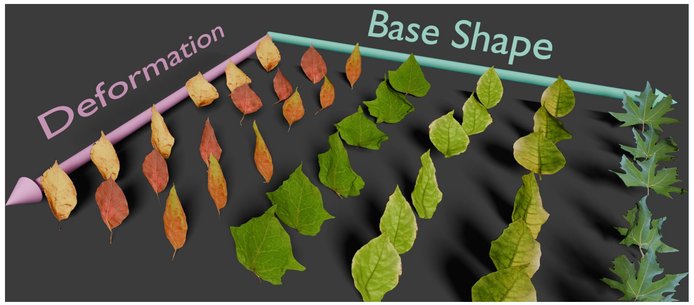
Parametric models (e.g., SMPL, FLAME, SMAL) successfully represent humans and animals

How about leaves?

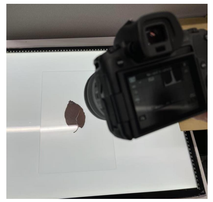
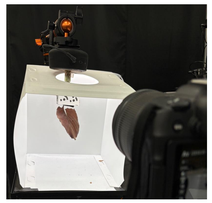
Challenges

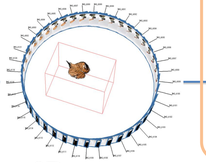
- Lack large-scale 3D leaf dataset
- Large variations of shape and deformation
- Lack constraint in deformation modeling

We build a neural parametric model for leaves, **NeuraLeaf**, represents shapes of various leaf species and natural 3D deformation, along with fine-grained texture.



DeformLeaf Dataset

2D capture

3D capture

Base shape

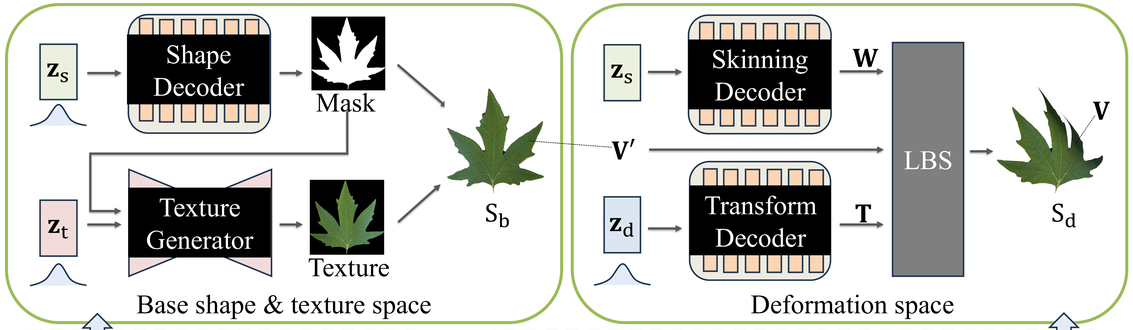
Deformed shape
Base-deformed shape pair

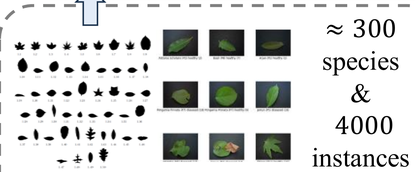
300+ 3D shapes
30+ leaf species

Download Here!

NeuraLeaf Model

Key idea: Disentangling leaf modeling into 2D base shape, texture, and 3D deformation spaces, each conditioned by an independent latent code.



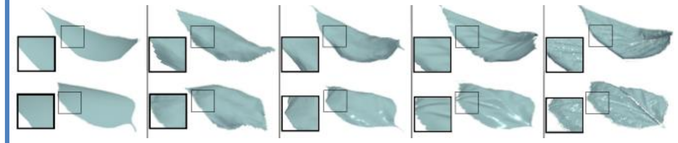

≈ 300 species & 4000 instances
Large scale 2D dataset


DeformLeaf dataset

Leaf Reconstruction

Method	C-ℓ_2 [mm] ↓	NC ↑	Corres-free	Temp-free	Inf. time [s]
PCA	32.7	0.924	×	×	157
B-spline	26.7	0.957	√	√	18
NPM	15.1	0.961	×	√	73
NeuraLeaf	**2.1**	**0.973**	√	√	55

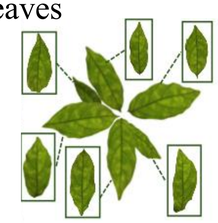
single leaf


PCA B-Spline NPM Neuraleaf GT

multiple leaves



Input image & depth


Output: occlusion-aware high-fidelity shape

Leaf Modeling