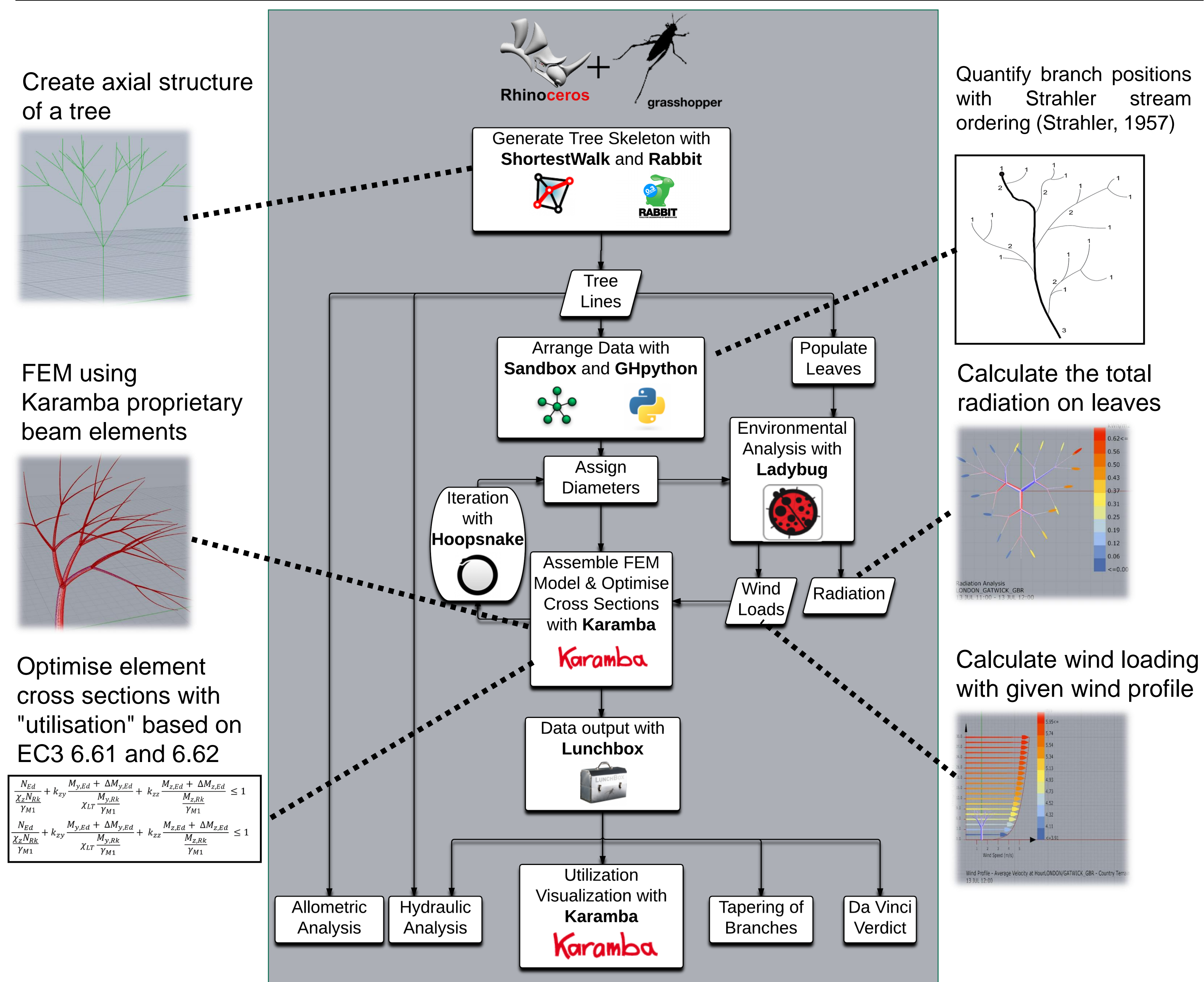


Introduction

Trees possess intriguingly complex features and play important roles in natural and built environments. The seamless integration of key performance functions, **structural**, **hydraulics**, **photosynthesis** and **reproduction**, through the tree structure formation enables strong adaptive capability of trees for various environmental challenges. By studying how trees adapt their form to the changing environment, the way various systems are integrated can be investigated and a mechanistic model of tree can be built for urban sustainability analysis. Parametric design tools **RhinoCeros 3D** and **Grasshopper 3D** are the main platform for this project.

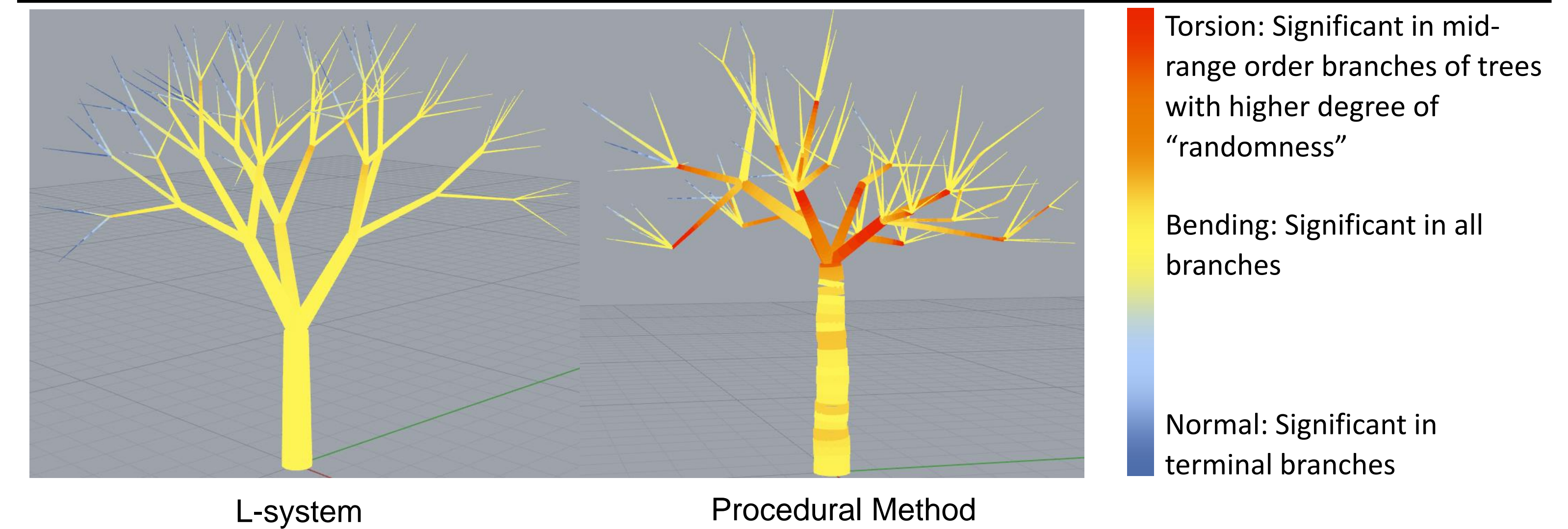
Methodology



Results and Discussion

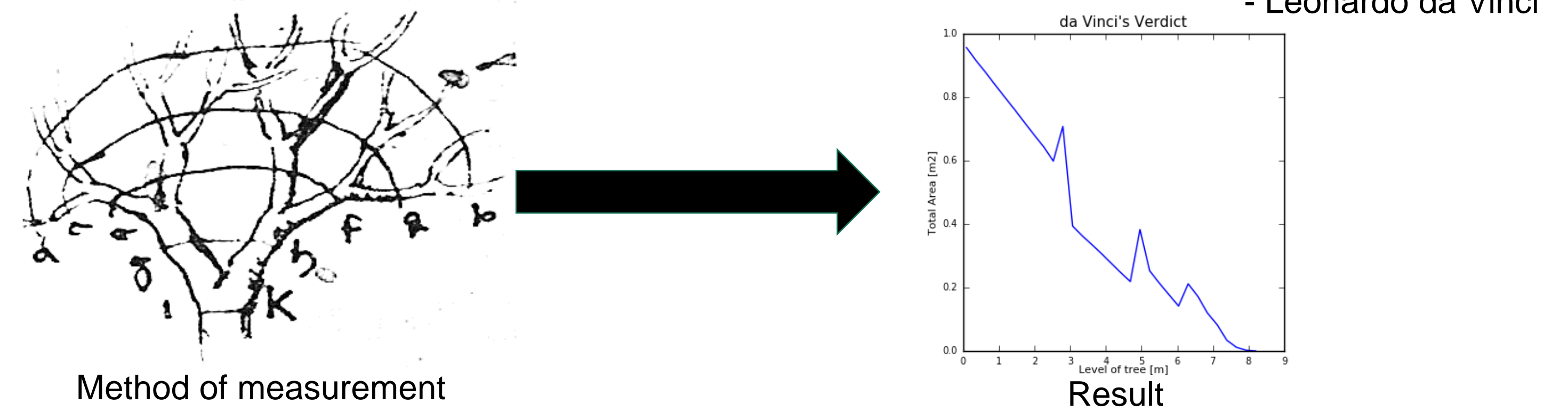
6 tree models are generated with the procedural method, 5 from the L-system and 3 for different weather data. Two tree models are selected for demonstration.

Structural Optimisation Strategy



Interaction with the hydraulic system

All branches of a tree at every stage of its height when put together are equal in thickness to the trunk. - Leonardo da Vinci



As tree models are purely optimized for structural performance, results unanimously show a decreasing trend, reflecting the linear tapering of branches. This indicates that the hydraulic system may play an important role in tree structure formation.

Climate impact

Climate has a significant impact on the resource allocation. In this case, radiation indicates the supply of resource and total mass the demand for structural performance

Location	London, UK	Los Angeles, US	Xi'an, China
Tree Height[m]	7.85	7.85	7.85
Tree Base Radius[m]	36.15	26.25	34.66
Total Mass[kg]	250.25	138.45	233.58
Total Radiation[kWh]	0.15	0.19	0.06

Conclusions

Implementation of parametric design tools is proven to be useful and convenient due to its visual feedback and strong extensibility. For tree structure formation, the interactions among various systems have significant impact and climate characteristics act as external input for the resource allocation for these systems. Further research is needed on integrating the hydraulic, photosynthesis systems and tropism into the tree model for more accurate prediction, and potential applications lie in urban environmental and sustainability analysis.

Reference

Strahler, A. N., 1957. Quantitative analysis of watershed geomorphology. *Transactions American Geophysical Union*, pp. 913-920.

Acknowledgement

I would like to express my deep gratitude for Dr Phillips for his patience and invaluable advice during the preparation of the project.