Title

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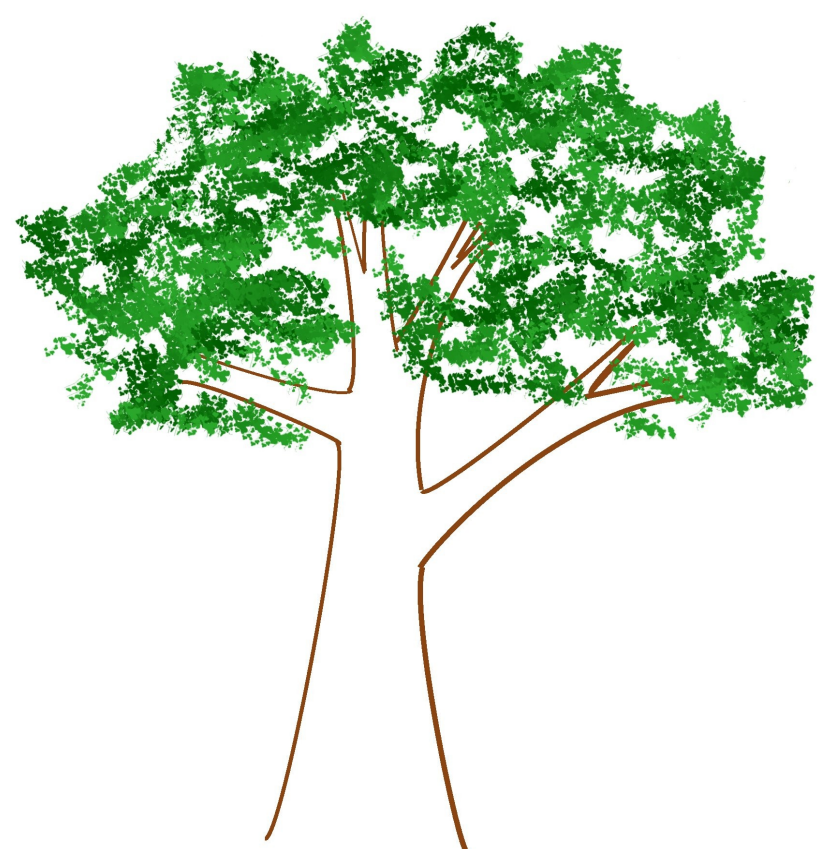
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Statistical Methods for Recovering 3D Models of Trees from Sensor Data

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Introduction: Using vision and sensors to automate data collection about trees

Measuring the biological parameters of trees can be a time consuming process. There are two main choices: painstakingly count leaves and measure hundreds of branches by hand, or use rough approximations obtained from sensors like hemispherical cameras or airborne laser scans. We hope to find methods for reconstructing models of trees in greater detail, by collecting large amounts of sensor data taken at relatively close range and fitting a model to this data. Once the model is created, parameters such as branch lengths and approximate leaf areas can be automatically calculated. If we are able to successfully automate data collection and model reconstruction, the process of extracting tree parameters will become considerably easier and more accurate than current methods.

Problem: How do we efficiently measure parameters of a tree?

What we want to know
- Geometric properties of the branch structure (branch lengths, angles, etc.)
- Approximate leaf distribution and total surface area

How to interpret the raw data
- **Laser Scans -** Accurate 3D measurements
- **Stereo Vision -** Less accurate than laser data, but provides color information
1. Combine the sensor data into one 3D point cloud.
2. Fit a model to the points using a technique such as EM
3. Estimate parameters of the real tree from the parameters of the model
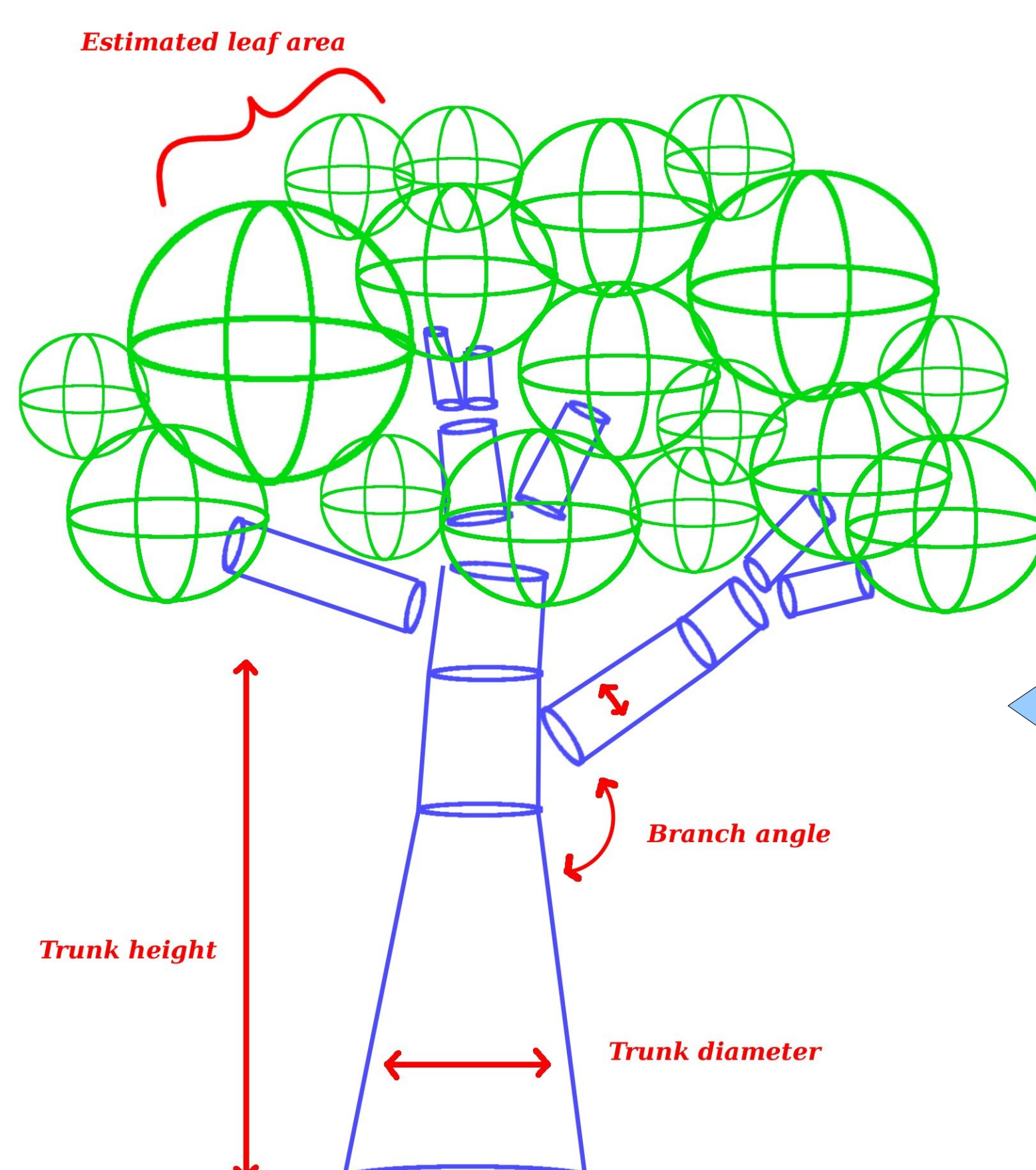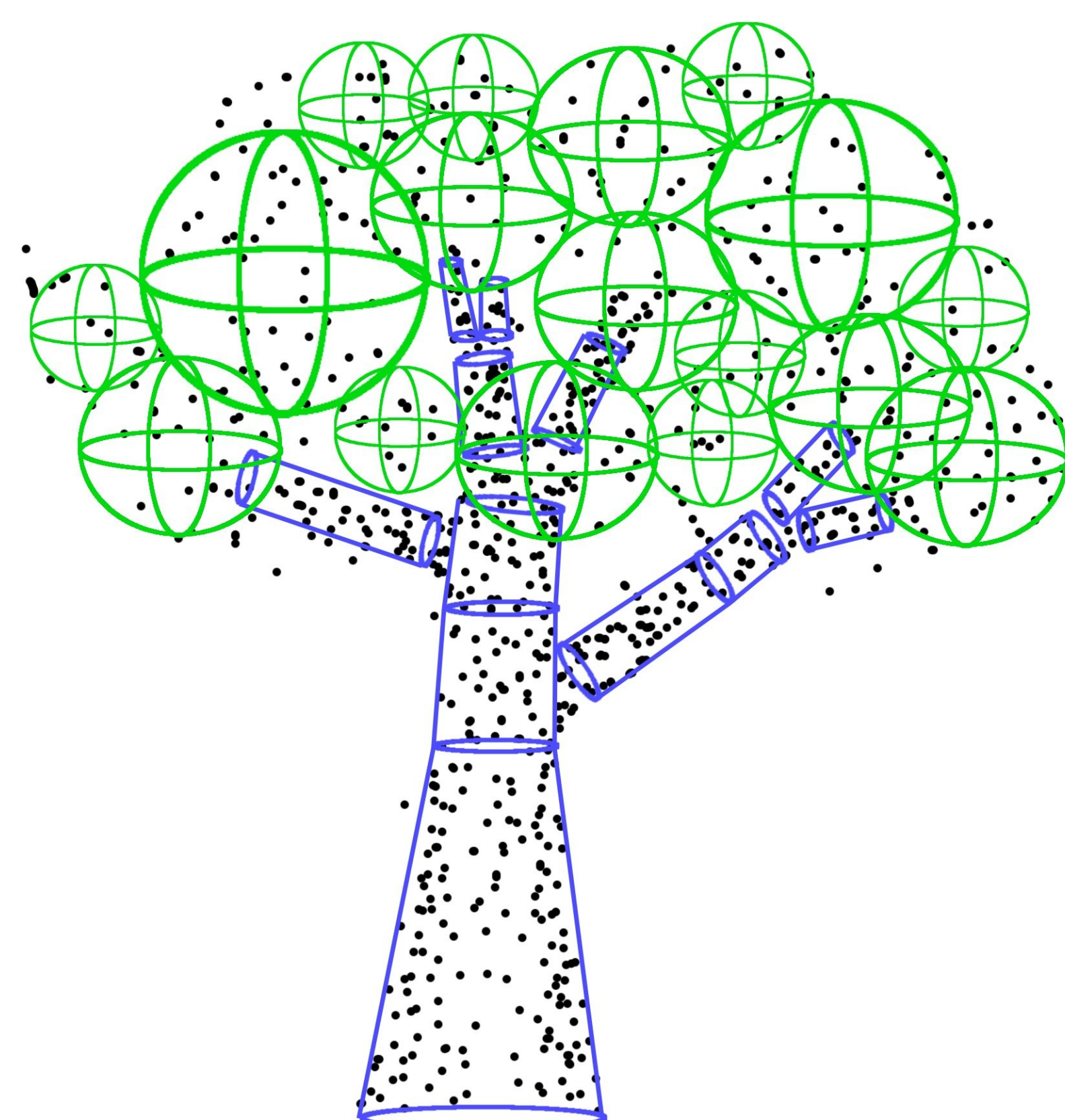
Problems
- How to formulate the general model of a tree?
- Any realistic model of a tree will be complex, making estimation of its parameters very difficult.

Proposed Solution: Use statistical techniques to model the tree and make the measurements
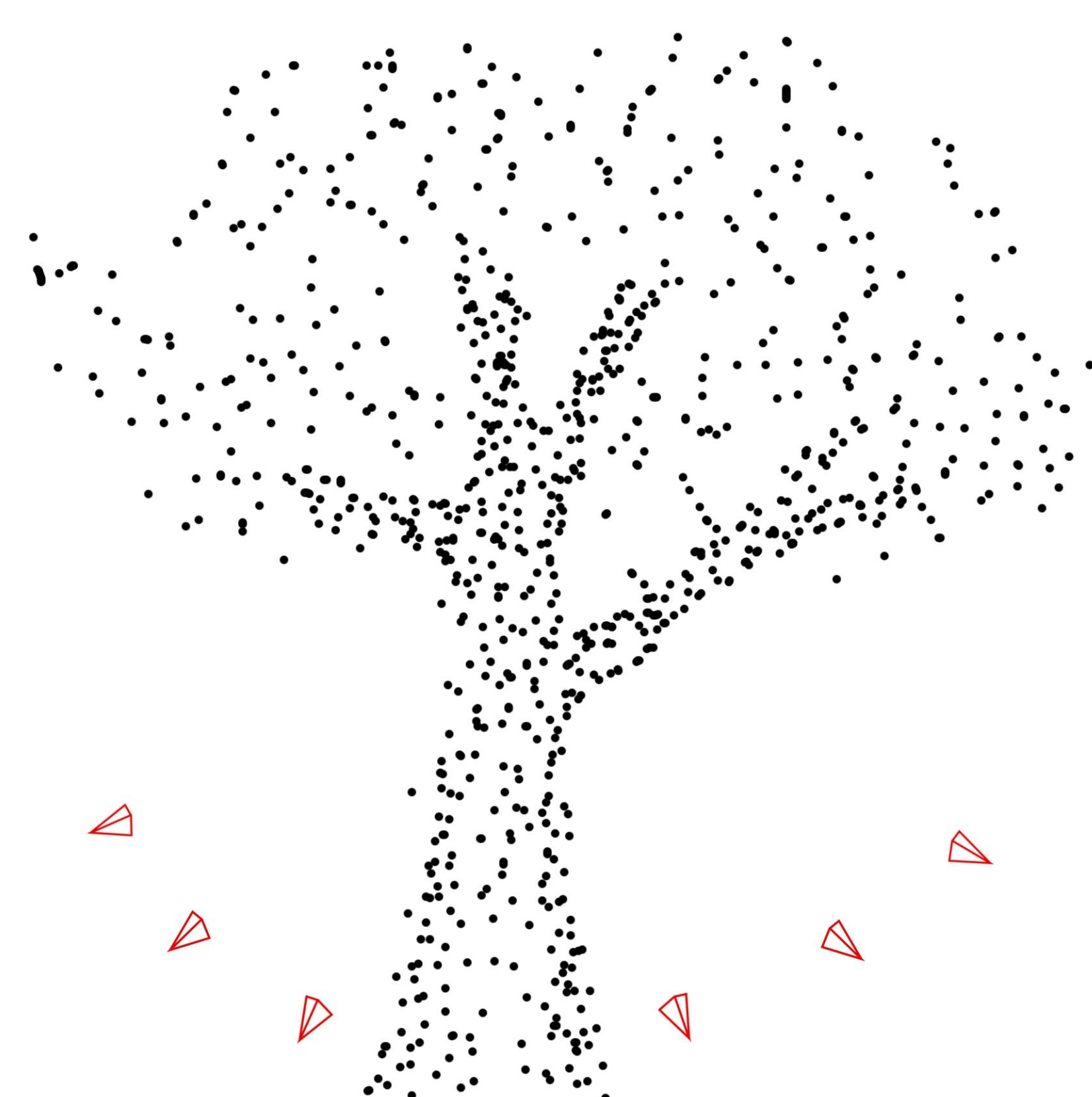
1. Collect sensor data

2. Fit a model to the data

3. Extract relevant parameters from the model

Estimated leaf area

Branch angle

Trunk height

Trunk diameter