Bachelor/Master short internship: 3D tree leaf reconstruction from laser scans

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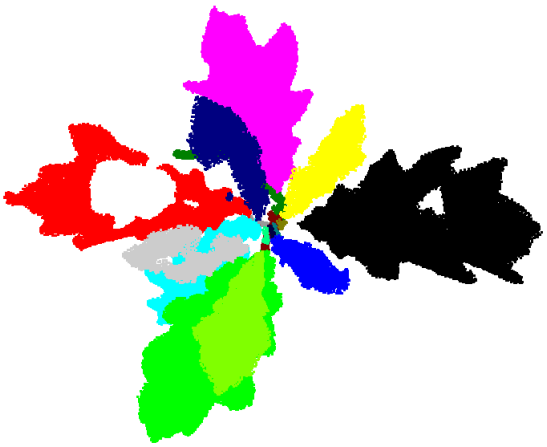
1 Context

In various domains such as agronomy, botany or forestry, engineers and researchers need to measure plants and trees: wood volume, leaf area, leaf distribution, branch angles, etc. These measures allow to estimate the biomass and to understand the interaction between the plant and its environment. Nowadays, measurements are made in a non destructive manner using digitization. A laser scanner is used to create a virtual 3D model of the plant, consisting of points sampling its surface (see images below). In order to make the desired measurements, first this point "cloud" should be partitioned (we say *segmented*) into the plant's organs, then each subset of the points should be approximated by a continuous surface.

This internship focuses on the second issue. This problem has already been tackled in the case of the branches [1]: Åkerblom and colleagues have shown that a simple (set of) cylinder(s) is an enough accurate approximation in most cases. Our goal is to compare various open surface discrete approximations in the case of leaves. However, the problem is more complex here for two main reasons: the high geometric variability between leaf shapes and the "holes" appearing in the point clouds because of occlusions during the scanning process.



2 Objectives

During the project, the student will study two surface approximation models: α-shapes [3] and VSA [2]. C++ code for both models will be provided. The student will have to adapt the code to our context and test it on various leaf point clouds.

3 Student profile

- Bachelor or Master student, preferably in computer science or applied mathematics.
- Creative and highly motivated.
- Solid programming skills; the project involves programming in C++.

- Solid mathematics knowledge (especially computational geometry).
- Fluent English or French spoken.

4 Advisors

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Bibliography

[1] M. Åkerblom, P. Raumonen, M. Kaasalainen, E. Casella. Analysis of geometric primitives in quantitative structure models of tree stems. Remote Sensing, 2015.

[2] D. Cohen-Steiner, P. Alliez, M. Desbrun. Variational shape approximation. ACM SIGGRAPH conference, 2004.

[3] H. Edelsbrunner, D. Kirkpatrick, R. Seidel. On the shape of a set of points in the plane. IEEE Transactions on Information Theory, 1983.