SONY COMPUTER SCIENCE LABORATORIES, PARIS

4D analysis of plants

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The Sony CSL sustainability team is developing an phenotyping platform that is light weight, low-cost, open source and targeted at laboratories in plant science. The objective is to capture the 3d structure of a plant using a camera attached to a robotic arm and to characterize its traits (architecture, growth, ...) using 3d vision techniques. The current application of the robot is dedicated to the measure of angles between organs of a commonly studied plant, Arabidopsis thaliana. This research, in collaboration with a plant science laboratory, has led to the development of a 3d segmentation algorithm that labels each 3d point of the plant corresponding to the type of organ it belongs to. Also, geometrical algorithms have been developed to measure the angles between successive fruits and extracted the skeleton of the plant.
The objective of the internship is to extend this 3d analysis to growing plants [1],[2,[3]. The aim to to follow the growth of organs and the appearance of new organs. A recently published paper [1] proposed to use non-rigid registration to align the skeleton of the plant at different times of acquisition. The internship will explore how the 3d segmentation of the plant could help this registration process beyond the skeleton. We will provide the required data for Arabidopsis and tomato plants.
The student should have knowledge about 3d vision. A familiarity with 3d registration algorithms would be useful. The internship will be in collaboration with the team "Informatique Géométrique et Graphique" of the iCube laboratory in Strasbourg.

[1] Yangyan Li et al., "Analyzing Growing Plants from 4D Point Cloud Data", ACM Transactions on Graphics 2013.
[2] Qian Zheng et al., "4D Reconstruction of Blooming Flowers", Computer Graphics Forum 2017.
[3] Tim Golla, Tom Kneiphof, Heiner Kuhlmann, Michael Weinmann and Reinhard Klein, "Temporal Upsampling of Point Cloud Sequences by Optimal Transport for Plant Growth Visualization", Computer Graphics Forum 2020.
[4]“Spatio-Temporal Non-Rigid Registration of 3D Point Clouds of Plants,” in Proceedings of the IEEE Int. Conf. on Robotics & Automation (ICRA), 2020.

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