Automatic instantiation of a structural leaf model from 3D scanner data: application to light interception computation

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Three-dimensional (3D) plant modelling has become a promising tool for simulating plant functional-structural processes (Godin & Sinoquet 2005), especially those related to the 3D plant organization. An emerging approach for constructing virtual plants is based on non-contact 3D measurement devices which offer a fast and accurate way to capture the plant hull into a dense set of 3D coloured points. Except for very simple cases, making a relevant description of 3D whole plant features from this type of punctual data remains a difficult task and it is often suitable to design the whole plant architecture from different sub-models representing the geometry of each organ (Dornbuch & al. 2007). For leafy tree reconstruction, the definition of a suitable leaf model and its assignment from data points remain a critical task which directly conditions the accuracy of further functional-structural simulations and the amount of computing time.

In this poster, a new parametric structural leaf model and its automatic instantiation from 3D digitized (Hanan & al. 2004, Loch & al. 2005) data are exposed. From a limited number of meaningful real-valued parameters controlling the main morphological leaf features (curvature, openness angle, border oscillations …), the proposed model allows representing a large spectrum of leaf shapes. Using a set of suitable geometrical hypothesis and a devoted curve fitting technique, we show how to automatically extract the model parameters from dense digitized data provided by a non-contact digitizer Konica Minolta vi-910. A quantitative assessment, based on an inversion algorithm allowing building a triangulated leaf model from a prescribed set of parameters, demonstrates both the reliability of the proposed model and the efficiency of the related instantiation process. Using the software VegeSTAR (Adam & al. 2002), an application to light interception computation is presented with virtual *Fagus sylvatica* trees. The related results exhibit the impact of the 3D leaf features on the light interception rate.

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