T-Lidar as a new high-throughput methodology for studying the genetic determinisms of apple tree architecture

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Growth, branching and reproduction processes are highly organized in space and time in plants. In many Rosaceae fruit tree species, this organization has been described by architectural analyses which have allowed deciphering the trait plasticity in responses to environmental conditions from traits genetically determined in young trees. However the study of genetic determinism of tree architecture requires the observation of large populations of individuals, from hundreds to thousands, over several years which is hardly compatible with manual or classical digitizing techniques. This led us to investigate new solutions based on T-Lidar technology that is currently developed and used mainly in forestry context.

First, we explored the capacity of T-Lidar technology to capture indicators of tree form on a limited of genotypes with contrasted architectures. Different precisions and distances of laser scans were tested in order to detect branches along the trunks and within the trees. Second, scans were collected on a larger range of individuals corresponding to the French core collection of apple varieties, implanted in Montpellier, France. The analysis of the scans collected for each single tree required the use of different algorithms to segment the scans, extract the point cloud of each single tree and rebuilt their 3D architecture. This procedure allowed us to extract several descriptors of tree height, shape and leaf area density on which GWAS analyses are currently performed. The next steps of our research will be the automatization of the procedure for scan analysis and the improvement of the set of descriptors that could be extracted and used for genetic studies. In this presentation, we will present and discuss the current state of our research and perspectives.