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基于可视化类库的植株三维形态配准方法及点云可视化

VTK-based plant 3D morphological visualization and registration

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中文摘要:

精确的植物三维静态形态结构模型有助于植物空间结构相关的各种研究，是虚拟植物、植物建模等问题研究的一个重要方面。研究植物生长过程中的三维信息的获 以获得作物生长过程中各参数的动态数据，可为精细农业植物生长模型建立等提供依据。该文以植物为研究对象，介绍了虚拟植物及植物三维可视化的研究现状，讨论 植物叶片三维可视化的可行性及必要性。针对植物三维点云的采集与处理上，讨论了三维扫描仪的精度测定方法，并针对基于基准体的植株点云配准问题，提出采用基 体点云平均法向量计算的方法，去除了部分基准体表面的噪声点，提高了植株体的配准精度；采用迭代最近点（iterative closest point，ICP）算法，对植株叶片进行进 的高精度配准。最后采用基于可视化类库VTK(visualization toolkit)实现了植物点云配准与三维可视化。

英文摘要:

Abstract: A virtual plant growth model is very important to agriculture and a crop growth mechanism model. The precise three-dimensional morphological structure of the plan model can be used to study the spatial structure associated with the nature of plants. The acquisition of a plant 3D point cloud is the first step to establish a plant 3D model. In th paper, the registration method and visualization method of the plant point cloud were mainly researched. At first, the research status of virtual plants and plant three-dimensional visualization was introduced, and the feasibility and necessity of the three-dimensional visualization of plant leaves was discussed. Then, a point normal calculation method of registration sphere was studied. Ensemble technology was used to improve the accuracy of the point normal value. By this technology, the normal value of the point cloud was substituted by the normal average value. This was done so that more accurate sphere centers could be calculated and we could get more accurate rotation shaft which was necess to register 3D points acquired from different sides. The outlier points and noise points of the original 3D point cloud can be removed at the same time. The point normal value is cl related to the number of point neighbors which are involved in the point normal calculation. So the effect of the number of point neighbors on calculating point normal was discus and compared. The Moving Lease Squares (MLS) was used to fit the surface of the registration sphere, and Gaussian curvature was calculated to recheck the accuracy of point normals. Two aluminum alloy elements were designed to evaluate the accuracy of the 3D point cloud collection equipment. Moreover, to improve the registration effect of plant le the iterative closest point (ICP) algorithm was used. At last, a point cloud processing system was developed based on Microsoft Visual Studio C++ 2010. The open source development toolkit: Visualization Toolkit was used to realize the 3D point cloud visualization effect and registration algorithms.