Iterative Partitioning and Labelling of Point Cloud Data

Sandro Spina

Department of Computer Science
University of Malta

Over the past few years the acquisition of 3D point information representing the structure of real-world objects has become common practice in many areas[4]. This acquisition process[1] has traditionally been carried out using 3D scanning devices based on laser or structured light techniques. Professional grade 3D scanners are nowadays capable of producing highly accurate data at sampling rates of approximately a million points per second. Moreover the popularisation of algorithms and tools capable of generating relatively accurate virtual representations of real-world scenes from photographs without the need of expensive and specialised hardware has led to an increase in the amount and availability of 3D point cloud data. The management and processing of these huge volumes of scanned data is quickly becoming a problem[2].

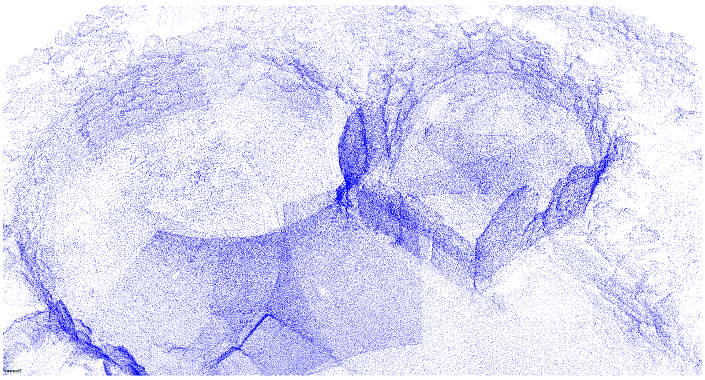

Fig. 1. Section of Mnajdra pre-historic temple scanned by Heritage Malta

Following the on-site acquisition process, substantial data processing is usually carried out. This scenario is contributing to an increase in importance for algorithms which are capable of analysing and processing point clouds efficiently. In general this post processing of data takes a set of points as input (the point cloud) and returns a set partition of the input. For example, point clouds acquired from external sites would usually require a cleaning process in order to remove points which are not relevant to the site. The input would thus consist of all points acquired and the output a set partition consisting of two sets; the first storing those points which are relevant and should be kept and the second storing those which should be discarded. I many areas, another important post processing task is that of grouping together points which logically fall under the same semantic definition. For example all points making up the floor of a site, or the windows, the benches, doors, etc.

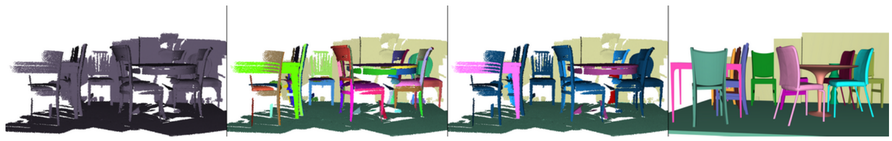

Fig. 2. Recognition and reconstruction of scanned 3D indoor scene [3]

In a similar fashion, techniques have been developed which address the problem of reconstructing scanned indoor scenes into their respective components. Figure 1 illustrates one such example. In these cases the challenges are mainly related to clutter, resulting in both object interferences and occlusions. This presentation focuses on a point cloud segmentation/partitioning pipeline which is being developed in order to facilitate (and automate) post-processing tasks following point cloud acquisition. We address both scenarios described above. The pipeline consists of two main stages; a segmentation stage and a fitting stage. The initial segmentation stage[5] partitions the input point cloud into the various surfaces making up the site and produces a structure graph. The fitting stage then tries to maximise usage of every surface (node) in the structure graph. The presentation outlines current research progress, objectives and future directions.

References

1. Fausto Bernardini and Holly E. Rushmeier. The 3d model acquisition pipeline. *Comput. Graph. Forum*, 21(2):149–172, 2002.
2. Paolo Cignoni and Roberto Scopigno. Sampled 3d models for ch applications: A viable and enabling new medium or just a technological exercise? *J. Comput. Cult. Herit.*, 1:2:1–2:23, June 2008.
3. Liangliang Nan, Ke Xie, and Andrei Sharf. A search-classify approach for cluttered indoor scene understanding. *ACM Transactions on Graphics (Proceedings of SIGGRAPH Asia 2012)*, 31(6), 2012.
4. Heinz Ruther. Documenting africa's cultural heritage. In *In Proceedings of the 11th International Symposium VAST. Virtual Reality, Archaeology and Cultural Heritage*, 2010.
5. Sandro Spina, Kurt Debattista, Keith Bugeja, and Alan Chalmers. Point cloud segmentation for cultural heritage sites. In Franco Niccolucci, Matteo Dellepiane, Sebastian Pena Serna, Holly Rushmeierand, and Luc Van Gool, editors, *VAST11: The 12th International Symposium on Virtual Reality, Archaeology and Intelligent Cultural Heritage*, volume Full Papers, pages 41–48, Prato, Italy, 11/2011 2011. Eurographics Association, Eurographics Association.