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Comparison between point cloud processing techniques

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ABSTRACT

Photomodelling is an innovative, economical and fast technique based on the same principles of photogrammetry, which leads to the creation of 3-dimensional models starting from the simple acquisition of photographs. The aim of this paper is to define performances and metrological characteristics of this new technique and to understand the full potential offered by point cloud processing software. The analytical comparison considers a structured light 3D scanning system Creaform Go Scan 50 with metrological certification as a reference, in order to verify the accuracy and precision of photomodelling, using a modified function of the ICP algorithm and spatial, volumetric and superficial comparison criteria.

1. Introduction

The paper describes the comparison between photomodelling technique and a structured light 3D scanning system for the design and modelling of the driving seat area of a boat. Photomodelling is a modern frontier of the survey, based on the extraction of information from digital images. The technique is a recent and fast image processing and alignment point cloud method that leads to the reconstruction of 3-dimensional models, starting from the simple acquisition of photographic images [1]. Through the common camera, the operator is able to extract spatial information of the elements present in a scene, acquiring multiple frames. A point cloud can be identified as a "pixel cloud", because of the direct relationship between photomodelling and photography: each pixel of an image corresponds to a point of the cloud, thus preserving the chromatic characteristics of the object surveyed [2]. Close to photogrammetry, the result obtained is a 3D point cloud, a set of x, y, z space coordinates, first form of the object surveyed [3].

Involving complex free-form geometric shapes, the design of a boat is hard to measure and survey with traditional metrology methods. Naval designers and engineers can use precise 3-dimensional models from scan data to ensure the quality of interior and exterior construction, as well as for simulation and inspection purposes.

2. Materials and methods

The survey of the driving seat area of a boat (Fig. 1) has been performed using the 3D scanning system Go Scan 50 first (Fig. 2); target stickers have been applied randomly to facilitate the capture process, due to the similarity of the surface pattern. By using photomodelling technique, a totality of 20 images have been loaded in three different dedicated software: Agisoft Photoscan, Visual SfM and Autodesk Remake. Each instrument is different because of their time data processing, difficulty of use, accuracy and precision of results [4]. Furthermore, the applications proposed are both open-source and commercial software.

Agisoft PhotoScan is a commercial software and it seems to be the most efficient solution for completeness of results. In case of good surrounding conditions, Visual SfM software is the best solution in the reproduction of point clouds, with better accuracy and precision. Based on the Structure from Motion technique [5], its output are close to Laser Scanner products ones. Autodesk Remake is a low-cost application to get quickly and automatically a borderline result with an average level of details, to be printed or to be loaded and displayed on an online platform [3].

A good photographic survey, especially in case of large sized objects, is a fundamental step in the workflow. Increasing the number of pictures might give high density output; however, the processing of a large amount of frames augment the calculations in term of time consuming and it may cause problems such as redundancy and overlapping (See Figs. 3–5).

2.1. Data processing

The 3D data acquisition and processing workflow starts from the analysis of the environment and the object to detect, until the

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Fig. 1. Beneteau First 456/s boat, 1984, with 3 cabin all with toilets, engine Yanmar 55 cv, 14 m length.

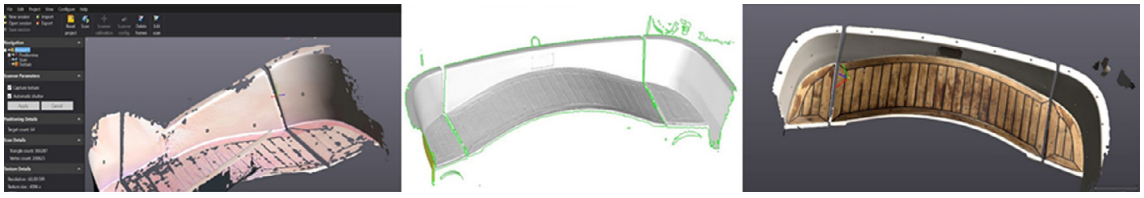

Fig. 2. Boat surface scanning by Creaform Scan Go 50.

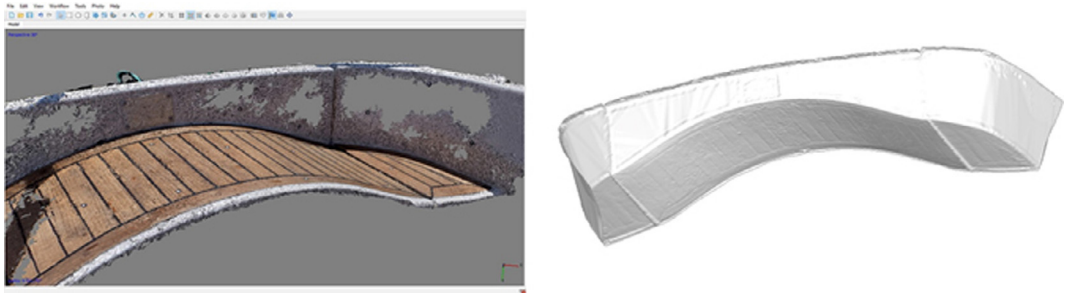

Fig. 3. Surface 3D model and point cloud by Agisoft Photoscan.

Fig. 4. Surface 3D model and point cloud by Visual SfM.

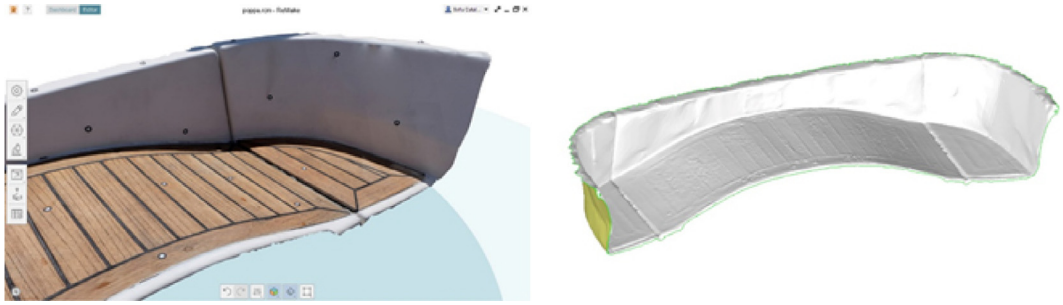

Fig. 5. Surface 3D model by Autodesk Remake.