FREE PAPER 2

A comparison of 3D shape capture technologies and methods in the assessment, prescription and manufacture of contoured seating

Presenters: Gareth Adkins and Lorna Tasker

Summary
This study reports on the relative accuracy of three methods of shape capture commonly used to manufacture contoured seating: a 3D digitising arm, a laser scanner and a white light scanner. Comparing accuracy with the overall processing time and other qualitative factors will highlight the merits of each method.

Aims And Objectives

To compare quantitatively and qualitatively the 3D shape capture methods used in contoured seating manufacture through the following objectives:

- Report on previous work comparing a laser scanner to high cost, high accuracy laser scanner

- Compare the accuracy of a low cost 3D digitising arm and a white light scanner relative to the laser scanner.

- Report processing times for each method.

Background
The use of CNC machining to produce custom contoured seating for wheelchair users has become more prevalent in recent years with several NHS wheelchair and seating services adopting this technology. There are a variety of 3D shape capture methods that have been utilised to produce a 3D computer model of the required contoured seat shape obtained using vacuum consolidation and bead bags. These include 3D digitising arms, laser scanners and white light scanners. Each method has advantages and disadvantages, which have not been widely evaluated and reported. Evaluation of the accuracy of the method is useful when used in conjunction with other quantitative measures such as cost, overall processing time and measurement volume to compare the methods objectively for a specific clinical application.

Previous work at Swansea Rehabilitation Engineering Unit (REU), funded by PMG, has measured the accuracy of a laser scanner (Microscribe G2LX Microscan ~£15,000 in 2007) relative to the gold standard of a high cost, high accuracy laser scanner (Faro platinum ~ £100,000) in capturing 3D shapes for use in contoured seating manufacture The Microscan and Faro scanners arm were used to create 3D models from plaster casts previously used to manufacture contoured seats.

Geomagic Qualify software was used to produce 3D comparison results, providing deviation results. Geomagic Qualify is 3D inspection software typically used to provide accurate, graphical comparisons between CAD models and as-built parts to provide 3D deviation results used for quality assurance and trend analysis in industry settings. The 'Best Fit Alignment' and the '3D compare' functions were used to virtually overlay the scan data from each scanner to create deviation results between the following tolerances:

- ±0.5mm (±1mm critical tolerance)

- ±1.0mm (±2mm critical tolerance)

These tolerances were chosen as they were greater than the specified accuracy of the Microscan and considerably superior to existing tolerances used within special seating which is estimated to be ±10mm.

The results from the 3D comparisons between the FARO scanner (high-cost, gold standard) and Microscan (low cost) revealed very good agreement, 80-99% of comparison points were within ±1mm.

The same 3D comparison technique will be applied to the Microscan laser scanner, the Artec White light scanner, and the Microscan digitising arm methods of shape capture. This further study will use direct scanning from bead bags used in a clinical setting to create contoured seats. 10 shapes will be captured using the 3 methods to produce 30 shapes for 3D comparison. The overall processing time will also be measured for each method.

The results to be presented at this conference will establish the relative accuracy and the time required for each method. This will allow cost-benefit comparison of the methods in terms of the accuracy (benefit) and the cost (time required).

Discussion

Initial results show that the relatively low cost Microscan laser scanner is sufficiently accurate for use in manufacturing contoured seating. It has been used for some time in the manufacture of contoured seating at Swansea's REU, but new technology has become available, the Artec White Light scanner which promises to be a faster data capture method.

The Artec scanner has been used clinically and reported by clinicians to be a faster data capture method, although this needs to be verified through measurement. It is also necessary to confirm its relative accuracy to the Microscan method. A third method of capturing shape with a 3D digitising arm may require less processing time overall, but this needs to be verified and confirmed that it is sufficiently accurate for use in manufacturing contoured seating.

The Artec scanner has been used by the Swansea REU for other clinical applications such as scanning parts of the body where it captures shape better than the laser scanner and the 3D digitising arm would not produce the level of detail required without extensive processing time. This indicates that the optimum shape capture method may be dependent on the intended clinical application.

The results to be presented at this conference will confirm the relative accuracy and processing time of each method, helping clinicians to select the most appropriate method for their particular clinical and service delivery circumstances.

References

Tasker LH, Shapcott NG, Holland PM. *The use and validation of a laser scanner for computer aided design and manufacturing of wheelchair seating*, Journal of Medical Engineering & Technology; 35(6-7): 377-85, 2011

Correspondence details

Gareth Adkins and Lorna Tasker
Rehabilitation Engineering Unit Morriston Hospital
Swansea
SA6 6NL

Email: gareth.adkins@wales.nhs.uk