INTRODUCTION:
The model-based RSA (MBRSA) technique uses pose-estimation of geometric triangulated surface models instead of attached tantalum-markers to compute prosthesis migration relative to the surrounding bone [2, 4]. Reverse engineering (RE) methods provide one source of the required geometric models. The number of RE models required for a given clinical study depends on the number of different prosthesis sizes implanted, as well as the number of design variations – e.g. differences in proximal plateaus intended for different types of inlays. It has been suggested that the number of RE models required can be reduced by limiting the contour used in the analysis to the portion of the prosthesis which does not vary with design i.e. the portion of the prosthesis below the plateau. The goal of this study was thus to evaluate the effect of contour selection (reduction) [3], and digitisation accuracy of the RE models used (number of polygons) on the accuracy of the MBRSA method in a typical clinical setting.

METHODS:
The radiographs of 34 patients from a clinical RSA study comparing manual against navigated TKA (Columbus Knee System, Aesculap, Tuttingen, Germany) were used to evaluate the variability of MBRSA computed migration using different RE models and reduced contours. RE models of four different prosthesis sizes were generated using a fringe-projection digitizing system for small objects (ATOS II, GOM mbH, Braunschweig, Germany). Each RE model was reduced from at least 390266 polygons in raw scanned state to either 5000 or 500 polygons by the MBRSA software. During mesh reduction, a nominal-limiting the contour used in the analysis to the portion of the prosthesis below 75 %, and patient at 3 and 6 month follow-up, one analysis series using a 5000 polygon numbers or by reduced contour detection are not of clinical relevance areas of the RE model. A beta actual value comparison was performed allowing maximum differences of ±0.08 mm in relevant areas of the RE model. A beta

RESULTS:
Reduction of the analysis contour detection to 75 % and 50 % resulted in a ±2SD interval criterion value of ±0.454 mm in the worst case for the z-axis, which corresponds to the anterior-posterior anatomical direction and is the out-of-plane axis in the analysis (Fig. 2). Polygon reduction resulted in a maximum interval criterion value of ±0.102 mm, again for translation along the z-axis. No observable systematic trends in the differences between measures were observed indicating that contour or mesh reduction did not result in a measurement bias. Summarizing the data about all axes resulted in a mean calculated difference ranging from -0.063 to 0.022 mm in translation and from -0.118 to 0.083 deg in rotation (Tab. 1). The observed SD was generally within the value of the RSA accuracy reported in the literature [2].

DISCUSSION:
Differences between MBRSA performed by RE models of different polygon numbers or by reduced contour detection are not of clinical significance based on the interval criterion suggested by Bland and Altman [1], when one assumes migrations of greater than 0.5 mm are meaningful in the detection of prosthesis migration. Some outliers were observed (Fig. 2) which were however associated with marginal condition number which suggests a bone rigid body measurement error and is thus not associated with the measurement of the prosthesis. The results of this study are directly applicable only to the prosthesis investigated in this study. Further investigations are therefore being performed to investigate the general applicability of these techniques to other prosthesis which are of clinical interest.

REFERENCES:

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