Predicting and Estimating Accuracy of Marker-Based Optical Tracking Systems

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ABSTRACT

Marker-based optical tracking systems are widely used in augmented reality, medical navigation and industrial applications. We propose a model for the prediction of the target registration error (TRE) in these kinds of tracking systems by estimating the fiducial location error (FLE) from twodimensional errors on the image plane. We have designed a set of experiments in order to estimate the actual parameters of the model for any given tracking system. We present the results of a study which we used to demonstrate the effect of different sources of error. The method is applied to real applications to show the usefulness for any kind of augmented reality system. We also present a set of tools that can be used to visualize the accuracy at design time.

Keywords: Optical Tracking, Accuracy Estimation, Error Propagation, Error Prediction, Target Registration Error

1 DESCRIPTION

In our paper [1] in ISMAR 2006 we propose a method to predict the accuracy of an optical tracking system based on error propagation methods.

In this accompanying demonstration we want to show the results of this prediction in an online augmented reality system. A coordinate measurement tool (cf. figure 3) is tracked using an external outside-in tracking system. The rotational accuracy and the positional accuracy at the point of interest are visualized in the image of an (additionaly tracked) webcam as augmented reality overlay.

More details on the algorithms and background can be found in the respective paper submission.

REFERENCES

[1] BAUER, M., SCHLEGEL, M., PUSTKA, D., NAVAB, N., KLINKER, G., *Predicting and Estimating the Accuracy of Marker-Based Optical Tracking Systems*, to appear in Proc. International Sympoium on Mixed and Augmented Reality ISMAR 2006 2006

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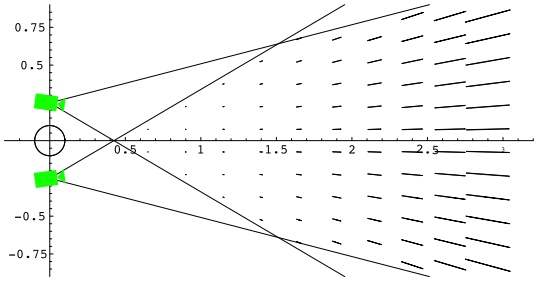

Figure 1: Fiducial location error in a typical two-camera setup

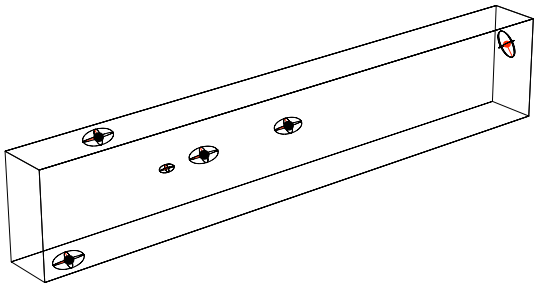

Figure 2: Computation of the fiducial location error (FLE), marker target error (MTE) and target registration error (TRE). The covariance propagation formulas are derived analytically using Mathematica and then exported to C++ for use in actual applications.

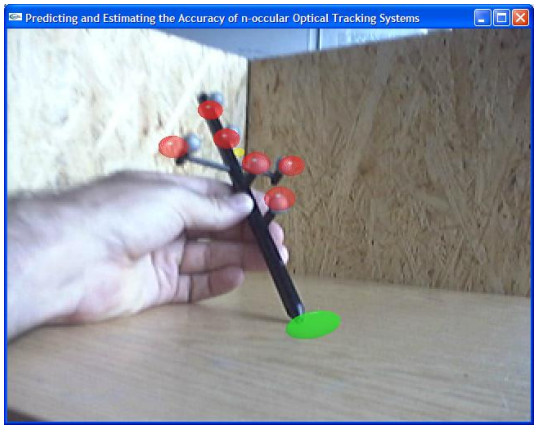

Figure 3: Visualization of predicted positional accuracy (green) at the tip of a coordinate measurement tool. Red are the FLE covariances for the single features. Error magnified by a factor of 50.