Full certification of calibration without metrology.

It has been shown with good results that the parameter of the laser projector can be found without using a laser track to find the model transform.

To certify and compare the data

Calibration wall at 10FT was used and a transform was calculated internally by the projector.

The projector runs through a calibration routine to find its intrinsic parameters and curve fits.

Afterwards a full certification is run, using 6 registration targets and calculating the rms error on 26 other targets that were not used for registration.

Below is the DAC error report for 12 FT Registration and Certification

Below is the DAC error report for 15FT Registration and Certification

Below is the DAC error report for 20 FT Registration and Certification

Central to the method is a good understanding of the mechanical arrangement of the critical projector parts. Namely the position of the axes and mirrors in the nominal zero position.

Calibration without a laser tracker based transform uses techniques and models previously developed in the search of an accurate method to calibrate the projector. In this paper no new models or techniques algorithms are presented as the method to calibrate without laser tracker based transforms relies on previously developed algorithms.

Central to calibration without using a transform based on laser trackers is the registration algorithm. Previously, the registration algorithm calculated transforms based on a 4 point subset in different combinations. The disadvantage of such a method is that when large numbers of registration points are used, it is not computationally feasible to calculate every 4 (nC4) point subset and return the best one. For example, based on 300 calibration points (which is common) there would be 330,791,175 transforms to exhaustively calculate. Furthermore, using only 4 points to calculate a transform is inherently more sensitive to errors both random and systematic.

The new transform technique is separated into three stages. The first stage is a critical step in determining a good initial guess of the transform. It leverages the solution found by Lepetit et Al. to the pose estimation problem for calibration cameras. The two further steps are specific to the galvanometer projector model and are used to refine the initial guess to good accuracy. After this process nominal points are transformed into the projector frame coordinates to begin calibration.

Calibration is done and a 2D curve fit is generated for each of the axes.

At this point the transform algorithm can be combined with a curve fit in order to increase accuracy further.

Key Inventions:

* New projector model based on the mechanical design
* Determining important constants for calibration
* Determining viable orders for which constants can be calibrated
* Developing novel technique to convert projector outputs to a camera analog for transforms
* Developing a model based transform refinement using projection and SVD

, instead the order of execution of functions is presented combined with full certification results.+