Registration Of Video Sequences Over A Mesh From 3D Scanning

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Registration and Video Analysis

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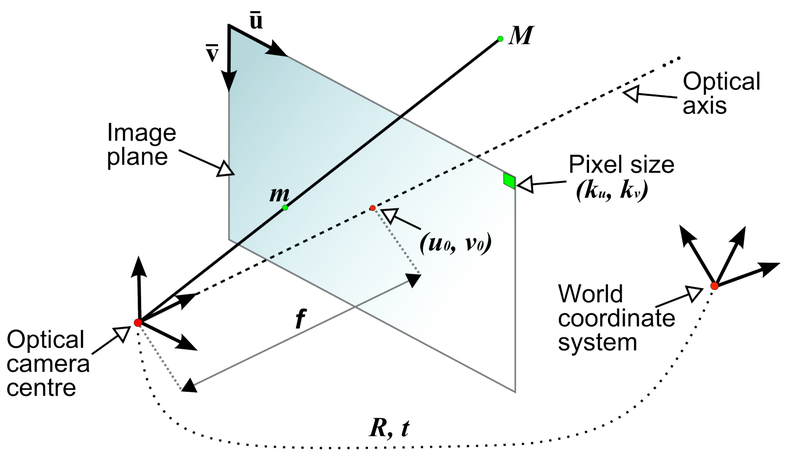
Abstract

We present a new method for the incremental registration of video sequences of a real object over its triangular mesh built with 3D scanning techniques. Our solution uses two different approaches: feature based registration by KLT video tracking; statistic based registration by maximizing the mutual information between the gradient of the image and the gradient of the rendering of the 3D model with some illumination related properties, such as surface normals and ambient occlusion.

Camera Model

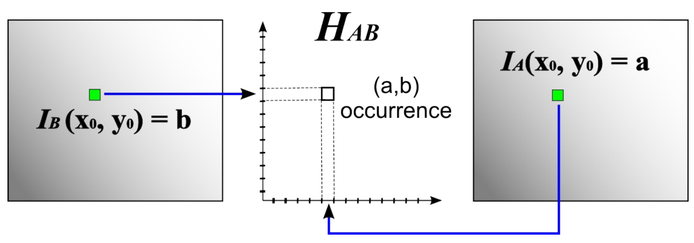


Lens radial distortion: k_1, k_2

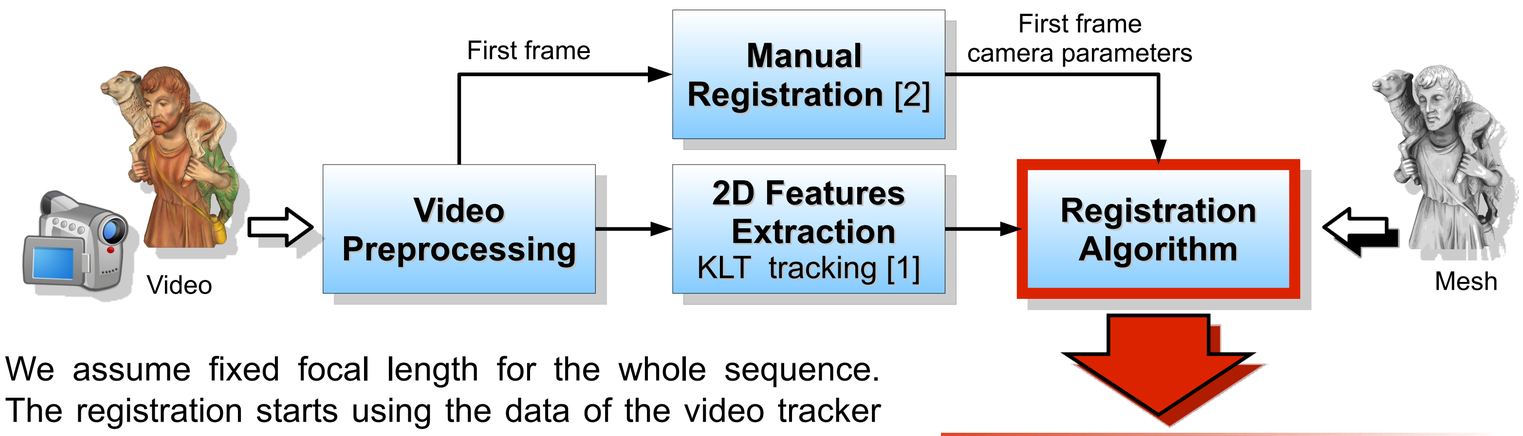
Image Registration by Mutual Information

$$MI(I_A, I_B) = \sum_{(a,b)} p(a,b) \log \frac{p(a,b)}{p(a)\,p(b)}$$

Approximation of the join probability $p(a,b)$ with the join histogram H_{AB} of the images I_A and I_B dividing by the total number of pixels [3].



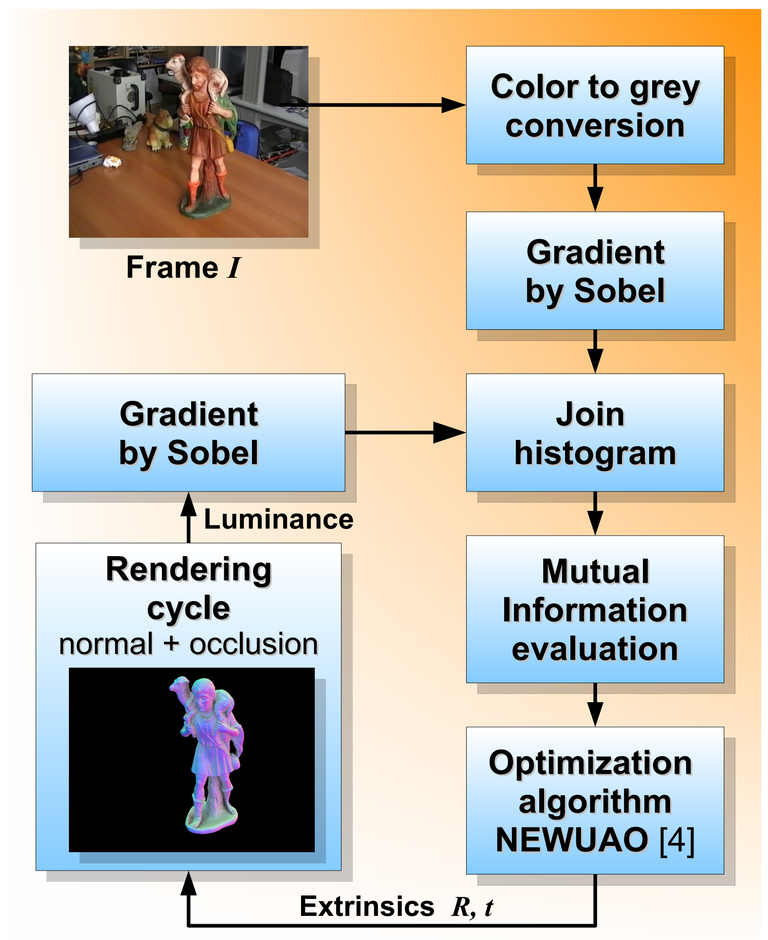
Registration Algorithm



We assume fixed focal length for the whole sequence. The registration starts using the data of the video tracker and when the error E is above an adaptive threshold we estimate the camera position with the Mutual Information. If S is the set of 2D-3D correspondences $\langle m, M \rangle$ and P the estimated camera:

$$E = \frac{1}{|S|} \sum_{\langle m,M \rangle} d(M, P^{-1}m)^2$$

The adaptive threshold depends by the field of view, the distance of the object from the camera, and the size of the object. The Mutual information starts from the camera parameters estimated with the 2D-3D correspondences and executes a fixed number of iterations.



References

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[3] M. Corsini, M. Dellepiane, F. Ponchio, and R. Scopigno. **Image to geometry registration: a mutual information method exploiting illumination-related geometric properties**. Computer Graphics Forum, 28(7), 1755 -1764, 2009.

[4] M.J.D. Powell. **The NEWUOA software for unconstrained optimization without derivatives**. Tech. Rep., Department of Applied Mathematics and Theoretical Physics, Cambridge, England, 2004.

Results