# Registration of Multi-View Images of Planar Surfaces

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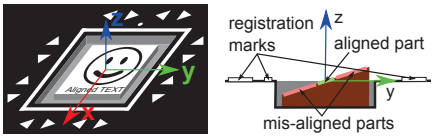
**Abstract**

**This paper presents a novel image-based registration method of high-resolution multi-view images of a planar material surface. Contrary to standard registration approaches, this method aligns images based on a true plane of material surface and not on a plane defined by registration marks. It combines the camera calibration and the iterative fitting of desired position and slant of the plane of the surface, image re-registration, and evaluation of alignment of the surface. To optimize images compression performance, we use an error of a compression method as a registration quality evaluation function. The proposed method shows encouraging results on examples of visualization of view- and illumination-dependent textures. In addition to a standard multi-view data registration approach it provides a better multi-view images alignment and thus allows more detailed visualization using the same size of compressed parametrization.**

## Problem Definition

Registration of multi-view high-resolution images of planar surfaces:

- surface points not lying in a single plane → misaligned after a projective transformation:

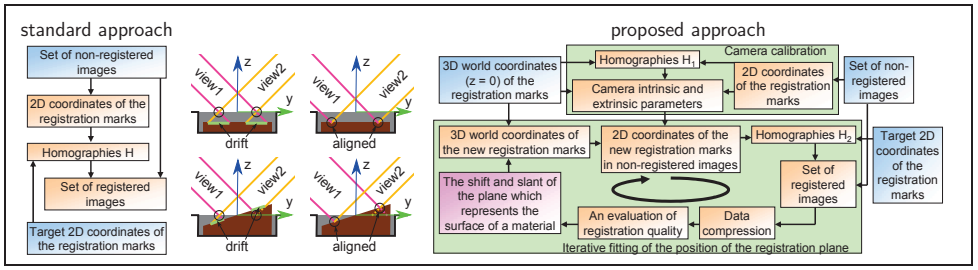


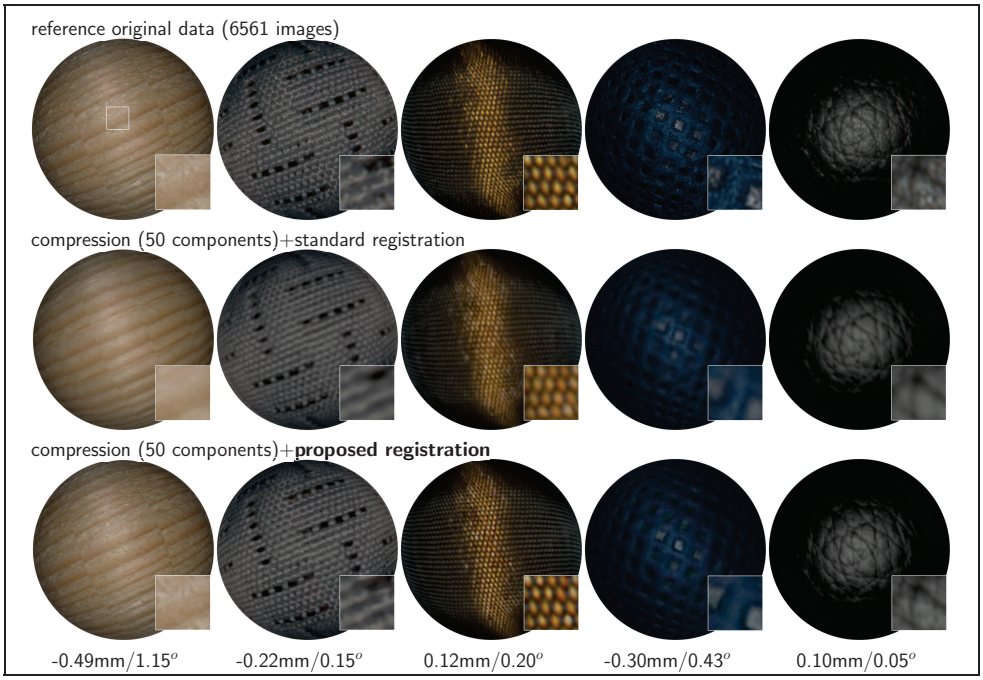

- registration marks on a separate plane → estimate true surface plane,
- feature-based methods unreliable (due to changing illumination & view directions),
- registration marks cannot be placed on the surface (easy sample replacement, surface height variations),
- higher image resolution → more apparent misalignment,
- mechanical compensation → less accurate.

## Proposed Registration Method

Camera calibration + iterative fitting of surface shift and slant → image re-registration → registration quality evaluation:

- uniform sampling of search space → global minima → local refinement,
- alternating between 3 parameters: plane shift and normal elevation & azimuth,
- registration quality criterion: PCA-based compression error.



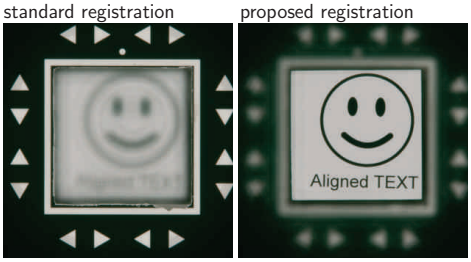




## Experimental Results

**Experiment 1**: flat image placed approx. 1mm below the registration plane.

- 80 uniformly distributed viewing directions,

standard registration | proposed registration




shift 1.24 mm/elevation 0.29°

**Experiment 2**: registration of 5 BTF samples, alignment based on 81 views (above)

- Improvement of preserved details when compressed (same number of PCA components).
- The more sample deviates from reference plane the greater is the improvement.
- Psychophysical experiment (5 subjects) proved method's visuals performance.

## Test Datasets

**UTIA BTF database** **http://btf.utia.cas.cz**

- 6 public HDR BTF/BRDF samples [1],
- 81 × 81 = 6561 images, 1000 DPI.

## Method's key features

- Novel method of multi-view images of planar surfaces alignment with respect to a reference registration plane.
- Robust, easy to implement.
- Compression/rendering error as the quality criterion.
- Computationally efficient: $O(n)$ to no. of pixels, $O(n^3)$ to no. of images (PCA).
- Improves performance of majority of image registration approaches.

[1] Filip J., Haindl M.: *Bidirectional Texture Function Modeling: A State of the Art Survey.* IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 31, no. 11, pp. 1921-1940, October 2009