

# Perspective Correction of Distorted Projectors with an Uncalibrated Camera

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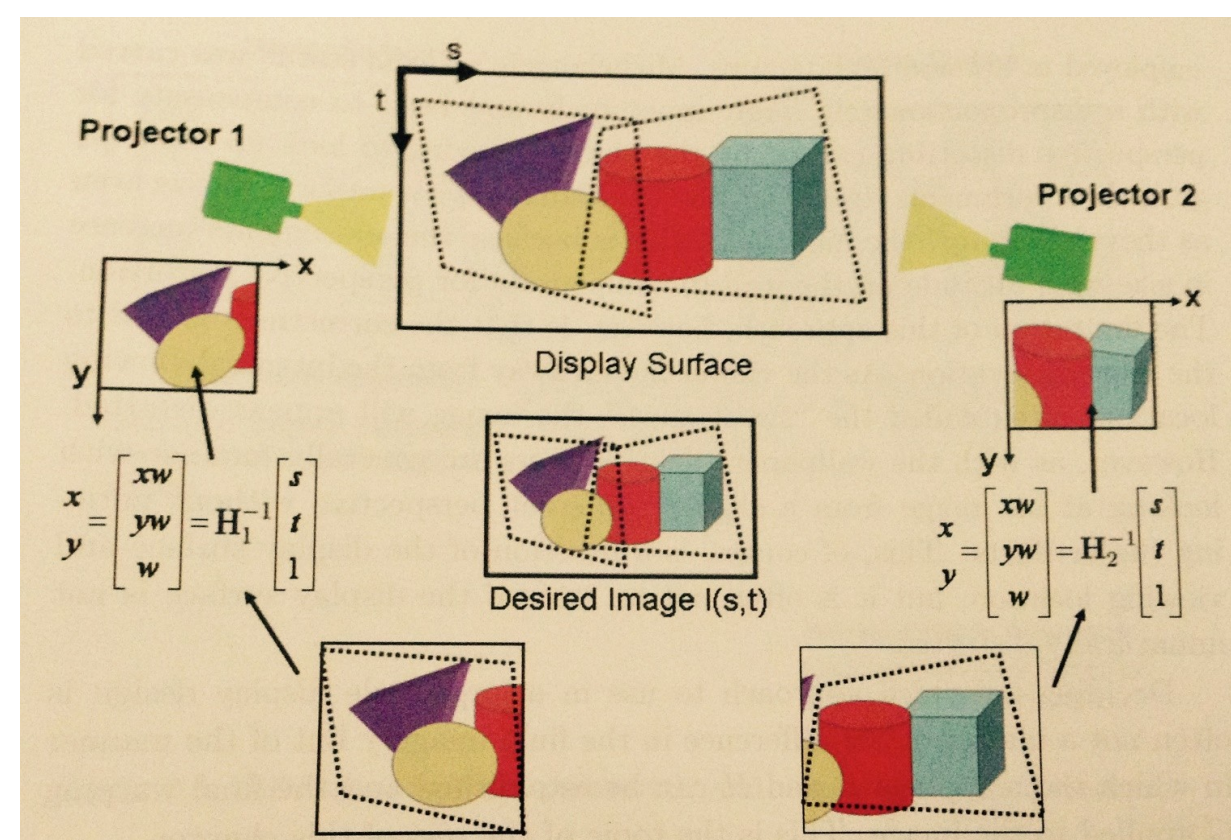
## Motivation

This project demonstrate image processing algorithms that allows the users to project extremely wide field distortion-corrected images on screens with horizontal discontinuity. Image pre-warping is used to achieve any non-parametric projector keystone correction and screen geometry correction.

This project involves two casually placed projectors (Epson EX3240), a camera capturing the full projection field, two laptops and one flat or right-angled projection surface. A MATLAB graphical user interface (GUI) is created for user-friendly application.

For wide field projection, two projectors are individually registered. A reasonable overlap of at least 5% of its total projection area is recommended for good linear blending result.

This algorithm can be further developed for applications with projectors located at the back of the projection screen, multiple projectors with horizontal discontinuous surface, and simultaneous wide field video projection. With the development of curved displays, algorithm developed in this project can be used for large tiled high-resolution display. Further work need to be conducted for color correction, pincushion and barrel distortion and other optical aberrations introduced by the hardware imperfection. This project has wide application in art visualization, face registration for make-up testing, virtual/augmented reality and Head-Up Displays. [1]



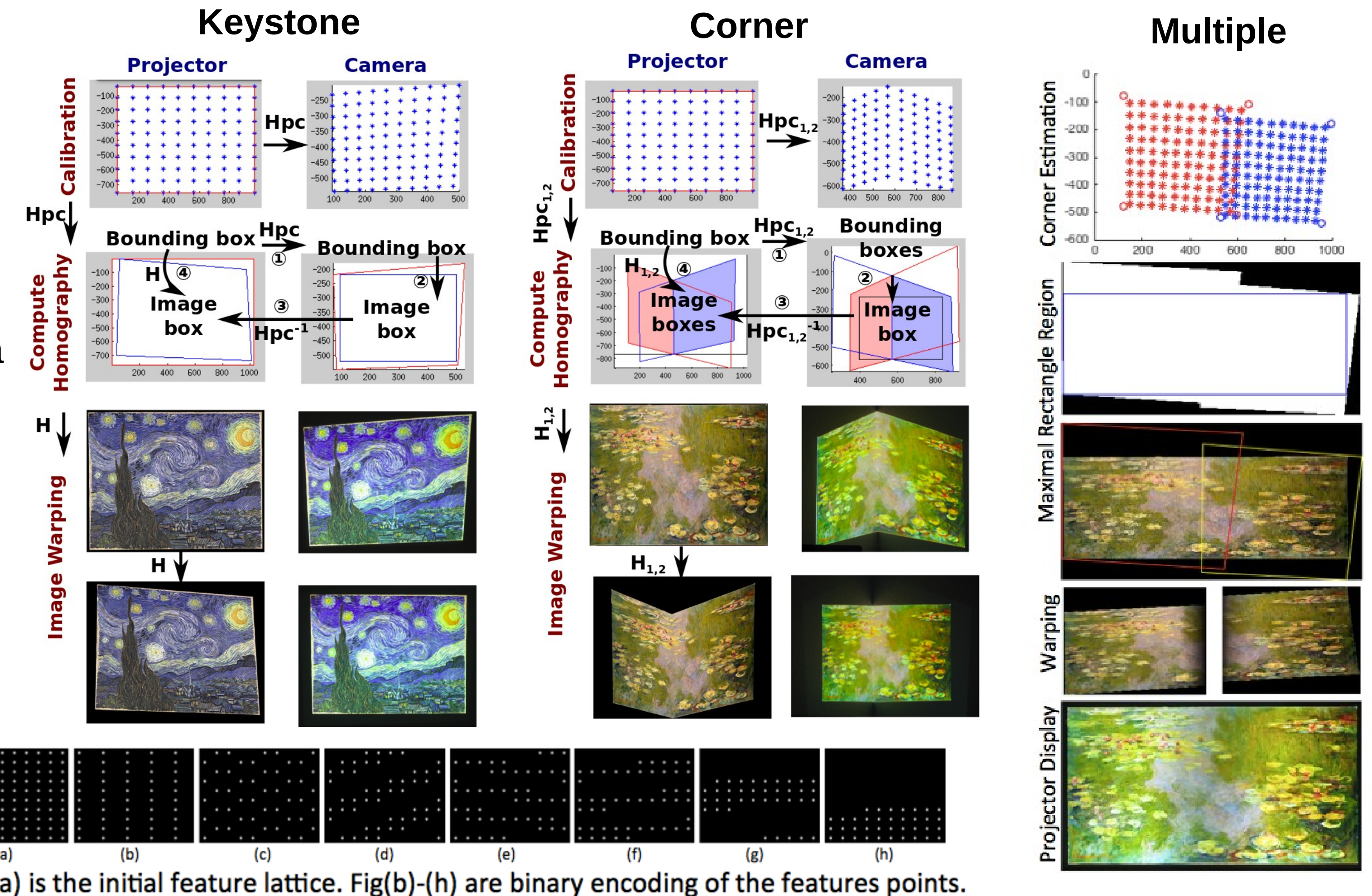
Reference

1. B. Sajadi, A Majumder. Markerless View-Independent Registration of Multiple Distorted Projectors on Extruded Surfaces Using Uncalibrated Camera.
2. M. Brown, A. Majumder, R. Yang. Camera Based Calibration Techniques for Seamless Multi-Projector Displays.
3. M. Brown, A. Majumder. Practical Multi-Projector Display Design.
4. R. Raskar, P. Beardsley. A Self-Correcting Projector. IEEE CVPR 2001.
5. A. Agarwall, C. V. Jawahar. P. J. Narayanna. A Survey of Planar Homography Estimation Techniques.

## Methods

Our project has 4 parts:

- Feature encoding and recognition for camera calibration
- Keystone: single projector correction on a flat surface
- Corner: single projector correction on a corner
- Multiple: two projectors correction on a flat surface



Fig(a) is the initial feature lattice. Fig(b)-(h) are binary encoding of the features points.

## Automation

MATLAB GUI is constructed to guide users through the process of projection application selection, dot array projection and capture, user-defined threshold, image transform and Power Point generation. With a scientific camera and MATLAB Image Acquisition tool box, automatic camera capture along with automatic dot array projection can be achieved.

This project has the limitation of image distortion correction for only the camera location. If the viewer walks away from this 'sweet spot', a head tracking system is needed and the distortion-corrected images needs to be updated.

