Overview

- Related Work
- Tensor Voting in 2-D
- Tensor Voting in 3-D
- Tensor Voting in N-D
- Application to Vision Problems
- Stereo
- Visual Motion
- Binary-Space-Partitioned Images
- 3-D Surface Extraction from Medical Data
- Epipolar Geometry Estimation for Non-static Scenes
- Image Repairing
- Range and 3-D Data Repairing
- Video Repairing
- Luminance Correction
- Conclusions

Motivation

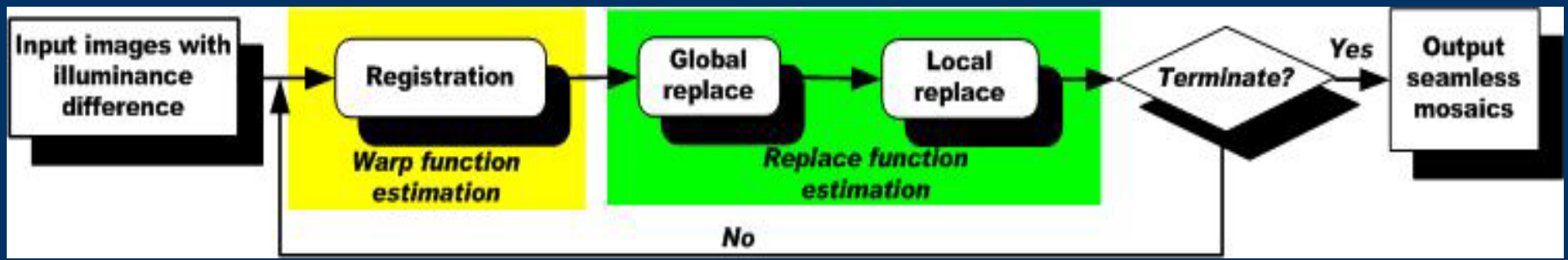
- Luminance inconsistency when registering images or frames
- Several factors
  - Exposure variance
  - White balance
  - Gamma correction
  - Vignetting
  - Digitizer parameters

Related Work

- Mosaic registration with exposure correction in the overlapping area
  - Block blending
  - Feather-based blending
  - Purpose: constructing natural transition
- Radiometric calibration
  - Construction high range image from several static images

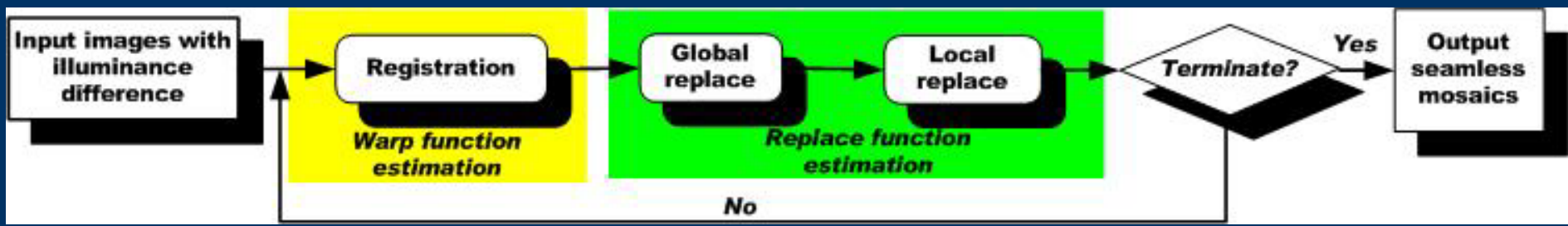
Our approach

- Warp function estimation
- Replacement function estimation
  - The function directly measures the color difference between images
- Modeless method



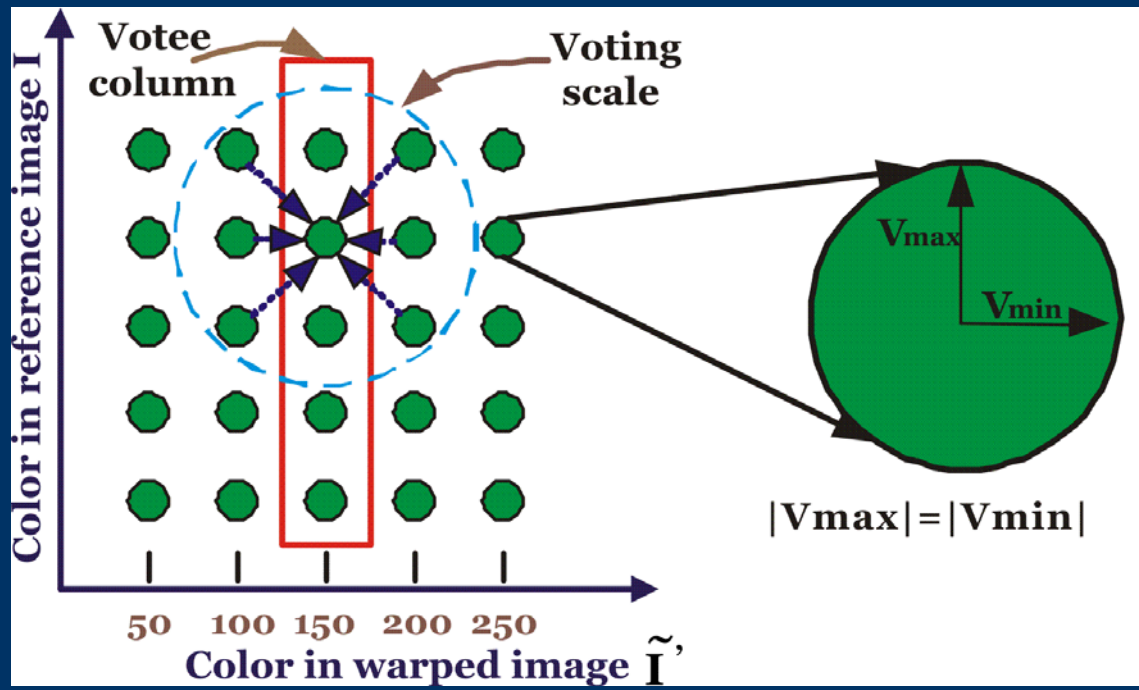
Our approach

- Global replace – globally map colors between images
- Local replace – estimate vignetting effect for each image
- Final replacement – global(local(.))



Global Replace

- Luminance Voting
- Voting space construction
  - Joint image
- Tensor encoding
  - 2D ball tensor for each sample
- Luminance voting
  - Exclusive voting



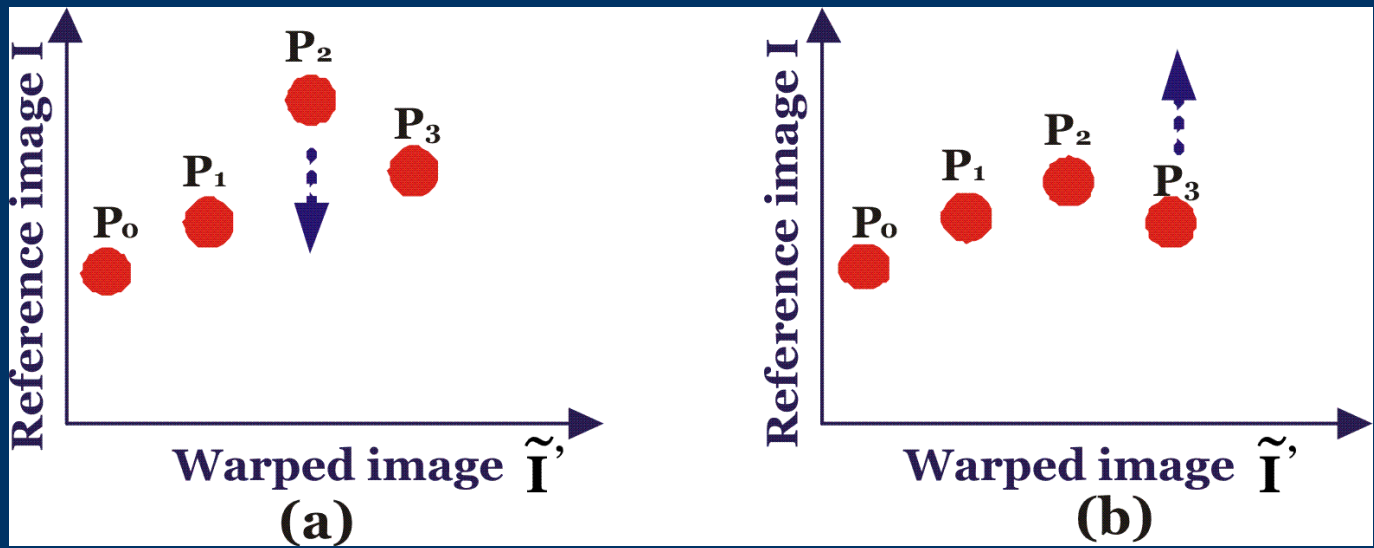
Monotonic Constraint

Monotonic constraint: Let (I', I) be the continuous joint image space.

If $I'(x_1'', y_1'') > I'(x_2'', y_2'')$, then $I(x_1, y_1) > I(x_2, y_2)$

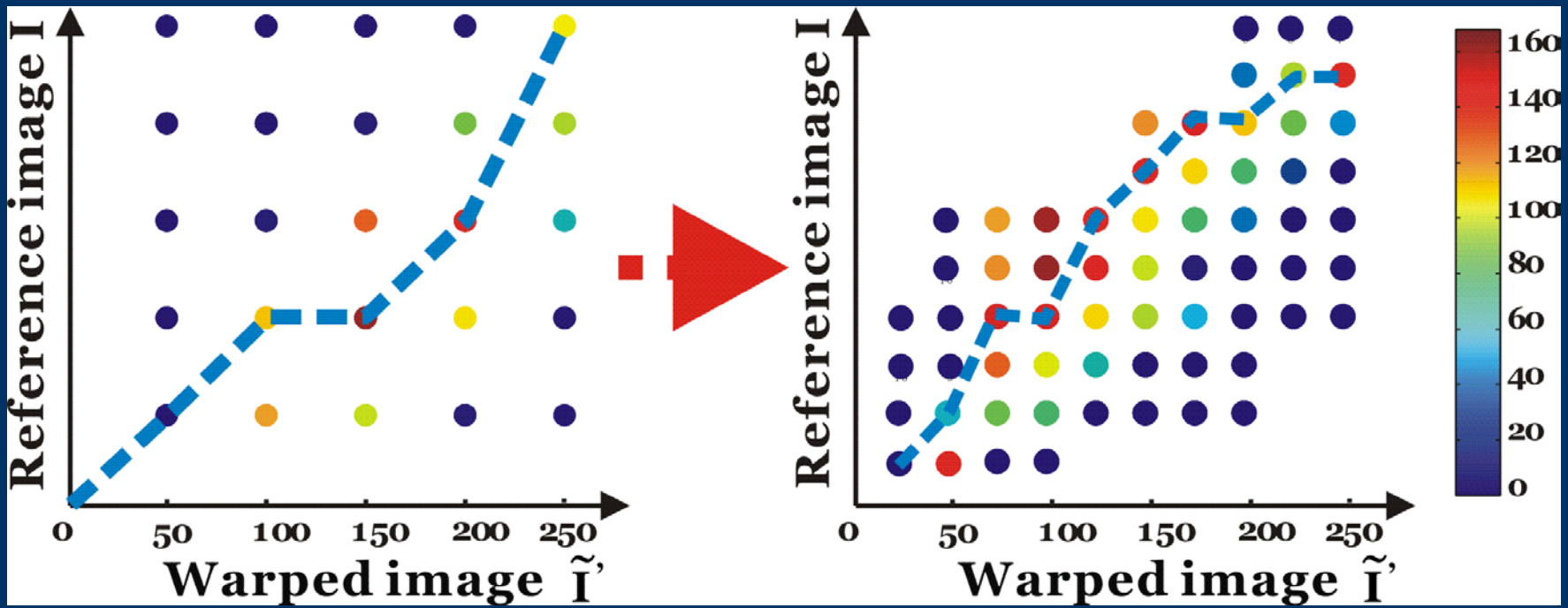
if $(x_1, y_1) \leftrightarrow (x_2, y_2)$ and $(x_1'', y_1'') \leftrightarrow (x_2'', y_2'')$ are corresponding pixel pairs in overlapping area

- Local fitting



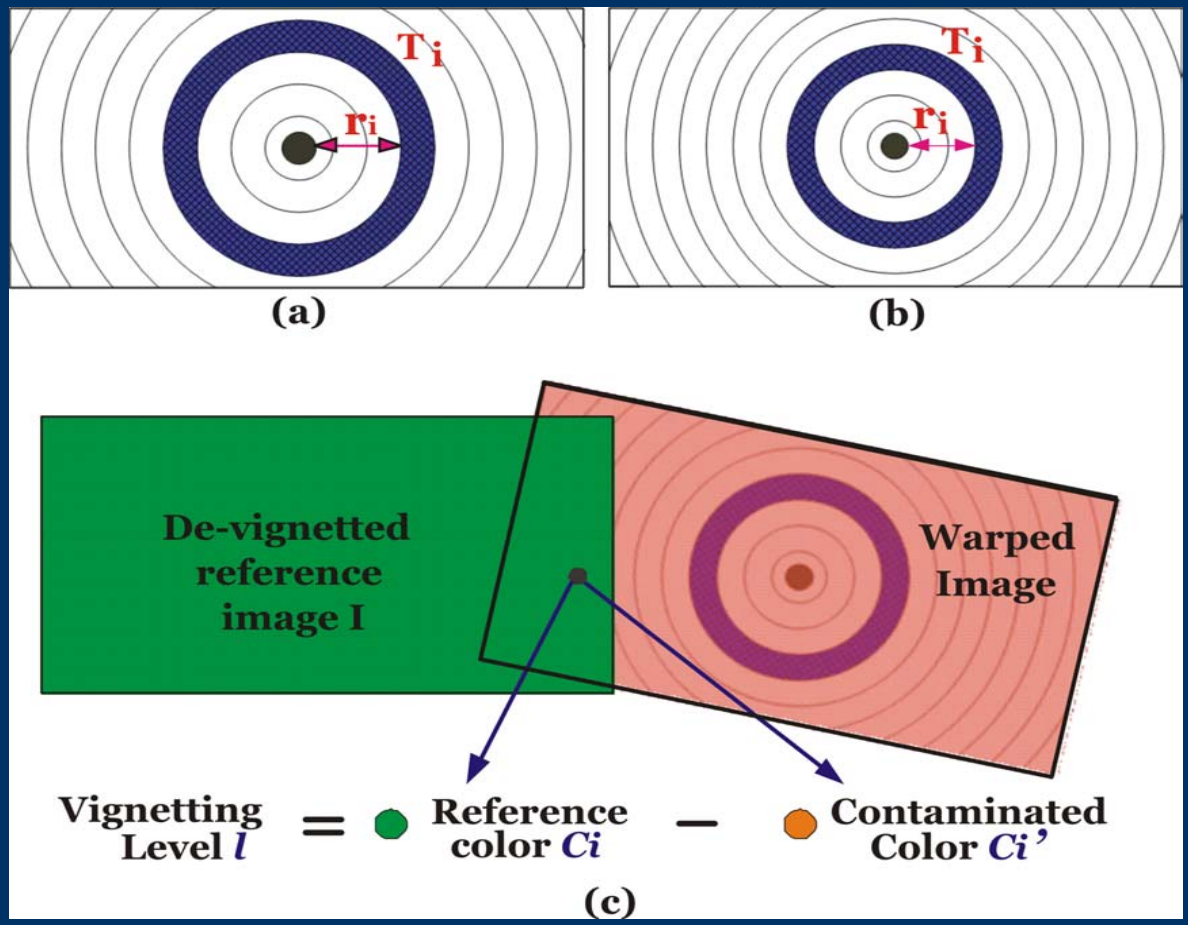
Multiscale

- Inferring the most-likely curve from noise
- Gaussian pyramid is constructed

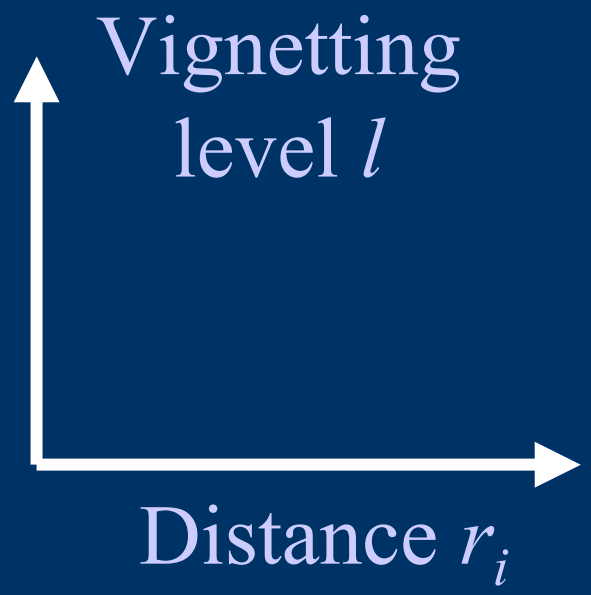


Local Replacement

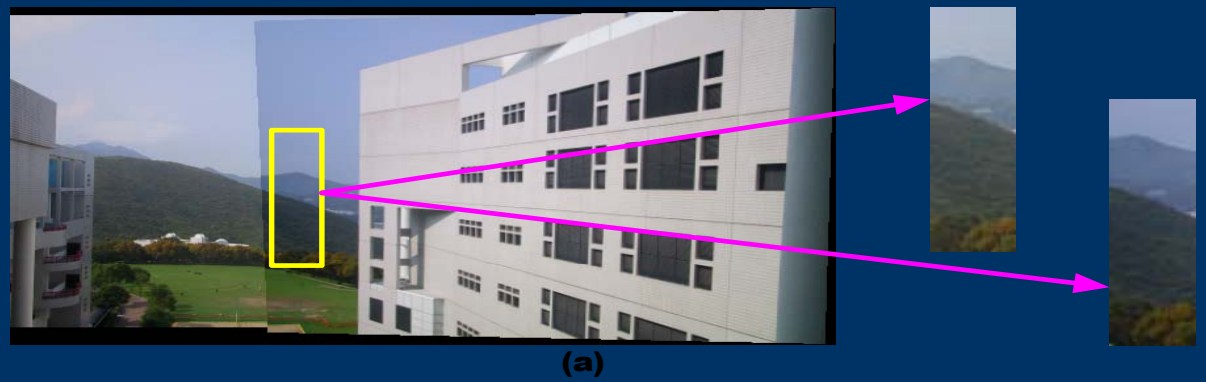
- Same process to estimate local replacement curve
- Vignetting is distance based optic phenomenon



- Only difference on voting space

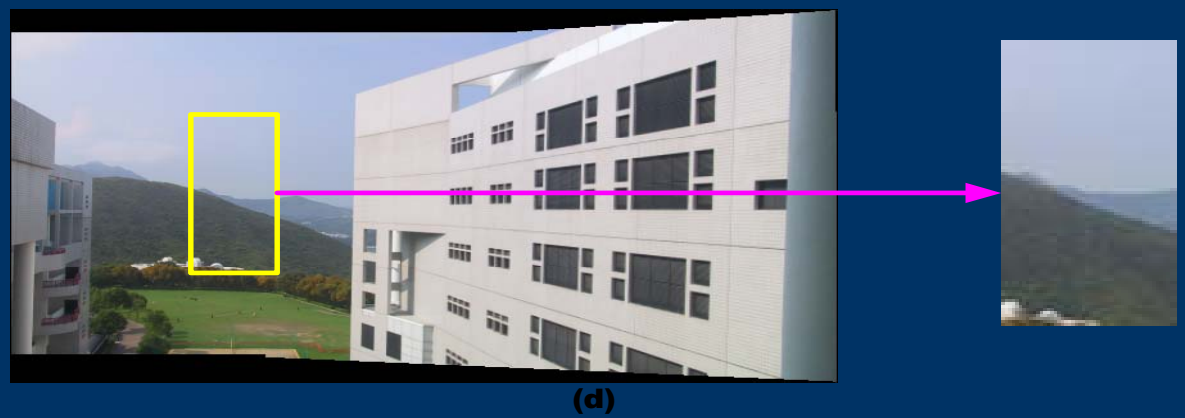


Local Replacement Results



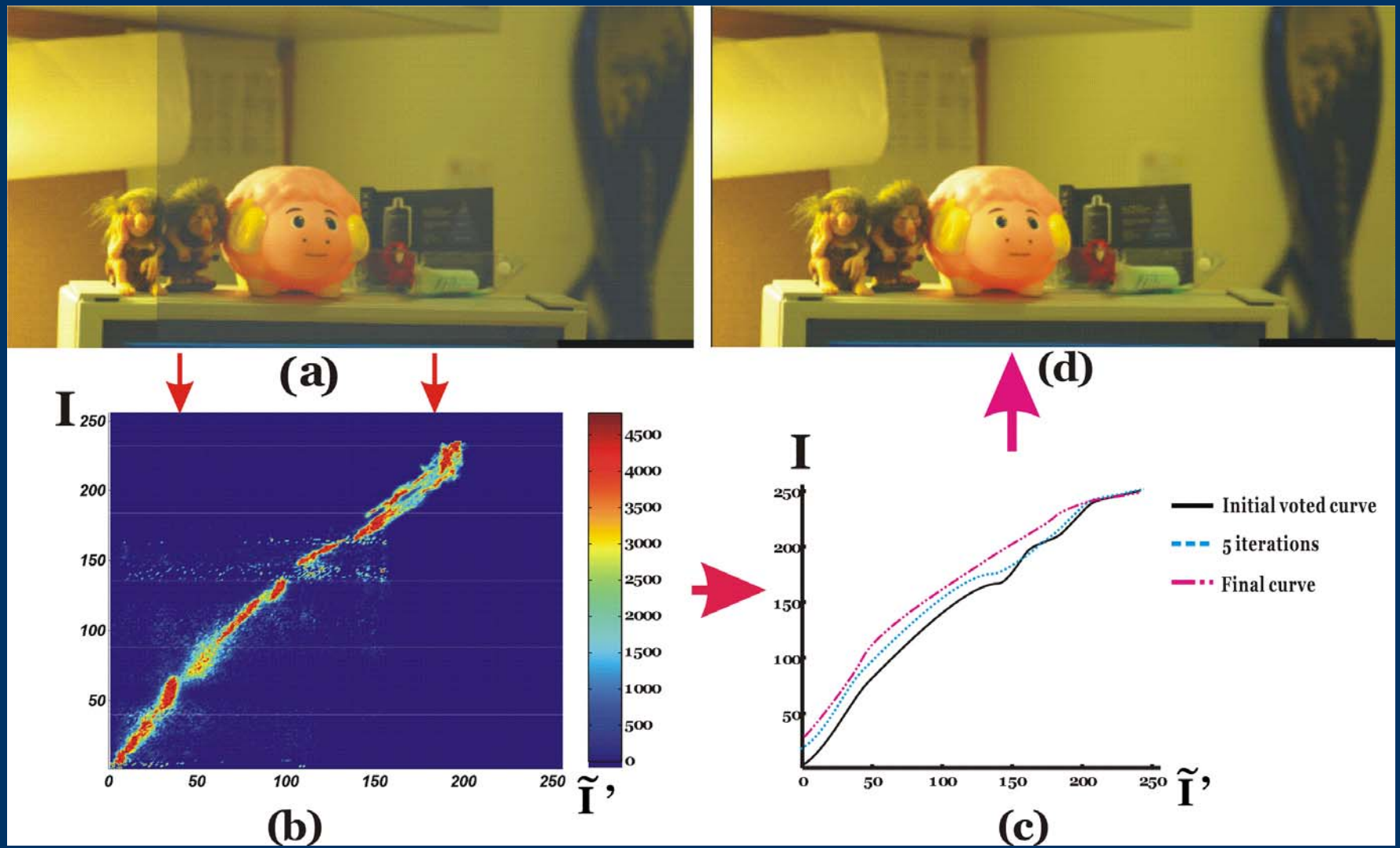
(a)

(b) (c)

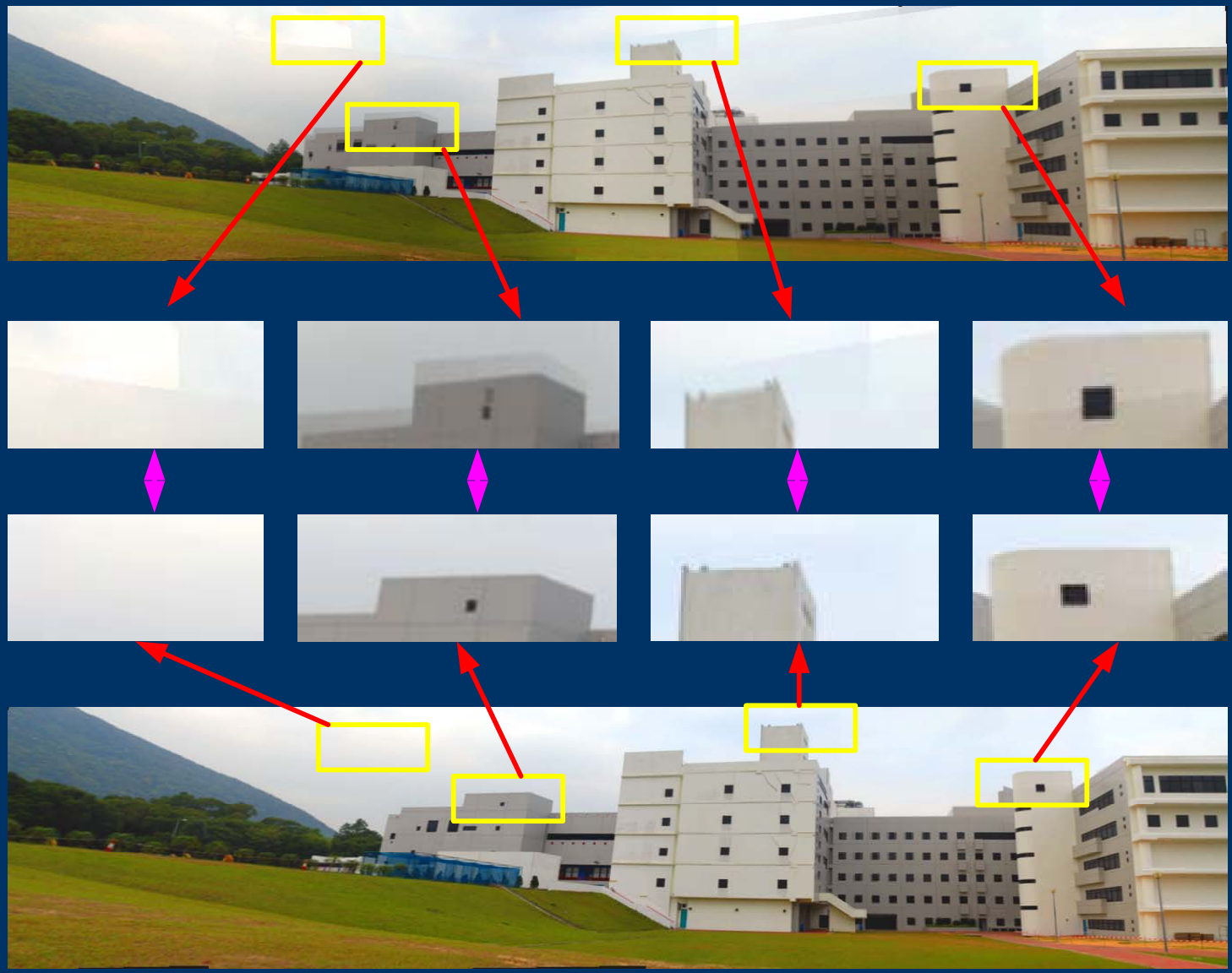


(d)

Results


(a)
(d)
I
250
200
150
100
50
0
50
100
150
200
250
Ĩ'
4500
4000
3500
3000
2500
2000
1500
1000
500
0
(b)
I
250
200
150
100
50
0
50
100
150
200
250
Ĩ'
Initial voted curve
5 iterations
Final curve
(c)

Results



Conclusion

- 2-D tensor voting method to connect curves
- Adaptive scale selection
- Geometric hole filling
- Layered background extraction and propagation
- Homography blending
- Luminance voting
- Global and local replacement function

Future work

- Movement registration
  - Mosaics with moving objects
  - Other image-based applications
- Generalized video repairing
  - Broader class of camera motions
  - Complex foreground

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Contributions

- General, expandable computational framework
- Unified and rich representation for all potential types of structure and outliers
  - No hard decisions at early stages
- Model-free
- Very little initialization requirements

Contributions

- Efficient local information propagation through Tensor Voting
- Non-iterative
- Robust to noise
- Good results in large range of problems in Computer Vision and other fields

Future Work: Multiple Scales

- Scale affects
  - Desired level of smoothness
  - Noise robustness
  - Detail Preservation
  - Ability to fill in gaps
- A single scale may be insufficient in most cases
- Work has been done on multiple scale Tensor Voting but more is needed

Future Work

- Scale adaptation based on local criteria / automatic scale selection
- Integration of time into the framework
- Improvements in computational efficiency

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