



Panoramic Reconstruction from Multiple Light-Field Images

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Motivation

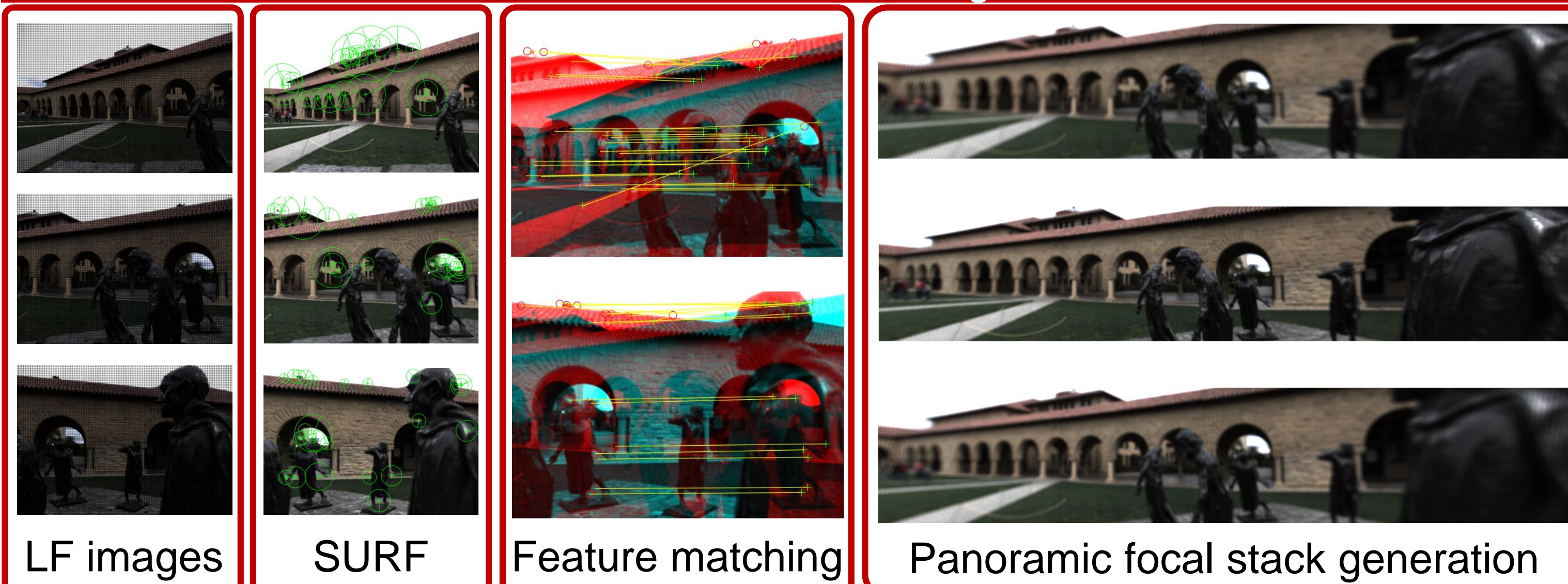
- ✓ Light-field (LF) imaging is becoming increasingly practical
- ✓ LF imaging offers synthetic refocusing, multi-perspective recording, depth estimation, depth-dependent filtering, 3D reconstruction, and much more
- ✓ LF photography needs to support the standard imaging modes in traditional photography to dominate the consumer market
- ✓ One of these modes is panorama imaging

Related Work

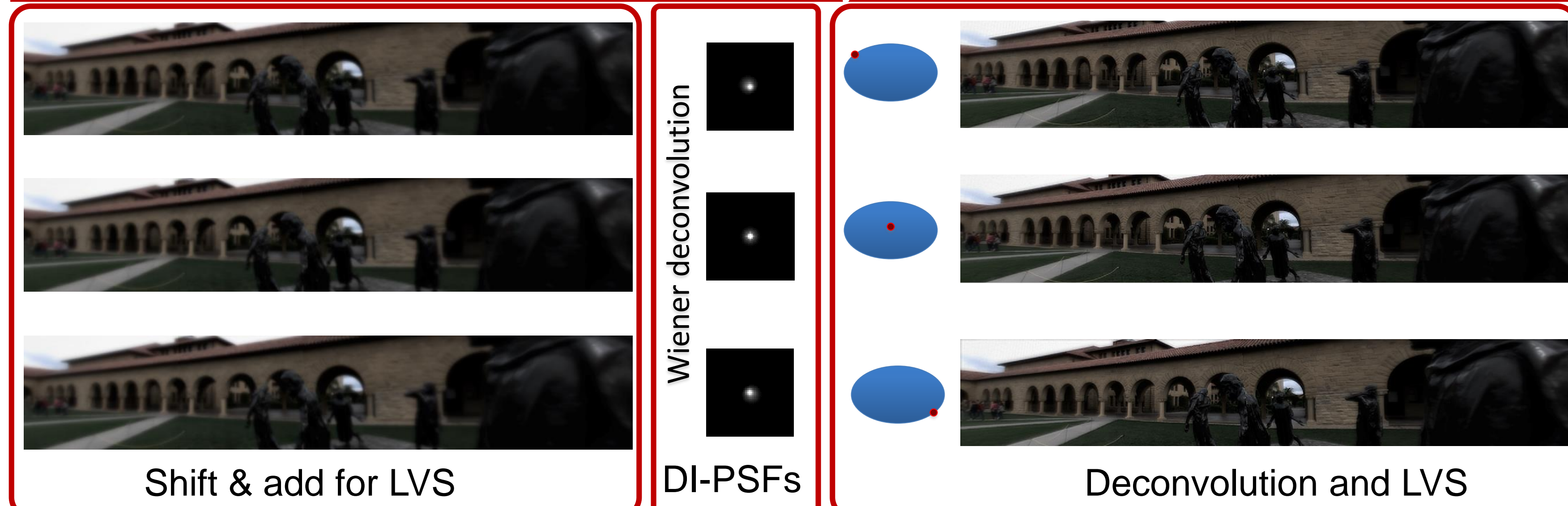
- ✓ One of the first examples of panorama LF imaging uses naïve multi-perspective image stitching.¹
- ✓ A “better” method stitches focal stacks and uses linear view synthesis (LVS)² to generate different perspectives.
- ✓ “State-of-the-art” method registers rays directly to avoid occlusion and anisotropic reflection problems.³

- + Fast, simple implementation
- Refocusing artifacts
- + Intuitive
- Only for Lambertian scenes
- + Best performing method
- Complex, calibration needed, computationally expensive

Panoramic Stitching



Linear View Synthesis



Technique

- ✓ Read the LF images and separate the contained perspectives
- ✓ Detect speeded up robust features (SURF)⁴
- ✓ Perform feature matching⁵ using SURF descriptors
- ✓ Compute the geometric transforms that merge the computed all-in-focus images from the LF data
- ✓ Apply these geometric transforms to the focal stack computed from the LF data to obtain a panoramic focal stack
- ✓ Apply a “shift-and-add” algorithm to obtain different perspectives from the focal stack⁶
- ✓ Deconvolve the sharp perspective views from the blurry images with depth-invariant PSFs⁶
- ✓ Detect the location of the face by Viola-Jones algorithm⁷
- ✓ Track the face by tracking feature points (KLT algorithm)⁸
- ✓ Choose the correct perspective view based on the face center



References

- ¹ Brown M., Lowe D.: Automatic panoramic image stitching using invariant features. International Journal of Computer Vision (2007) 74, 1.
- ² Birklbauer C., Opelt S., Bimber O.: Rendering gigaray light fields. In Computer Graphics Forum (2013), 32.
- ³ Birklbauer C., Bimber O.: Panorama light-field imaging. Computer Graphics Forum (2014), 33, 2.
- ⁴ Bay, H., A. Ess, T. Tuytelaars, L. Van Gool.: SURF: Speeded up robust features. Computer Vision and Image Understanding (2008), 110, 3.
- ⁵ Muja M., Lowe D.: Fast matching of binary features. Conference on Computer and Robot Vision (2012).
- ⁶ Levin A., Durand F.: Linear view synthesis using a dimensionality gap light field prior. IEEE Conference Computer Vision and Pattern Recognition (2010).
- ⁷ Viola, Paul A. and Jones, Michael J. "Rapid Object Detection using a Boosted Cascade of Simple Features", IEEE Conference Computer Vision and Pattern Recognition (2001),
- ⁸ Carlo Tomasi and Takeo Kanade. Detection and Tracking of Point Features. Carnegie Mellon University Technical Report CMU-CS-91-132, (1991).

Head Tracking

