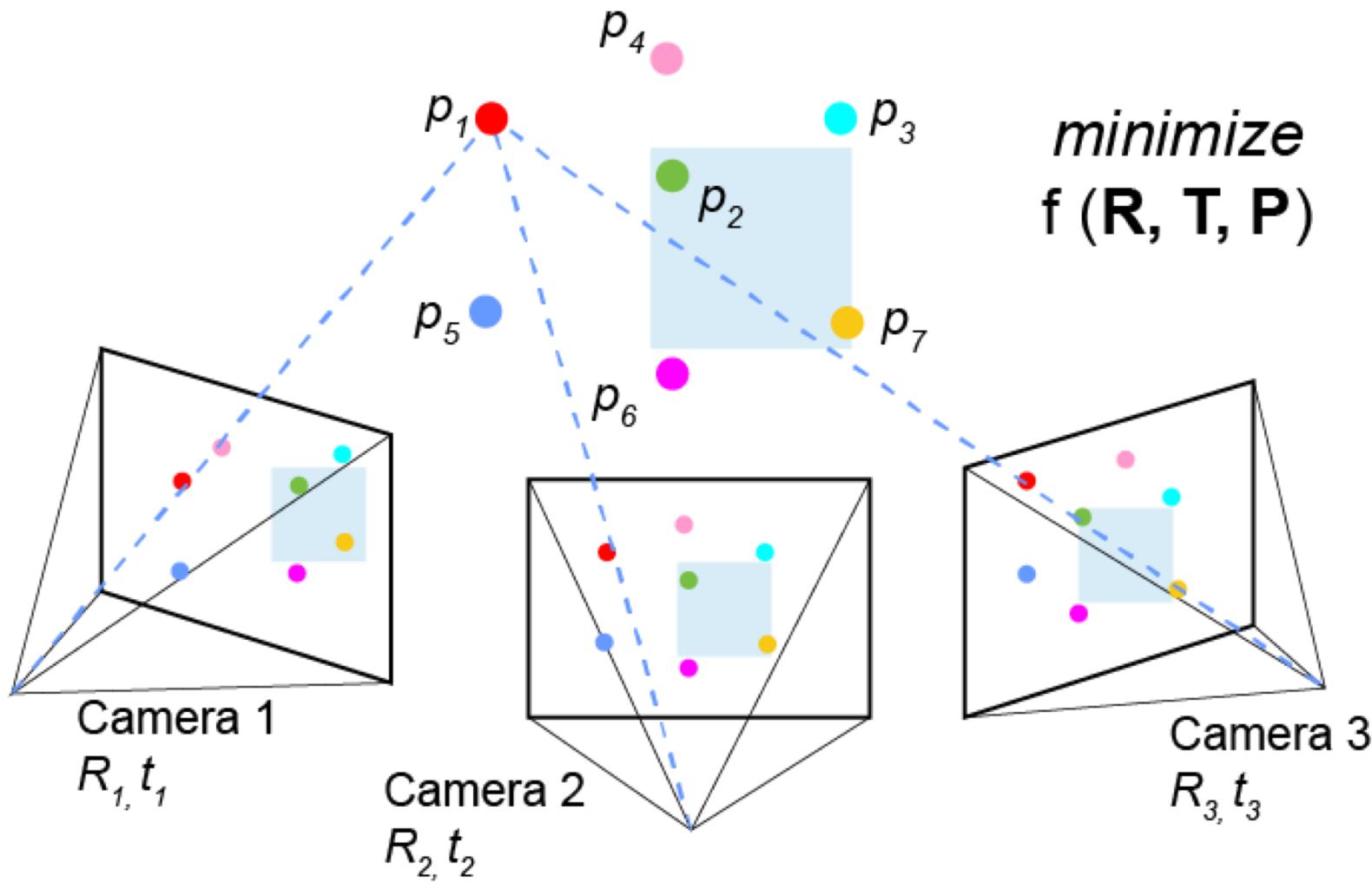

Robotic Perception

Structure from Motion (SfM)

Yezhou Yang, Ph.D.
Assistant Professor
Zhiyuan Fang, Teaching Assistant
Arizona State University

The Problem of SfM



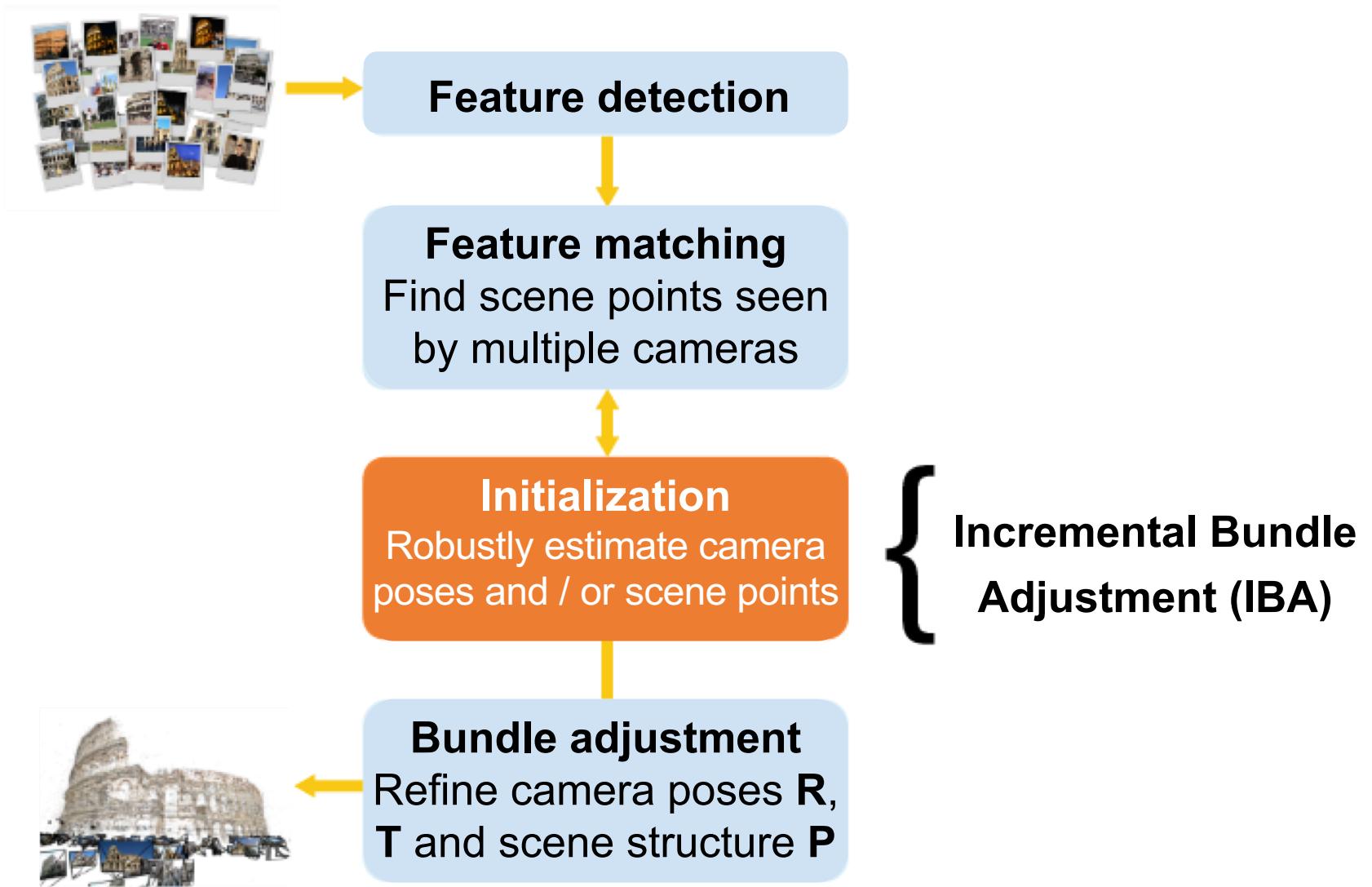
The Problem of SfM

| Structure from Motion:

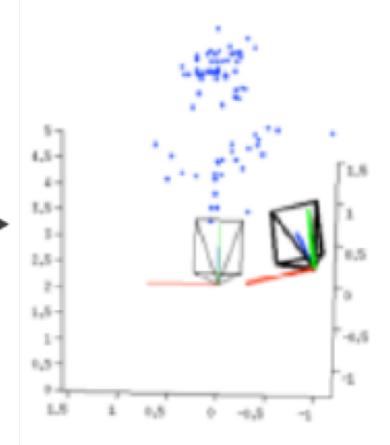
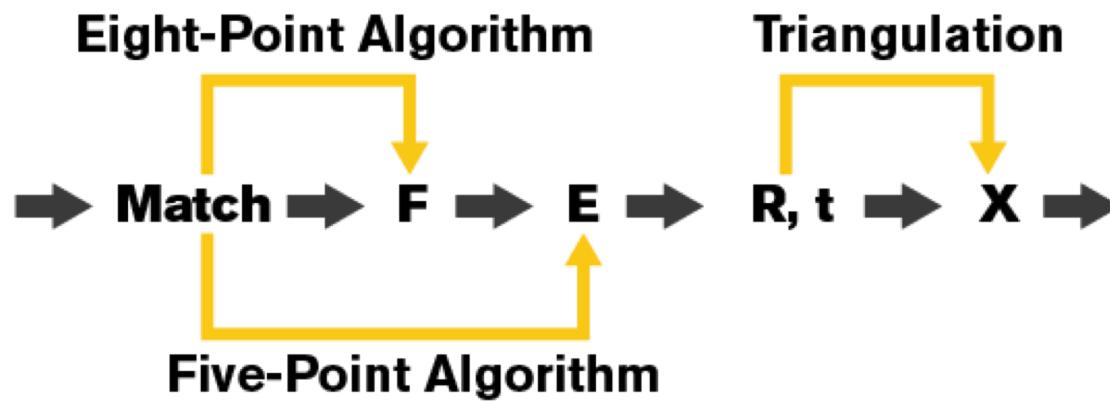
- Take some images of the object to reconstruct
- Features (points, lines, ...) are extracted from all frames and matched among them
- All images are processed simultaneously
- Both camera motion and 3D structure can be recovered by optimally fusing the overall information, up to a scale factor.



Reconstruction Pipeline



Two View Reconstruction



Iterative Bundle Adjustment

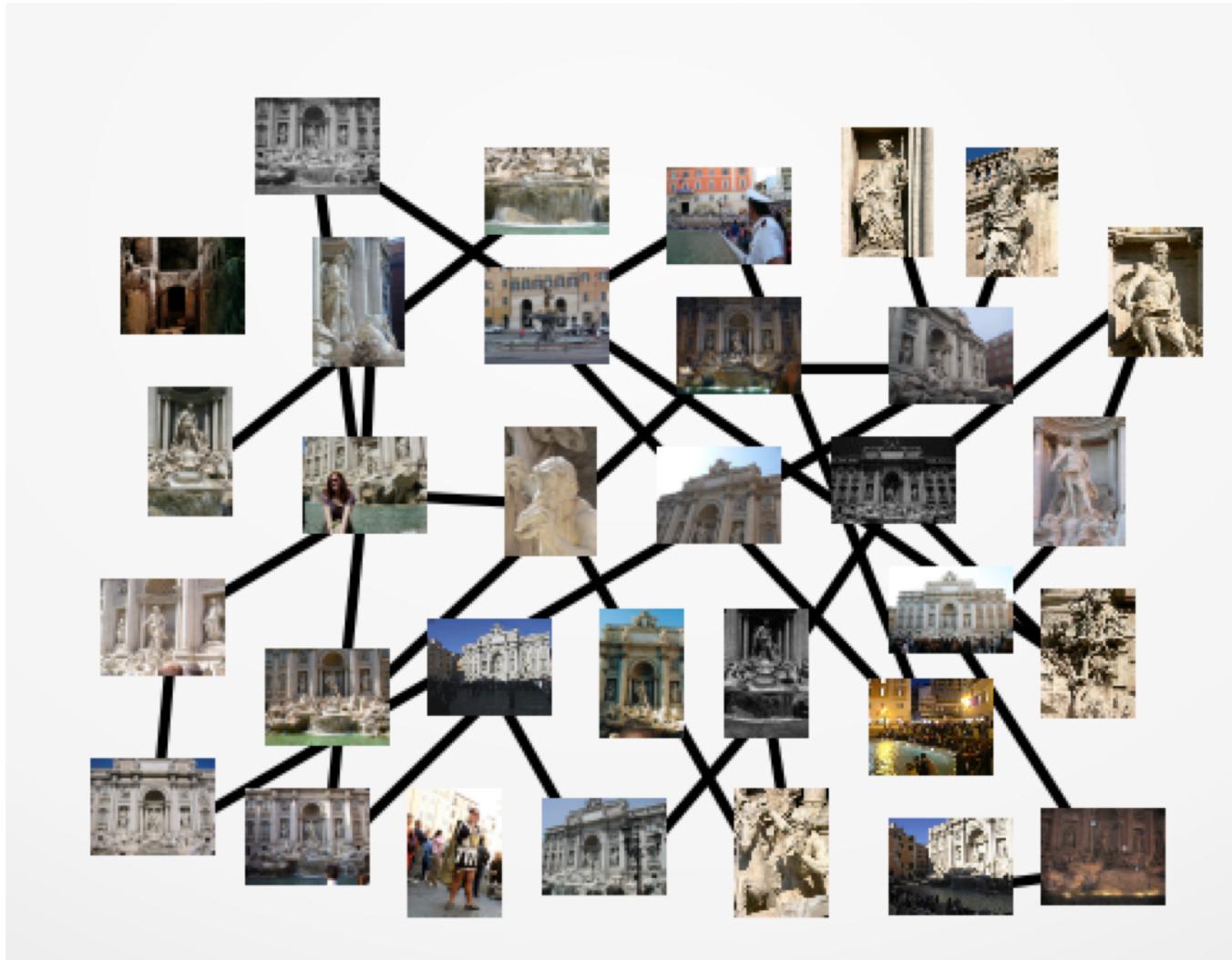


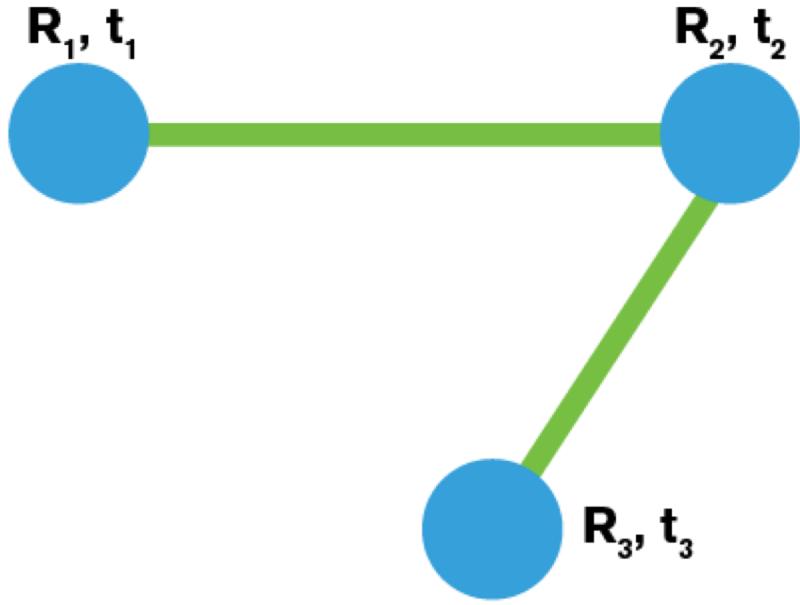
Image graph with pairwise point correspondences

How IBA Works



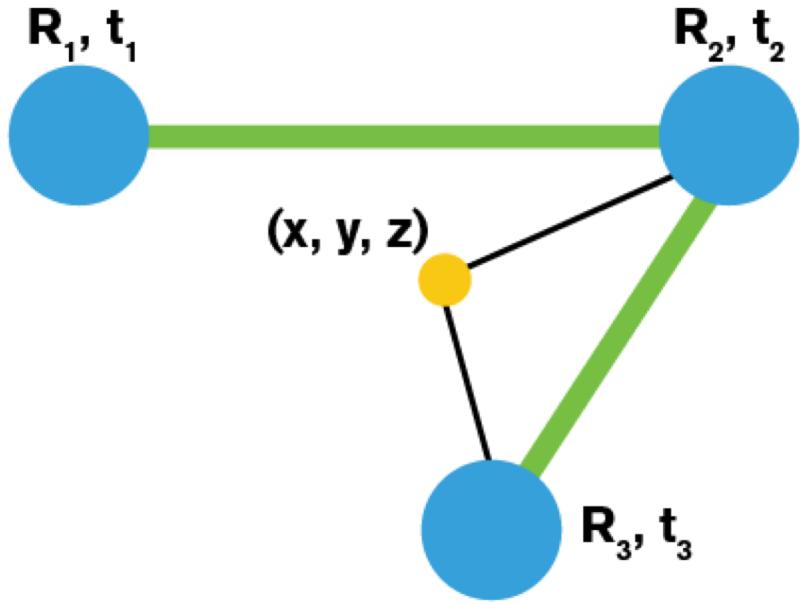
| Start with a seed pair

How IBA Works



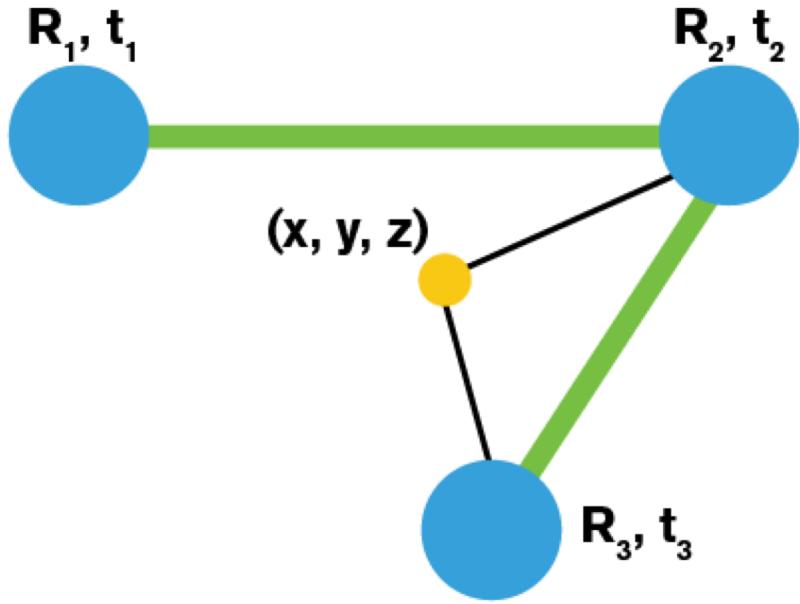
| Add new cameras to the seed

How IBA Works



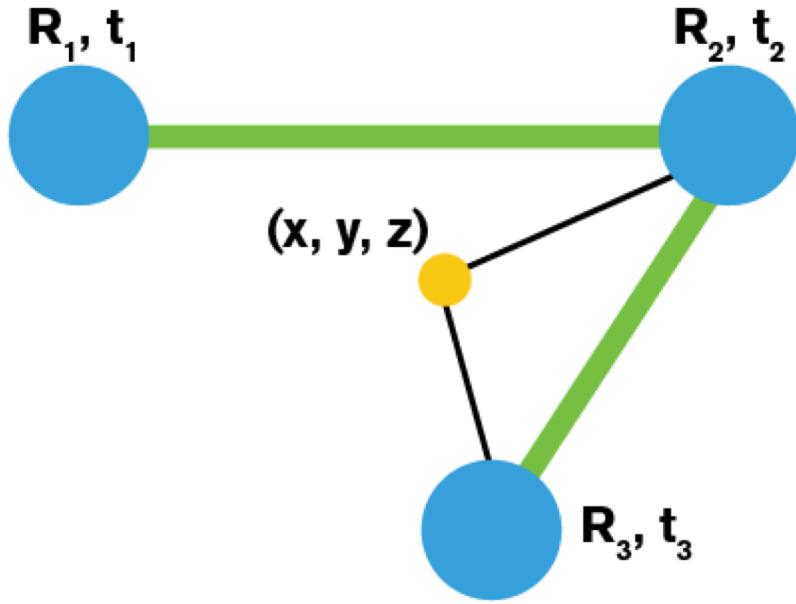
| Add new cameras to the seed

How IBA Works



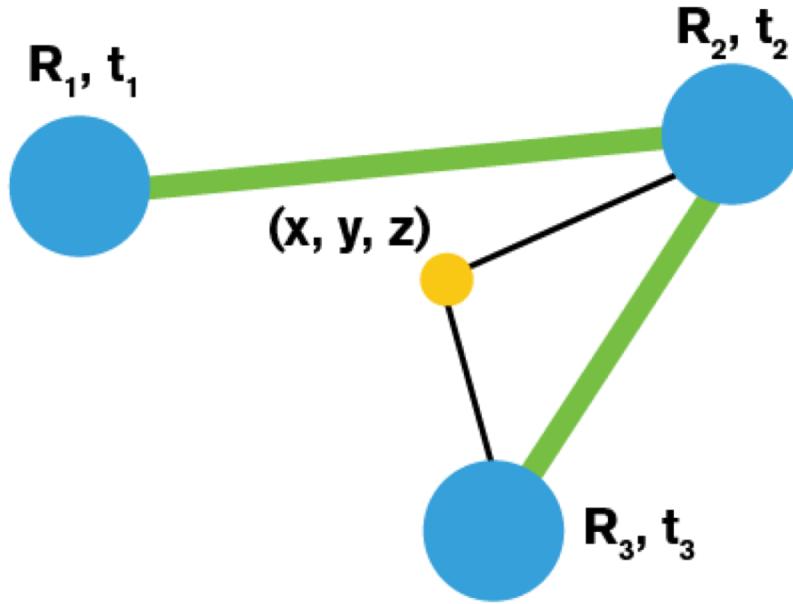
| Also calculate 3D positions of points that cameras see

How IBA Works



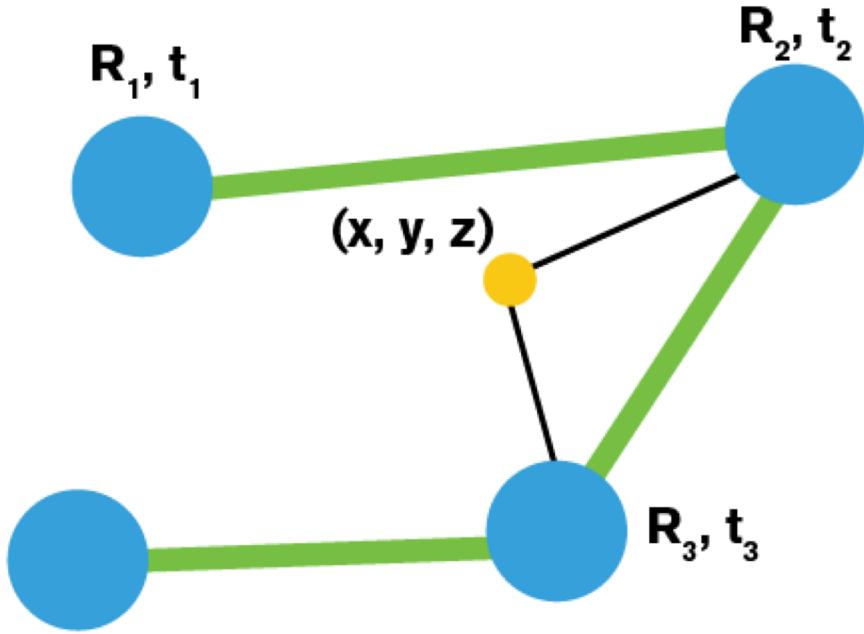
| Wiggle solution periodically to get a better solution

How IBA Works



| Wiggle (Bundle adjust) solution periodically to get a better solution

How IBA Works

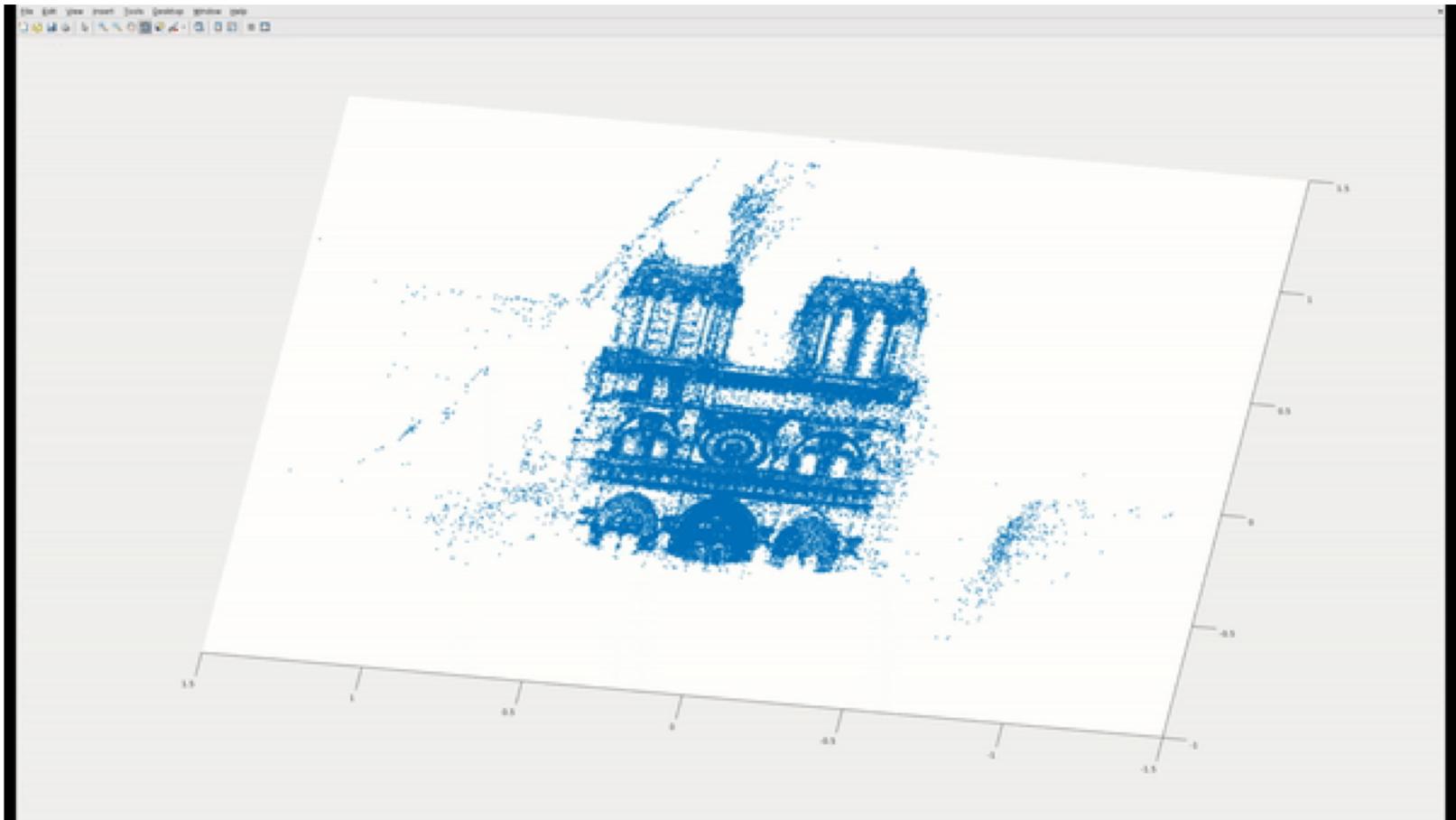


| Keep adding more cameras

Experimental Results



Experimental Results



[Notre Dame Cathedral Dataset](#)

More References

- | **Photo Tourism: Exploring Image Collections in 3D.**
Noah Snavely, Steven M. Seitz, Richard Szeliski.
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- | **Building Rome in a Day**
Sameer Agarwal, Noah Snavely, Ian Simon, Steven M. Seitz and Richard Szeliski, ICCV 2009
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