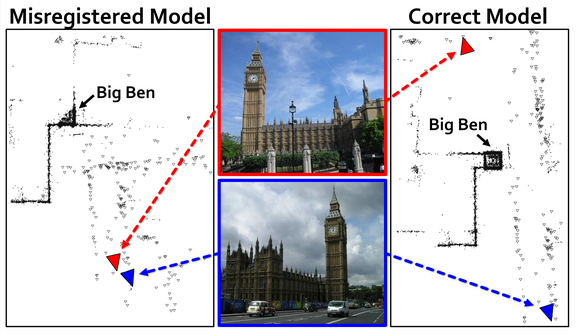
Correcting for Duplicate Scene Structure in Sparse 3D Reconstruction

Jared Heinly, Enrique Dunn, Jan-Michael Frahm
University of North Carolina at Chapel Hill

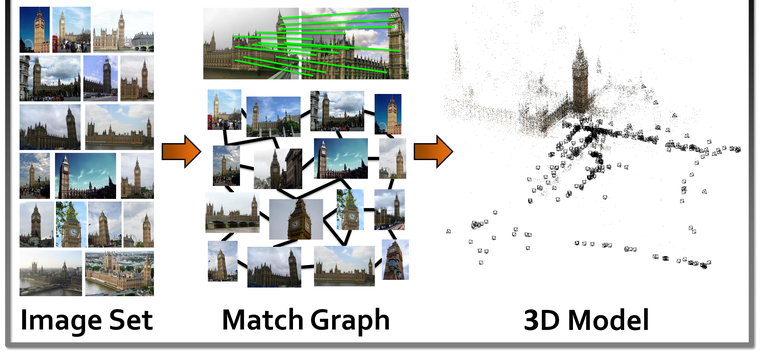
Motivation



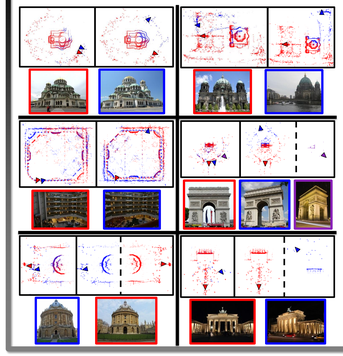
Contributions

- Method is a post-process step to existing structure-from-motion (SfM) pipelines
- Split reconstruction into consistent sub-models without oversplitting
- Recover correct reconstruction by merging sub-models

Input

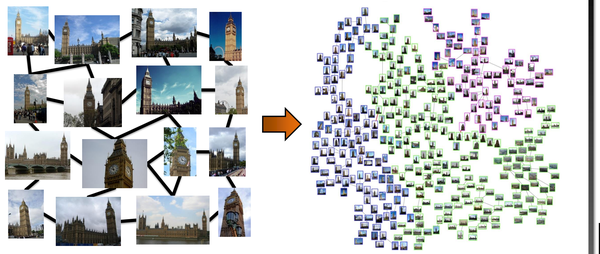


Results



Dataset Name	# Cams	Time
Big Ben (using iconics)	13590	20.5 m
Berliner Dom	1618	9.8 h
Sacre Coeur	1112	4.4 h
Notre Dame (iconics)	885	1.8 h
Alexander Nevsky Cathedral	448	16.6 m
Arc de Triomphe	434	16.3 m
Radcliffe Camera	282	31.9 m
Church on Spilled Blood	277	1.4 h
Brandenburg Gate	175	3.0 m
Indoor	152	3.1 m
Cereal	25	36 s
Street	19	39 s

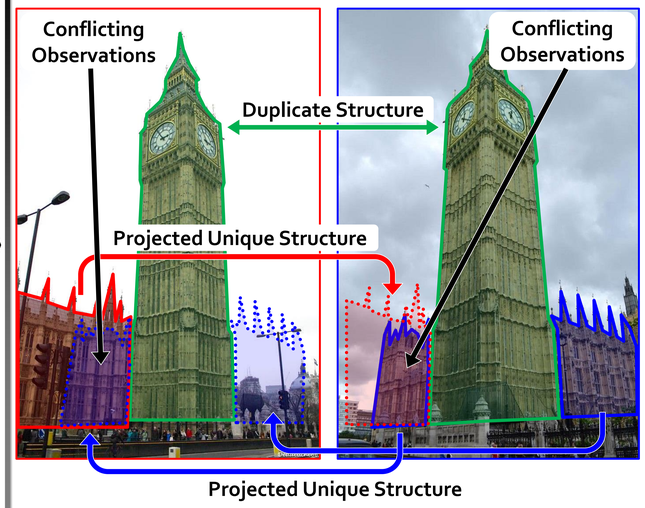
Camera Graph



$$\text{Edge weight} = 1 - \frac{|P_i \cap P_j|}{|P_i \cup P_j|}$$

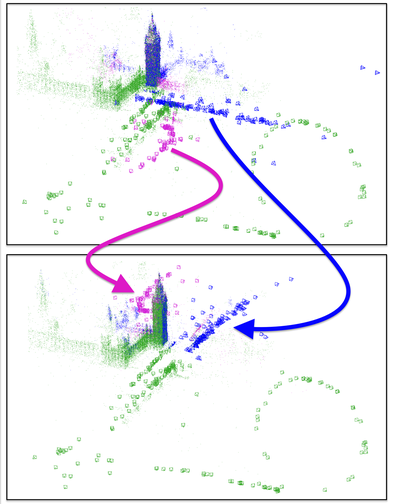
P_i = 3D points seen by camera i

Conflict-Based Model Splitting



- Determine conflict between camera pair by counting conflicting observations within same superpixel
- Split minimum spanning tree edge with highest conflict
- Update conflict and recursively split until negligible conflict

Model Merging



- Find camera pairs from match graph that were not used in final 3D model
- Propose similarity transform to align sub-models by sampling unused camera pairs
- Compute conflict on merged model and accept if conflict is negligible
- If conflicting merge found, remove offending cameras and repeat

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