Photogrammetric Block Adjustment

Chapter 5
Automatic Aerial Triangulation

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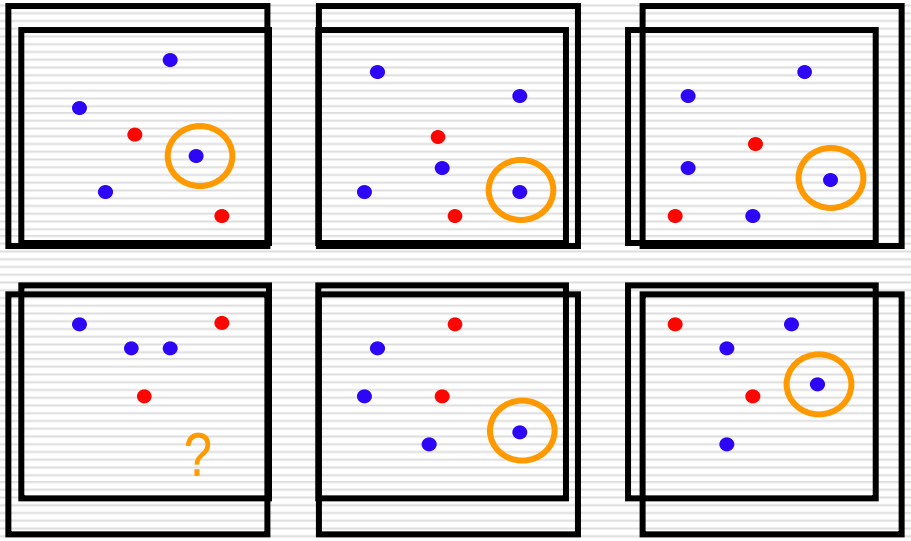
Major Challenges of AAT

- Differences between human operator and computer operator
- Automatic selection of suitable tie points
  - suitable, overlapping sub-areas
  - suitable tie points within sub-areas
- Matching tie points
  - approximations
  - multiple image matching
  - reliability of tie points

Tracing Tie Points Through Pyramids



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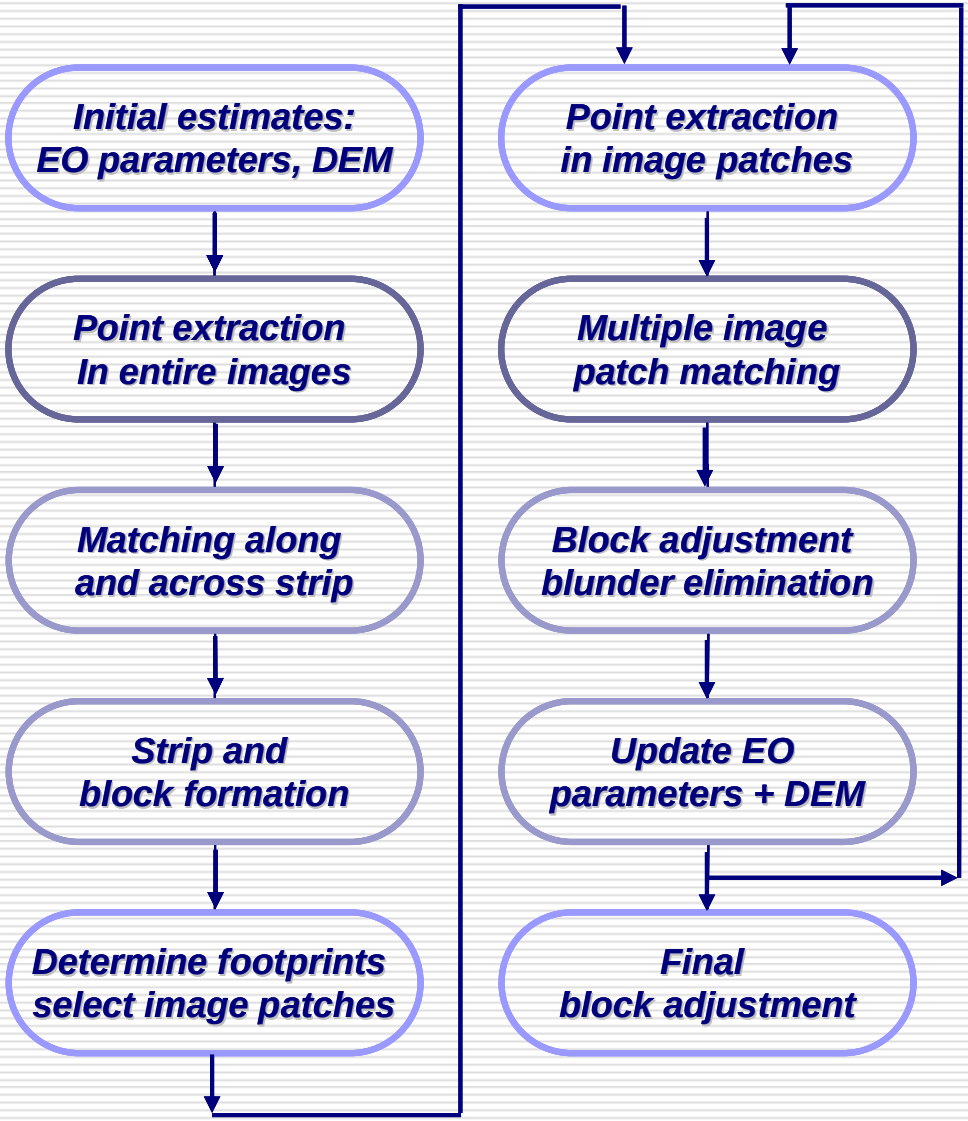
Generic Workflow of AAT



Clusters of points in regular pattern

For good overlap configurations

For better estimates of matching windows

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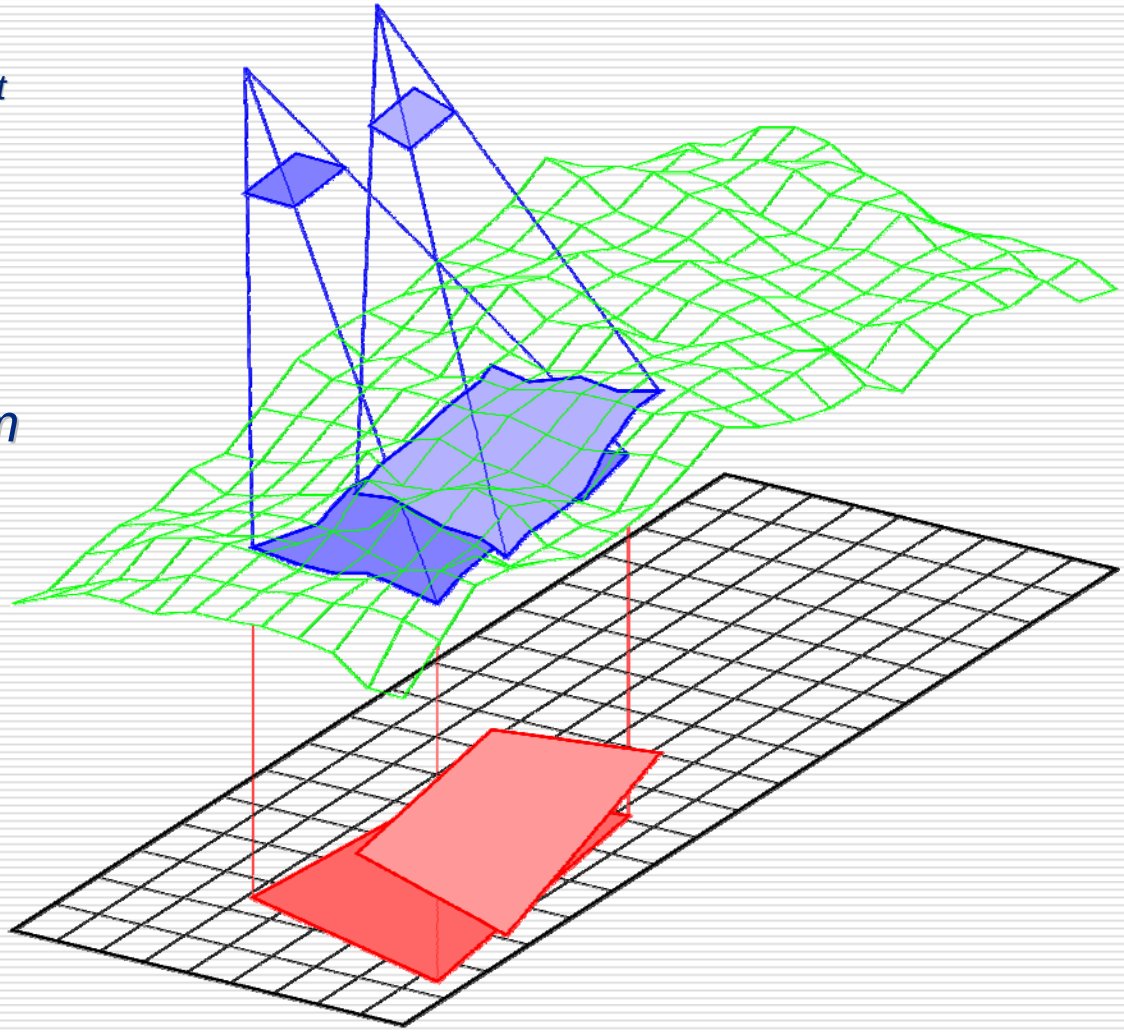
Concept of Blocksystem

EO obtained from 1st blockadjustment

surface obtained from 1st blockadjustment

compute footprints for precise overlap configuration



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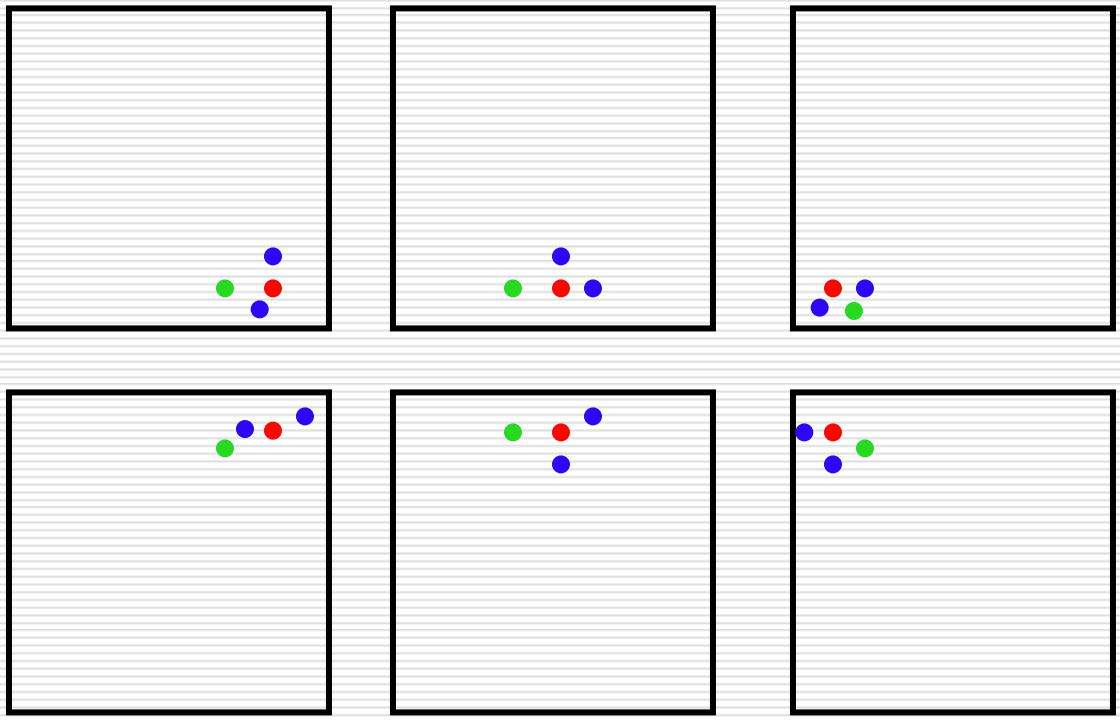
Experiment with Multiple Overlap Tie Points



tie point in 6 images:

6 x 2 = 12 equations

3 unknowns

➔ redundancy = 9

Idea: replace 6-overlap tie point by 2-overlap tie points

2 x 2 = 4 equations

3 unknowns ➔ r = 1

➔ find 9 pairs

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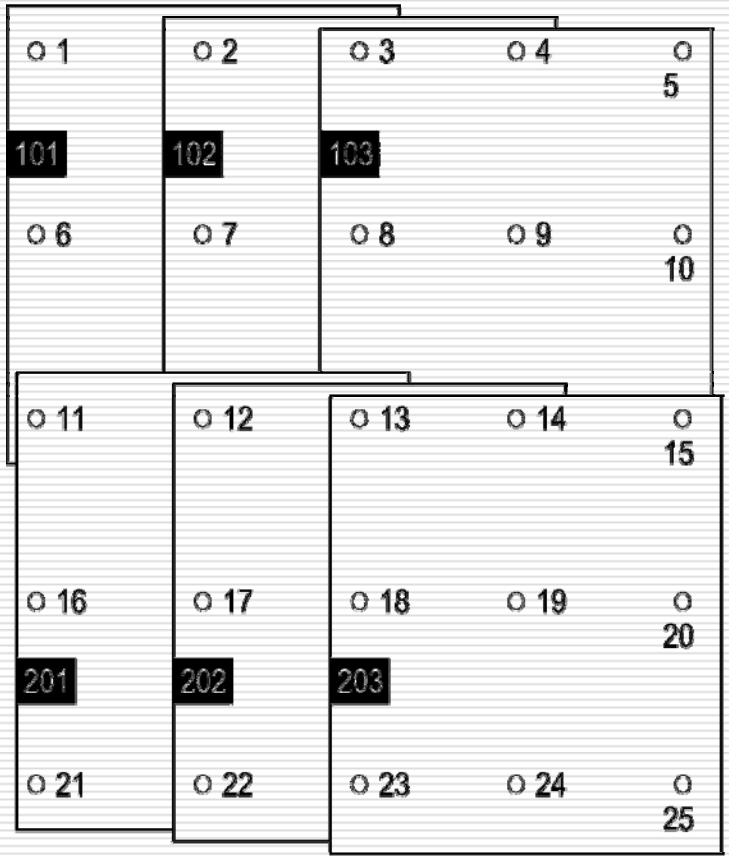
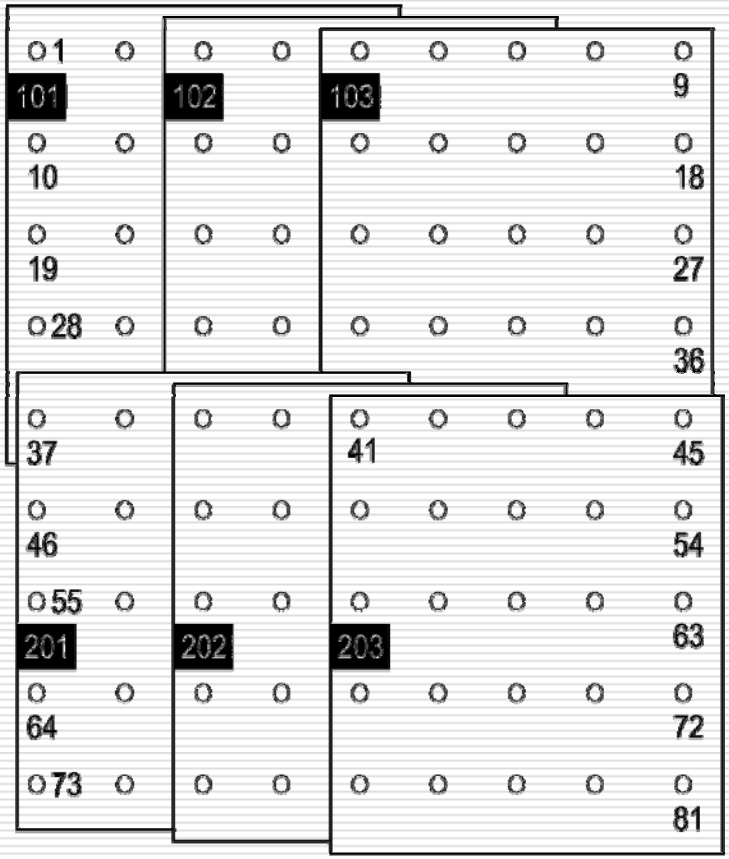
Block for Multiple Overlap Tests



a)



b)

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Decomposition of Multiple Overlap Tie Points into 2-Overlap Points

point	images					
	101	102	103	201	202	203
13	x	x	x	x	x	x
13a	x	x				
13b	x		x			
13c		x	x			
13d				x	x	
13e				x		x
13f					x	x
13g	x			x		
13h		x			x	
13i			x			x

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Dual Overlap vs. Multiple Overlap

case	σ –ratios of EO parameters					
	X	Y	Z	ω	φ	κ
E3/E1	0.98	0.37	0.40	0.36	0.92	1.01
E2/E1	1.55	2.85	2.85	2.82	1.49	1.17
E4/E3	1.33	2.53	2.41	2.55	1.28	1.33
E4/E1	1.30	0.94	0.97	0.93	1.17	1.35

E1: *9-point pattern,* ***multiple overlap***

E2: *9-point pattern,* ***dual overlap***

E3: *25-point pattern,* ***multiple overlap***

E4: *25-point pattern,* ***dual overlap***

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Conclusion from Overlap Experiments

1. Replacing multiple overlap tie points by dual overlap points works. The standard deviation of the orientation parameters degrades slightly but it can be compensated by a higher density of tie points.

2. The standard deviation of dual tie points is inferior to that of multiple overlap tie points. This degradation cannot be compensated by increasing the point density.

3. When replacing multiple overlap tie points it is important that the dual overlap tie points connect all overlapping images by independent pairs. If the condition that $2 \cdot n - 3$ independent dual tie points is consistently violated then the block stability degrades quickly.

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Concluding Remarks

Automatic aerial triangulation works, but

- Not 'fully' automatic
- Control points must be measured manually
- In hilly areas a good block system must be used for predicting overlapping image patches
- Performance in areas with lots of forest or vegetation?
- Detecting anomalies in point distribution

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