VIENNA UNIVERSITY OF TECHNOLOGY
DEPARTMENT OF GEODESY AND GEOINFORMATION
RESEARCH GROUPS PHOTOGRAMMETRY & REMOTE SENSING

2nd EuroSDR Workshop
High Density Image Matching for DSM Computation

Results from Participant: TU Vienna

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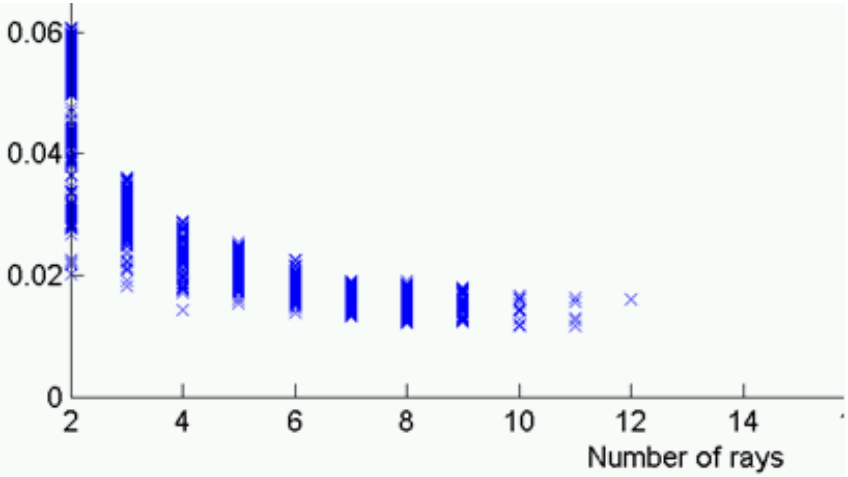
Software used: Match-T 5.5

- Cost based Matching (CBM) similar to SGM
- Default: matches every 3rd pixel (also every 1st or 2nd possible)
- Match-T itself matches **only one image pair** for each XY-location
  - BUT: the error of the 3D point decreases with the number of rays:



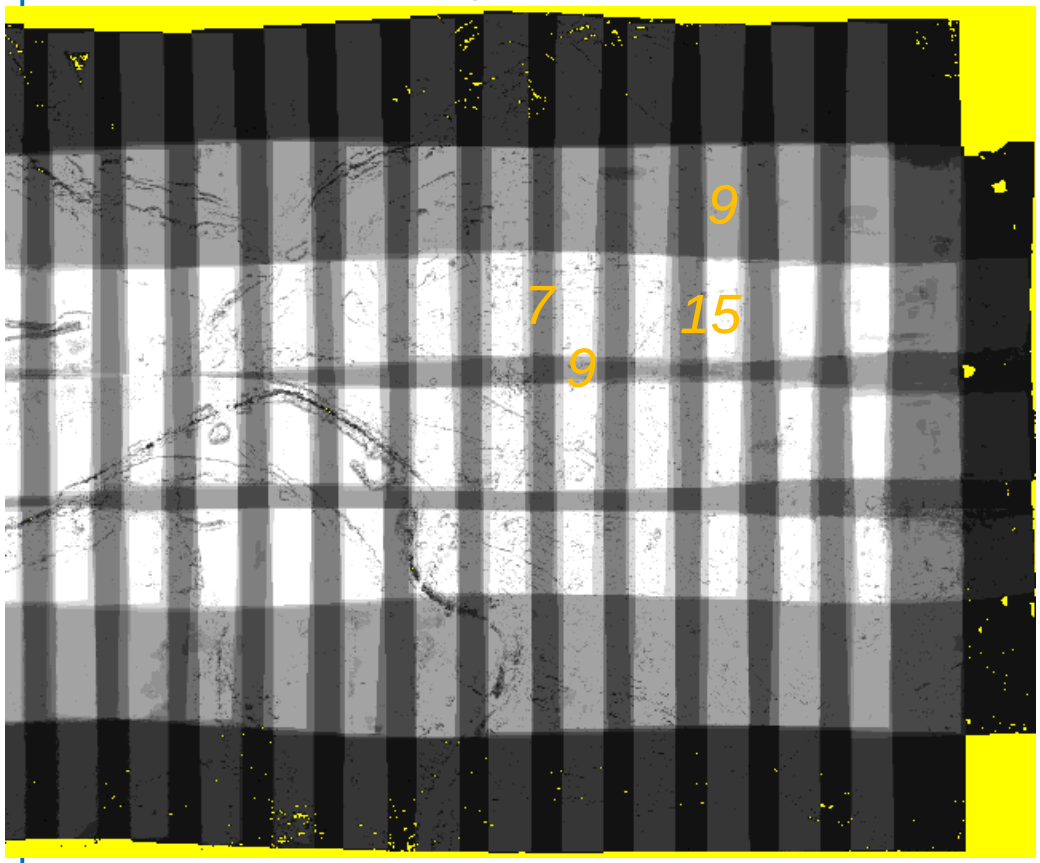
Using >2 overlapping images increases:

- *accuracy*
- *reliability*
- *completeness*

  - Exploit high image overlap using Match-T by matching overlapping image pairs and fusion of the pair wise matched DSMs

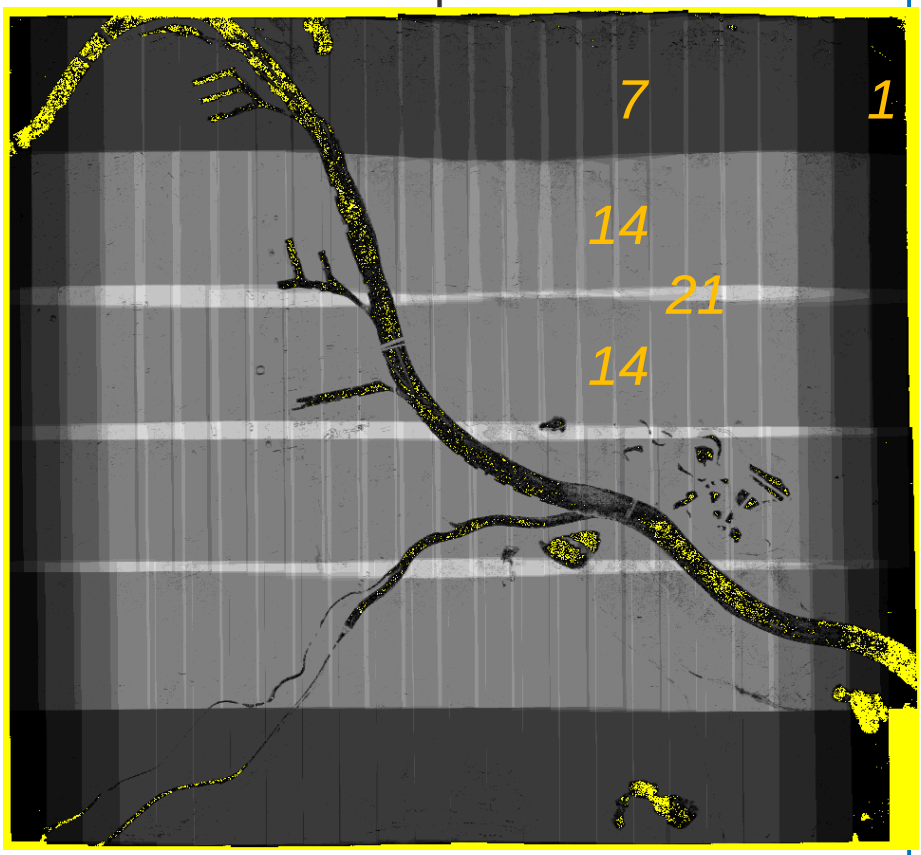
Layout of overlapping images

forward/side overlap: 60% / 60%



inhomogeneous coverage: 7 or 15 pairs

forward/side overlap: 80% / 50%



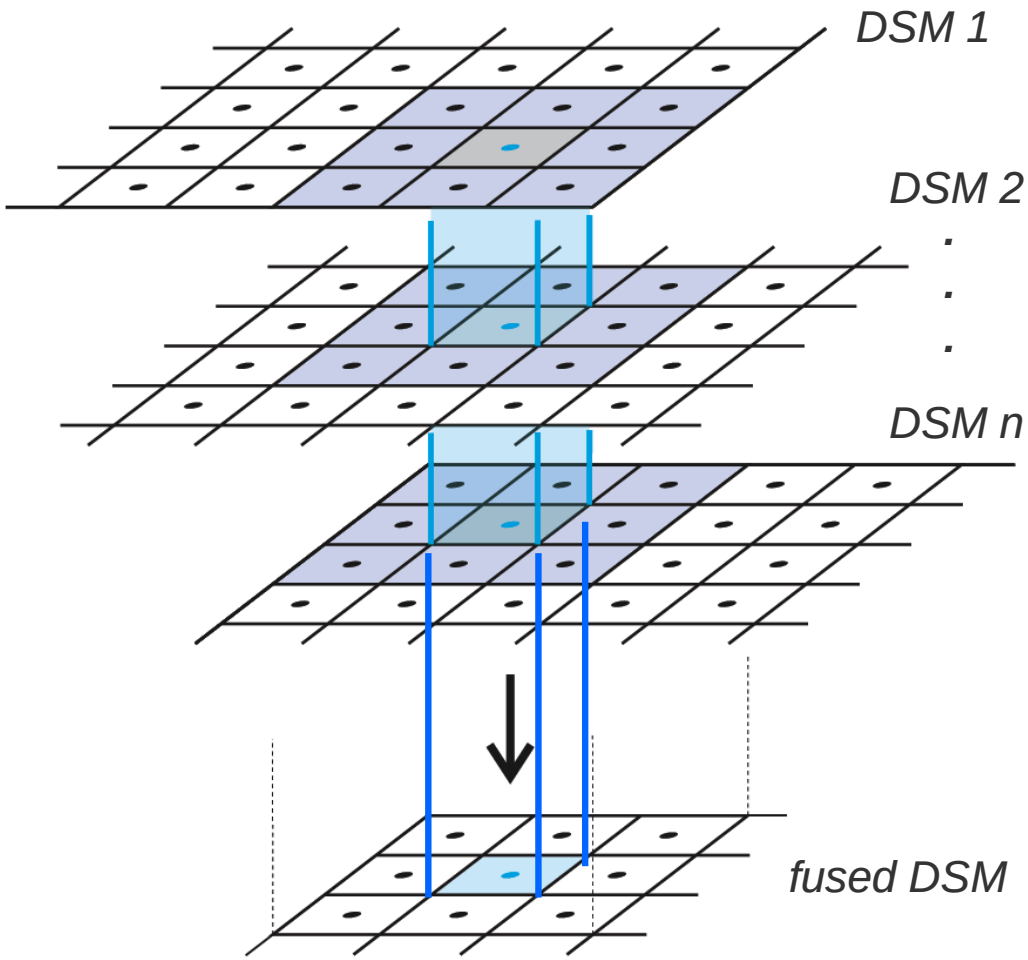
homogeneous coverage: 14 pairs

use overlap (n-1)/n (e.g. 50%, 66%, 75%, 80%,…) to get homogeneous coverage (i.e. each point is in exactly **n** images)

Fusing the DSMs of image pairs

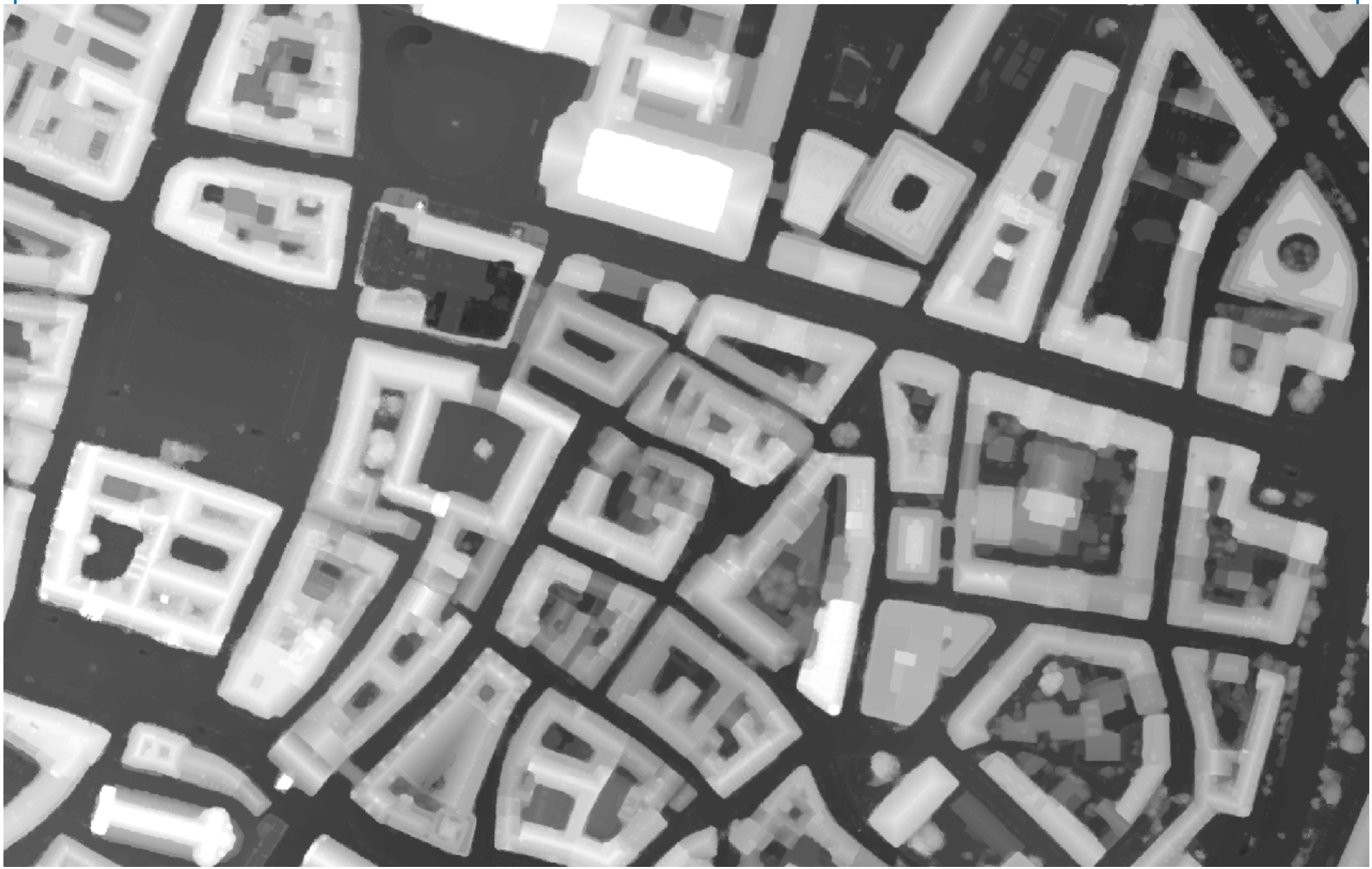
- Run Match-T on every possible image pair (within each strip; or across strip)
- e.g. forward lap 80% **à** pairs with 80%, 60%, 40% and 20% overlap
- Match-T returns point cloud PTS
- Interpolation of PTS to yield congruent DSMs

Stack of n DSMs
(one for each image pair)



à *Fusion* *of n DSMs:*
median, standard deviation (sigMAD)

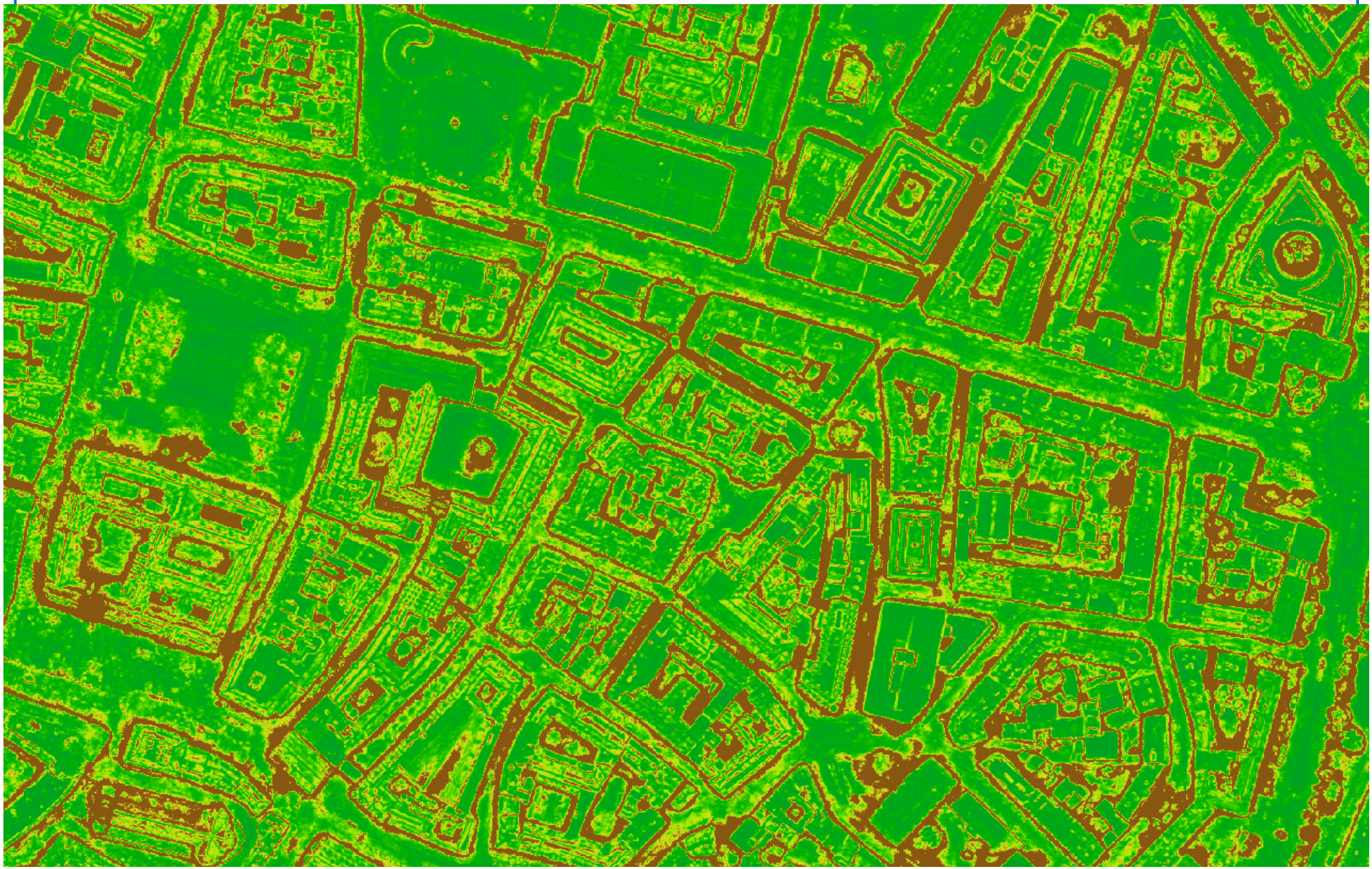
Comparison: Match-T-direct vs. Fusion



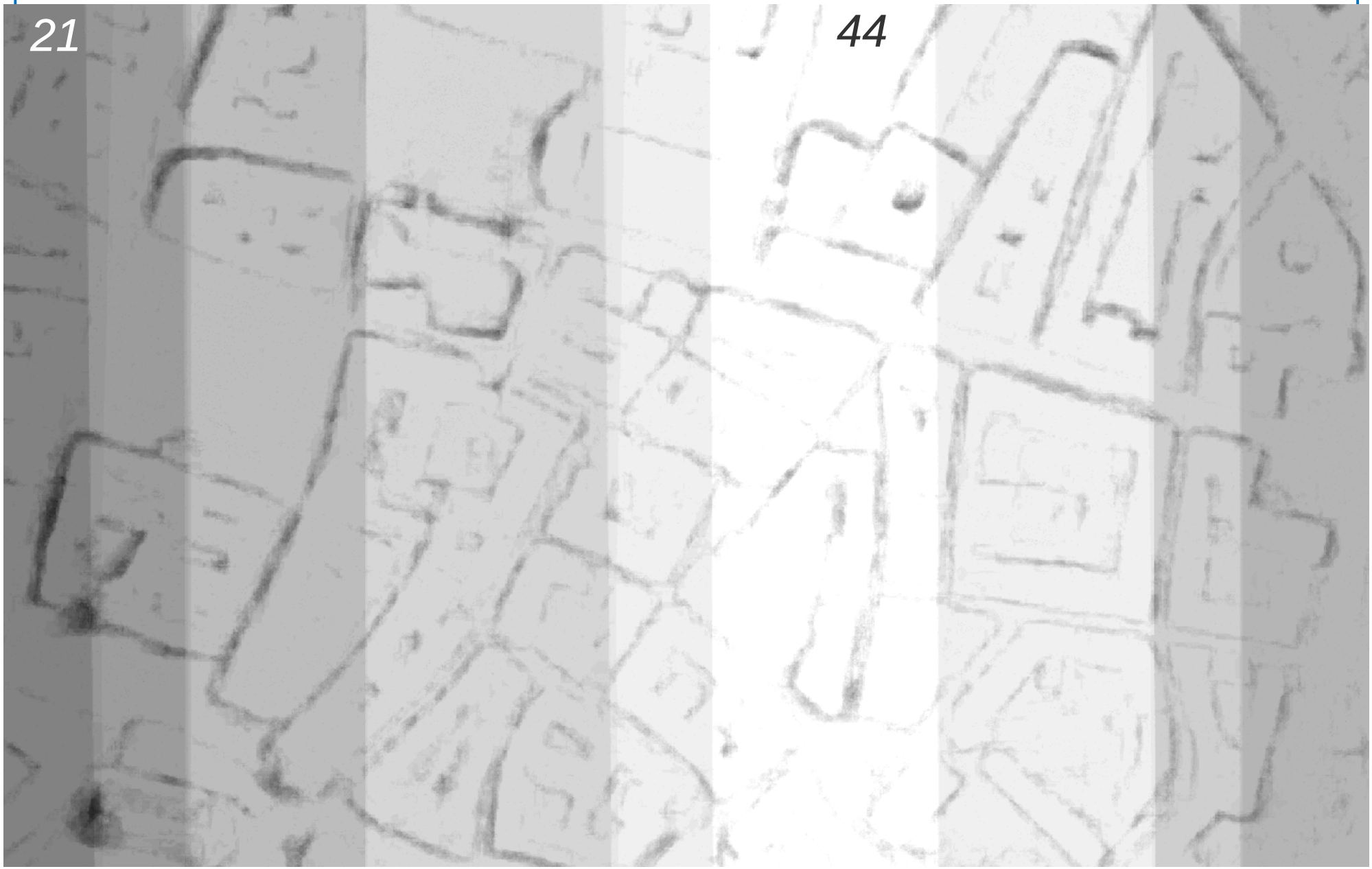
Comparison: **Match-T-direct** vs. Fusion

Comparison: Match-T-direct vs. **Fusion**

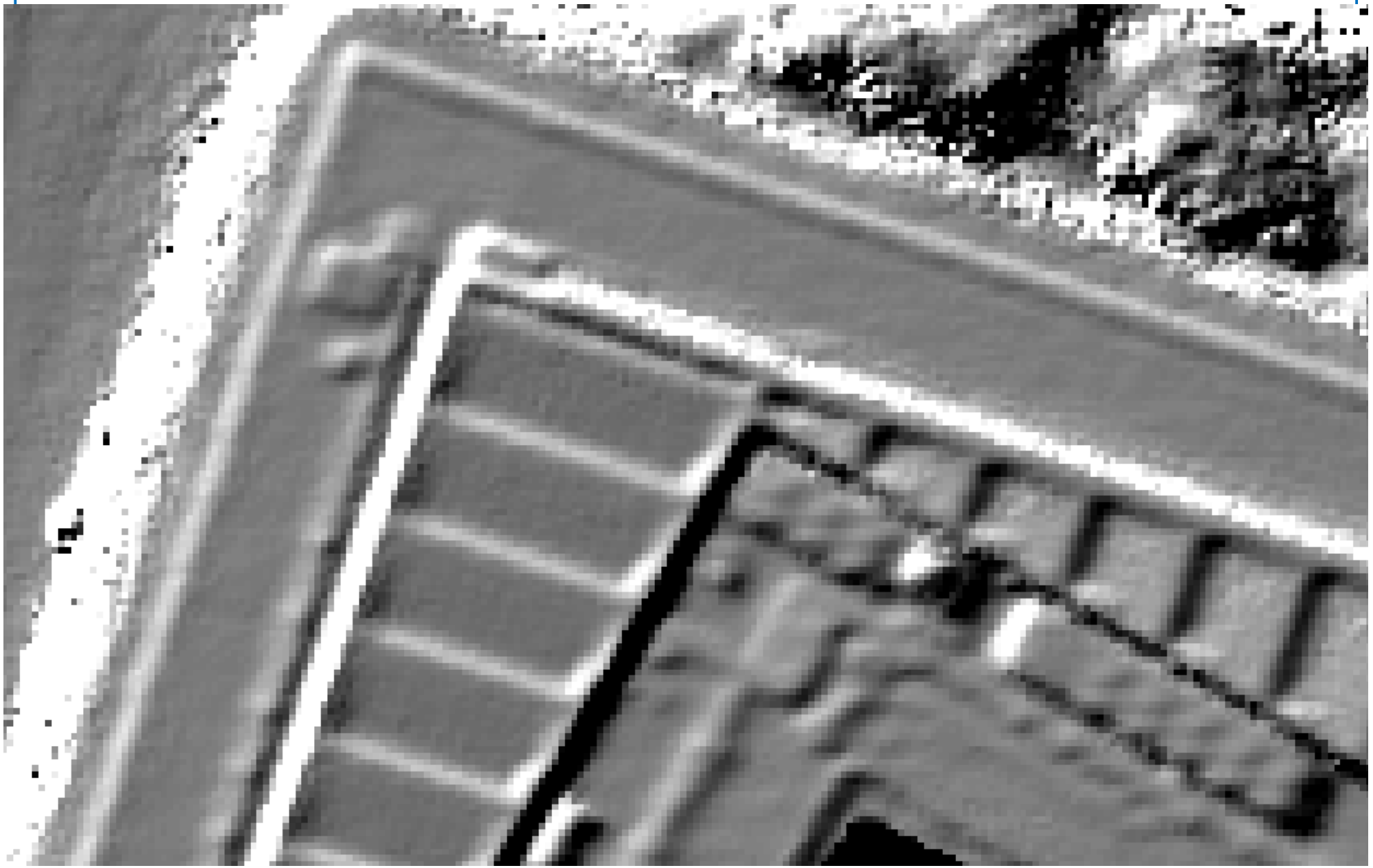
Add on: Standard Deviation of Fusion



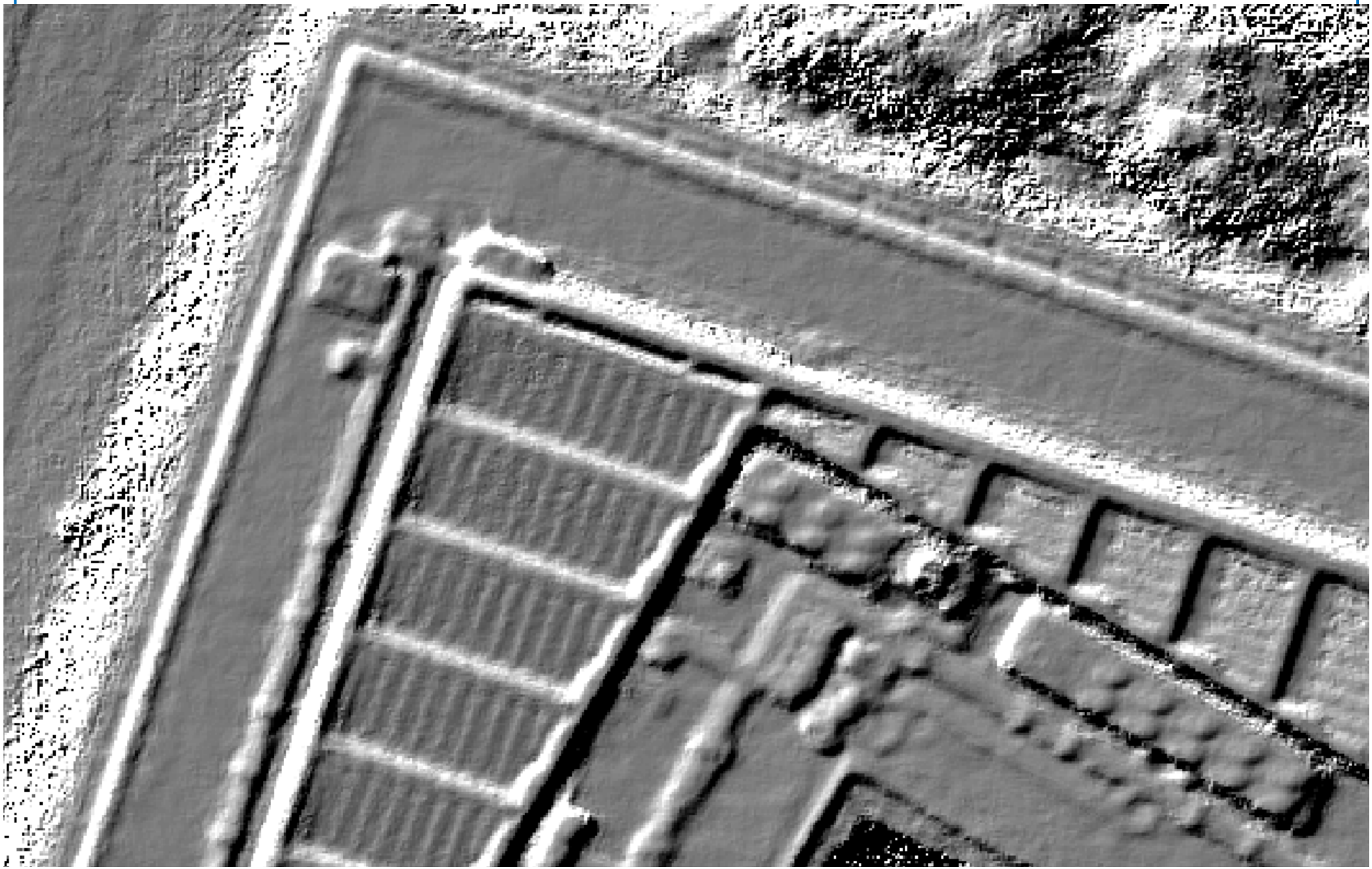
Fusion: number of DSMs (i.e. image pairs)



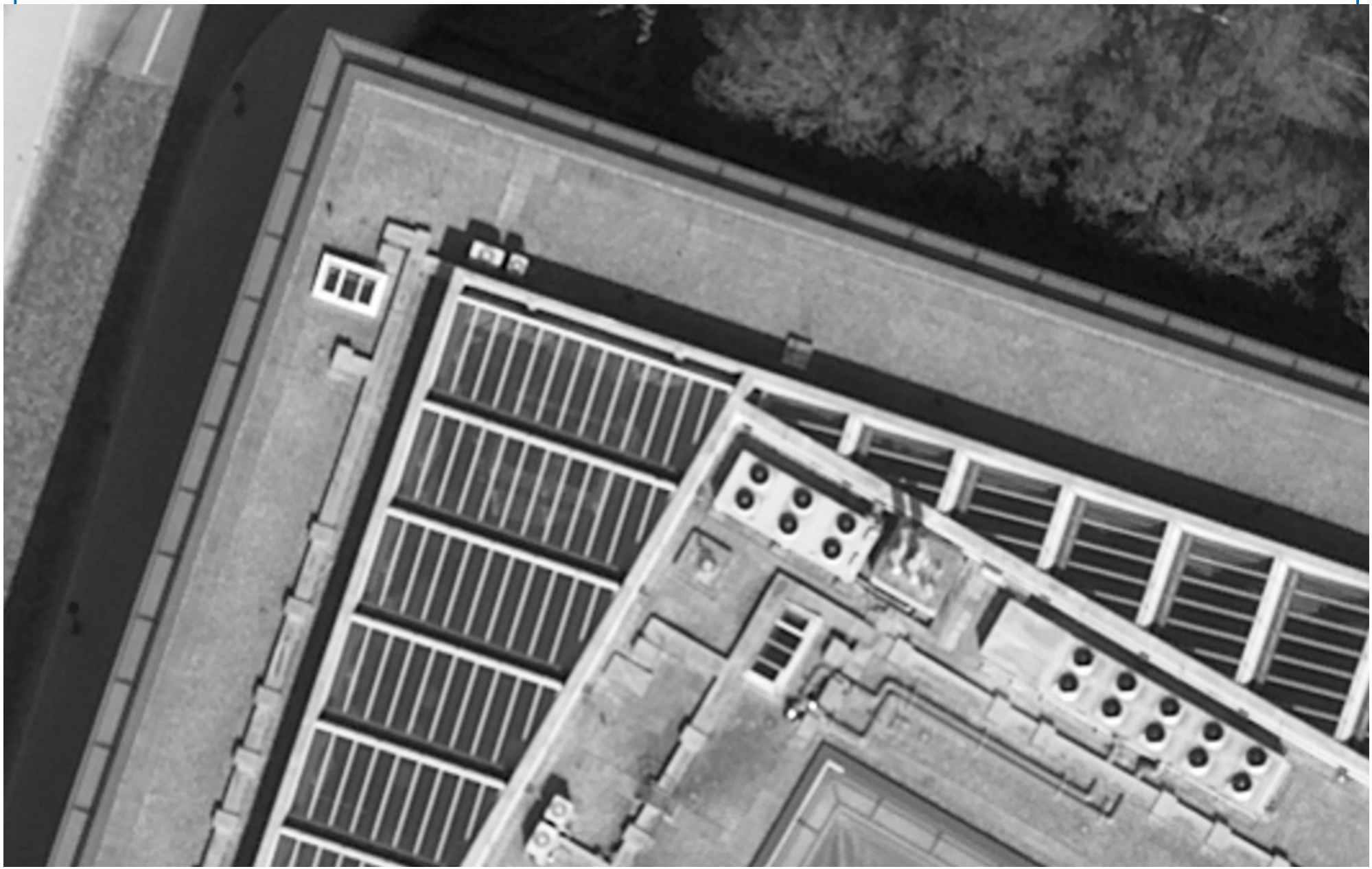
Munich: image GSD 10cm, Grid **25**cm



Munich: image GSD 10cm, Grid **10**cm



Munich: image GSD 10cm



Munich: Hardware & Runtime

- Processor: Intel Core i7 CPU, 3GHz, 8 cores; Memory: 8GB; 15 images on net drive
- Processing times for grid width = GSD = 10cm

	Fusion (all)	Fusion (minimum)
In strip: 20%	3 pairs	
In strip: 40%	6 pairs	
In strip: 60%	9 pairs	9 pairs
In strip: 80%	12 pairs	12 pairs
Across strip: 60%	5 pairs	
Across strip: 80%	10 pairs	
Matching*	19 h	10 h
Import++	5 h	3 h
Gridding++	29 h	14 h
Fusion++	4 h	3 h

Software used: * Match-T ++ Opals

Vaihingen: Hardware & Runtime

- Processor: Intel Core i7 CPU, 3GHz, 8 cores; Memory: 8GB;
  36 images on net drive
- Processing times for grid width = GSD = 20cm

	Fusion (all)	No Fusion (= Match-T direct)
In strip: 20%	30 pairs	
In strip: 60%	33 pairs	
Across strip: 20%	12 pairs	
Across strip: 60%	24 pairs	
Matching*	23 h	4 h
Import++	5 h	1 h
Gridding++	23 h	7 h
Fusion++	10 h	

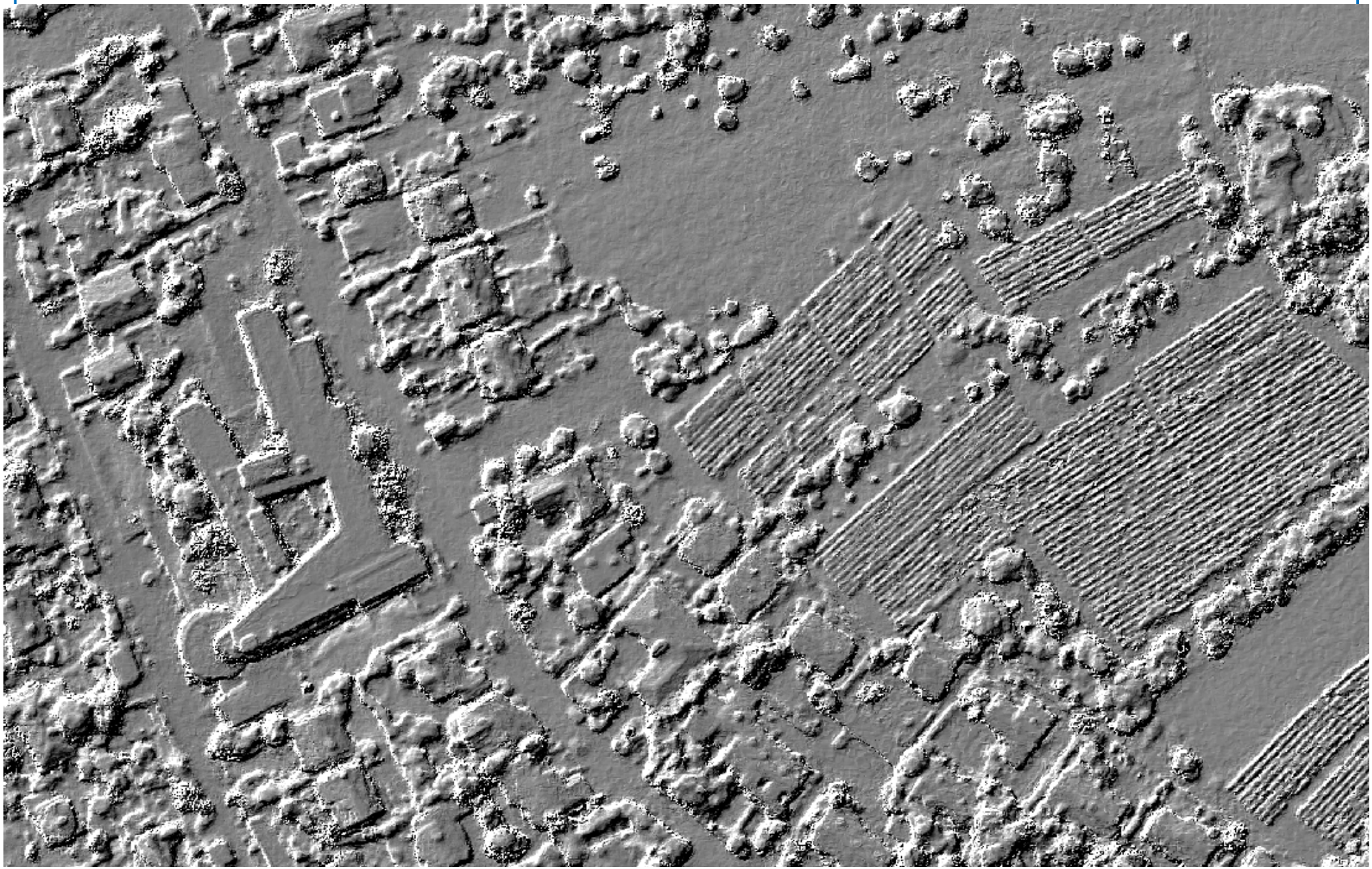
Software used: * Match-T ++ Opals

Conclusion

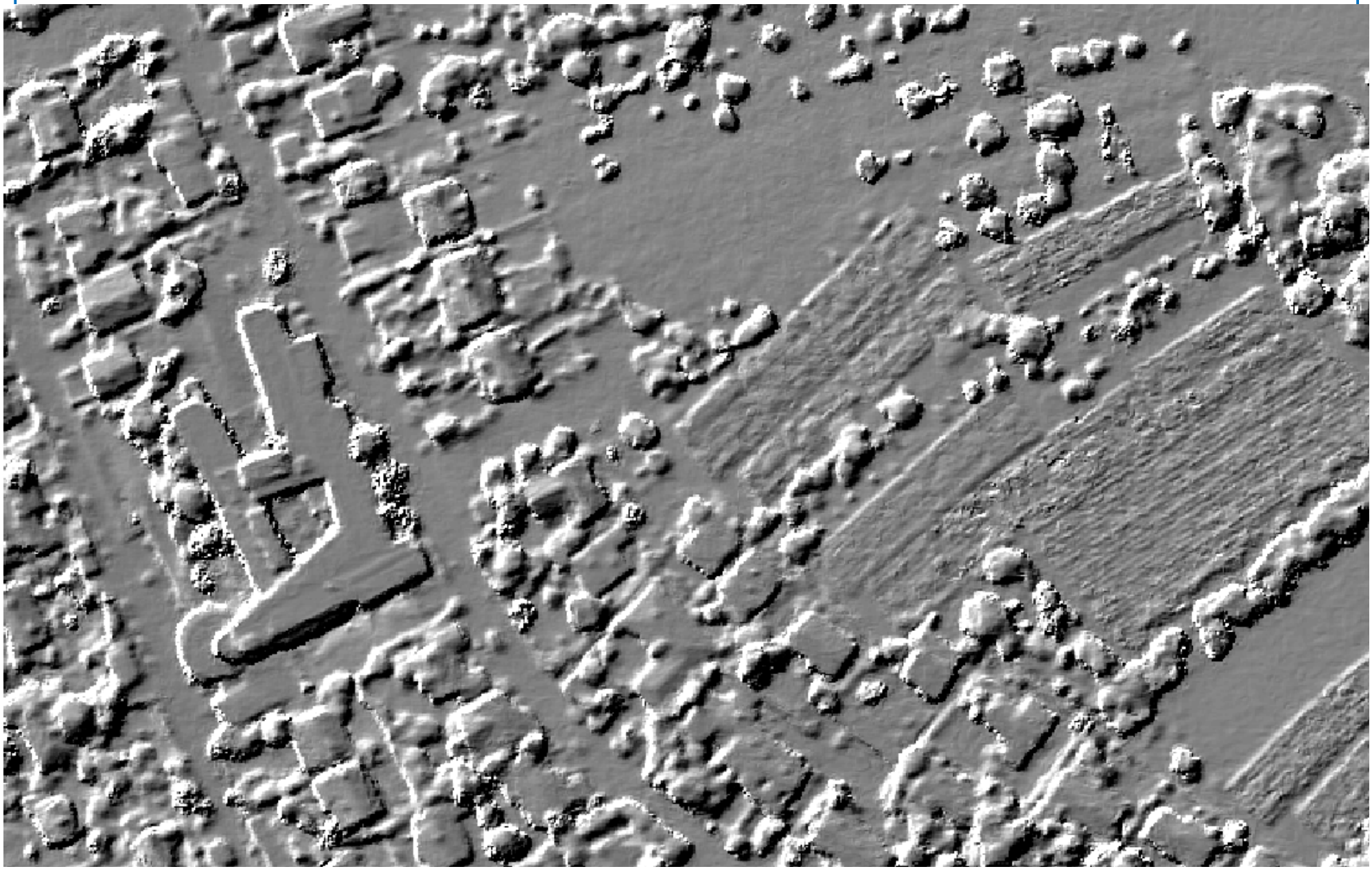
- Match-T: dense Matching ~ SGM
- Match-T direct: very fast, but no multi image matching
- Pseudo multi image possible by pair wise matching and DSM fusion
- Details of fusion are subject of future research:
  - selection of pairs with which overlap(s)?
  - only within strip, or also across strip?
  - method of fusion in city areas?
  - All above not necessary, because Inpho comes up with own fusion method?
- Grid width == GSD not useful, factor 2 or 3 seams appropriate

- Take care of homogenous image overlap! **à** use 75%, 80%, …

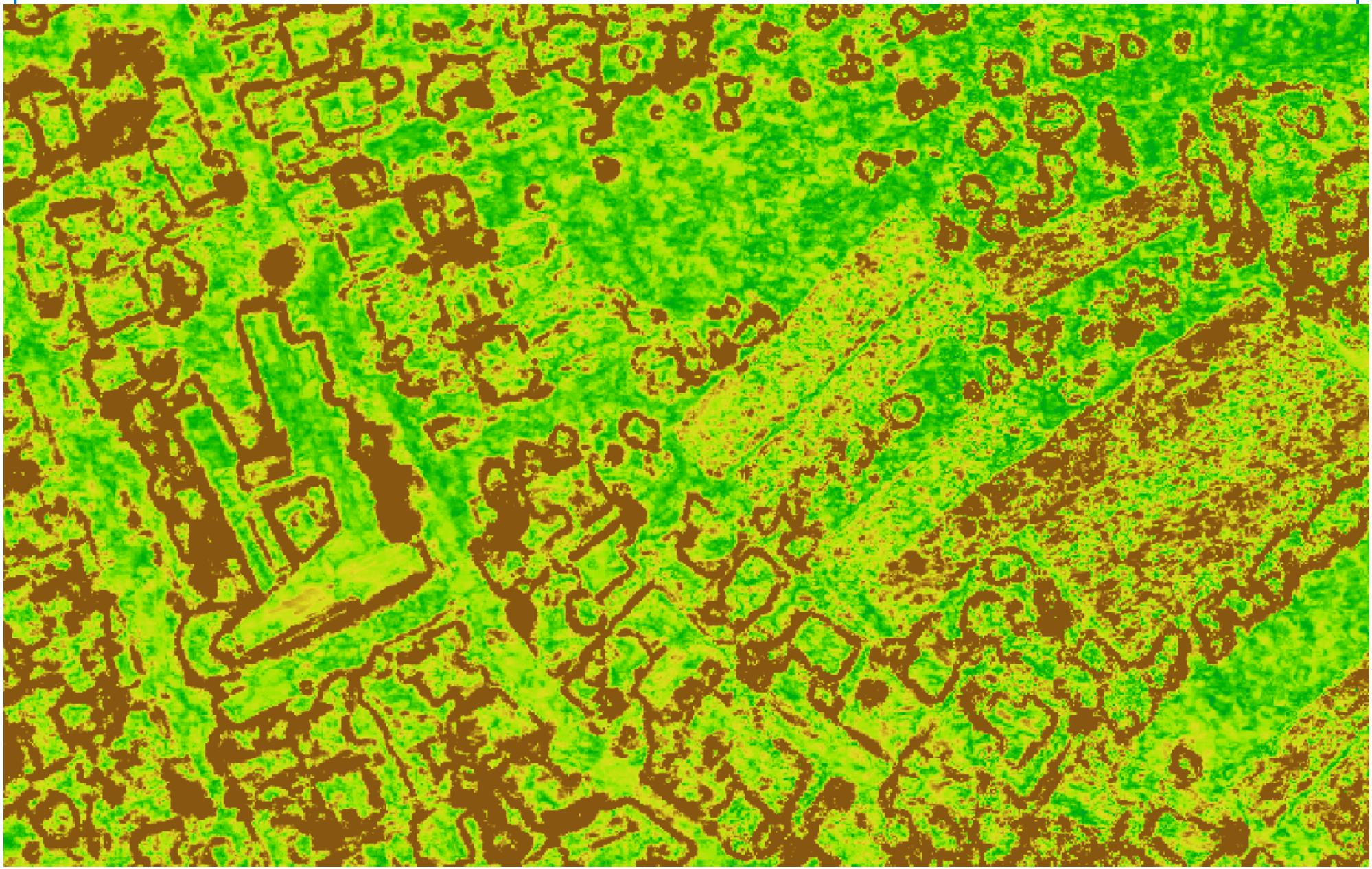
Vaihingen: image GSD 20cm, Grid **20**cm



Vaihingen: image GSD 20cm, Grid **50**cm

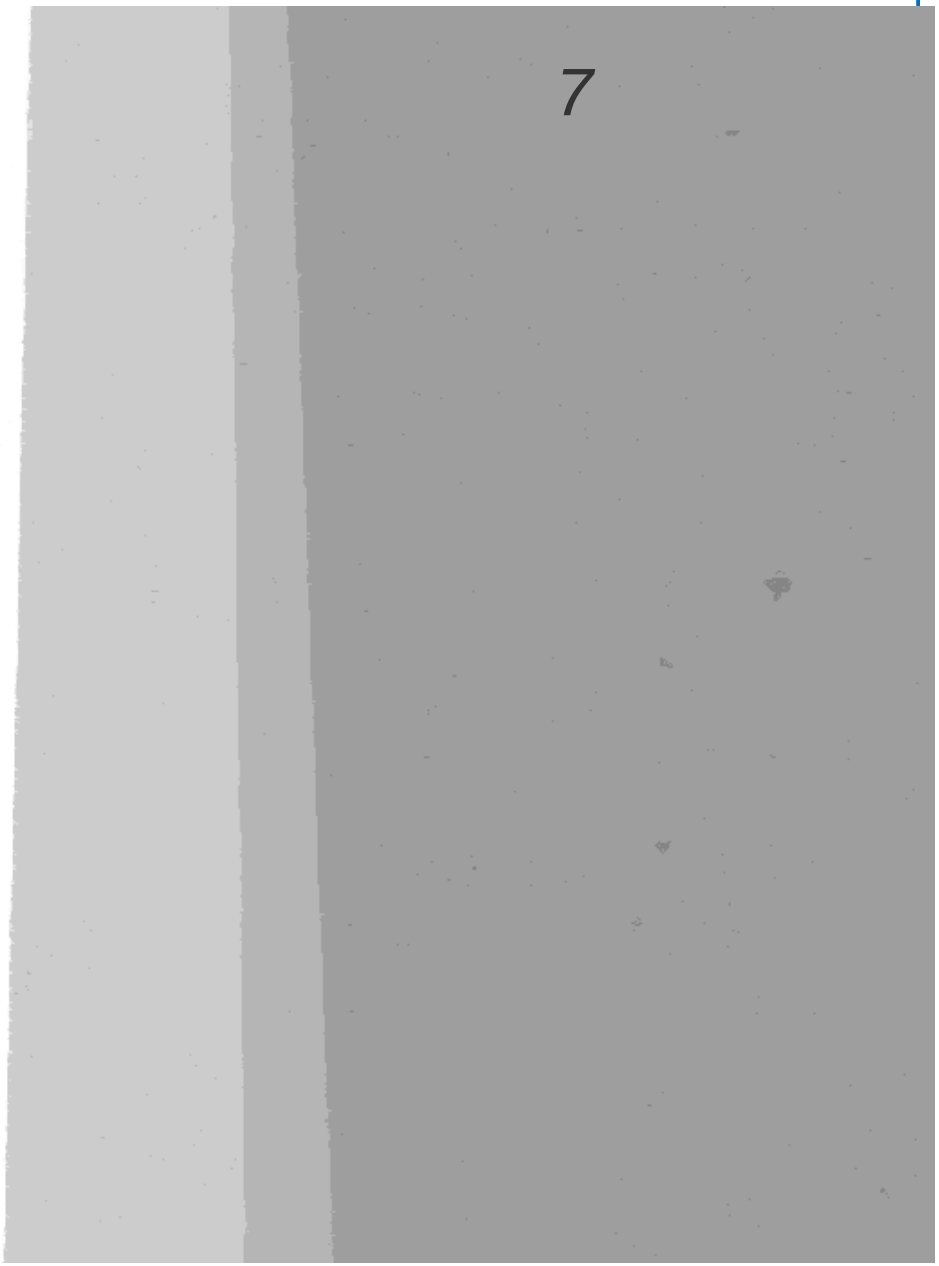


Vaihingen: Standard Deviation of Fusion



Vaihingen: number of DSMs (i.e. image pairs)

12



Vaihingen: image GSD 20cm, Grid **50**cm (Match-T direct)