

Multiple View Geometry

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Exercises: Julia Bergbauer & Jakob Engel



Reconstructing the World from Images

Some Recent Developments

Reconstruction from Aerial Images



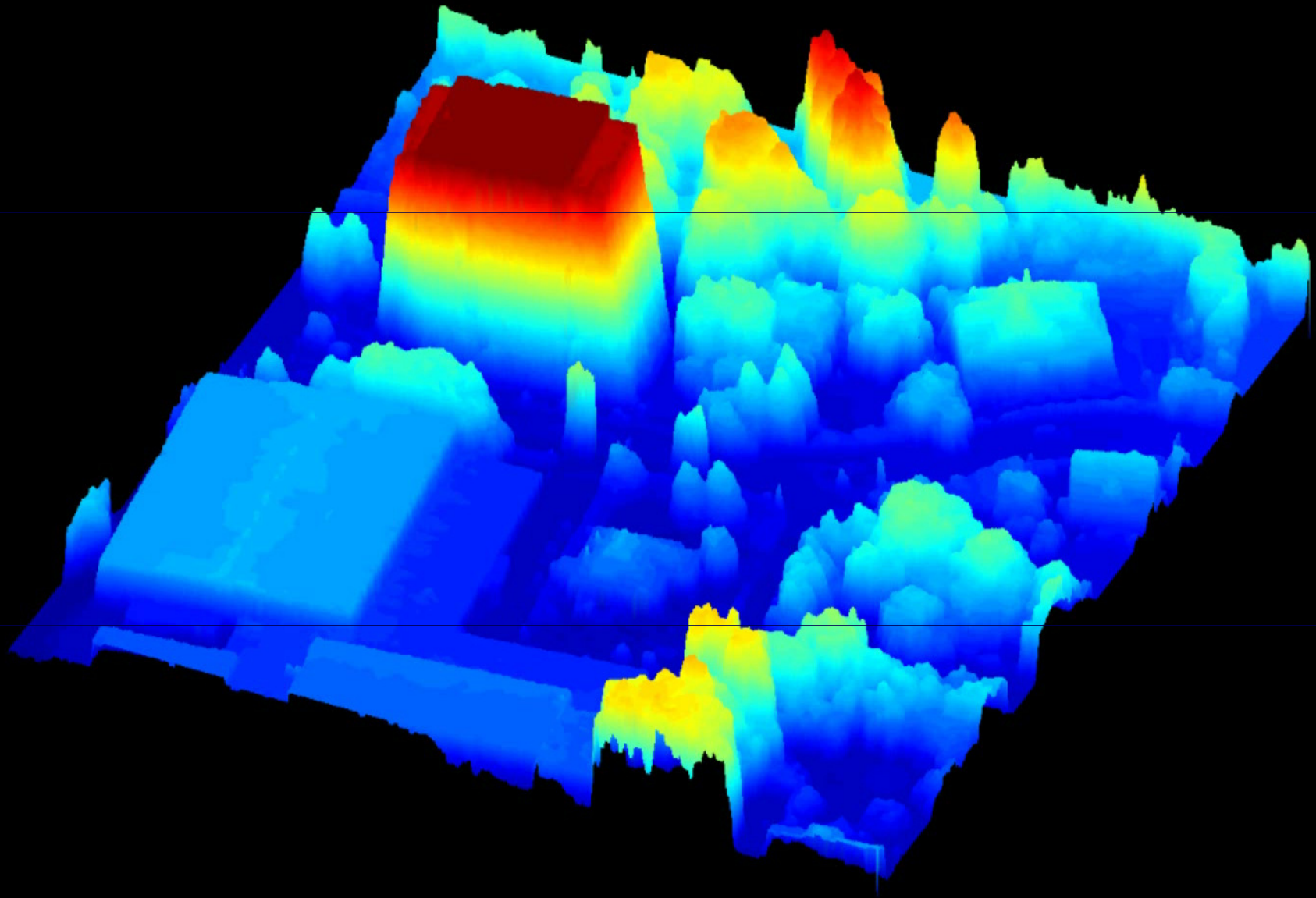
One of two input images



Depth reconstruction

Pock, Schoenemann, Graber, Bischof, Cremers, ECCV '08

Reconstruction from Aerial Images



Application: Driver Assistance

Original left image



Toward Free View-Point Television



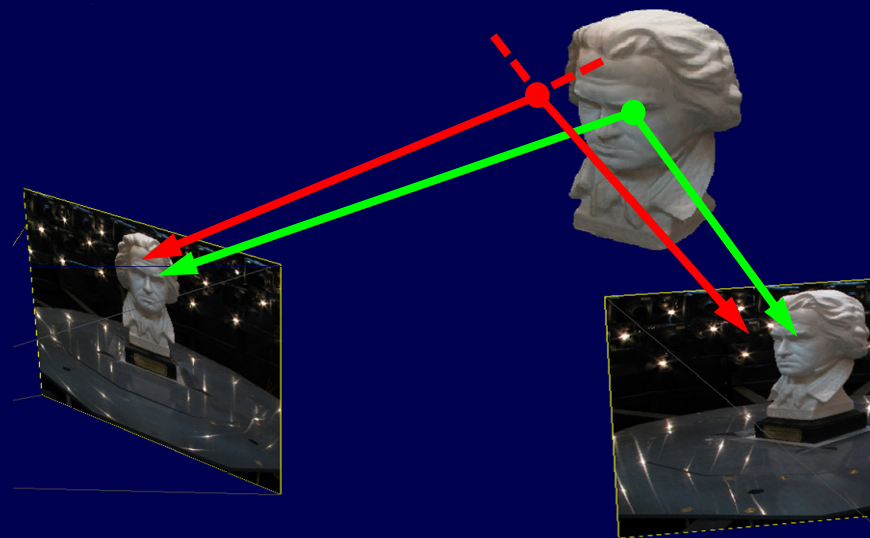
Multiple View Reconstruction



Solutions via Energy Minimization

Photoconsistency function:

$$\rho : \mathbb{R}^3 \rightarrow [0, 1]$$



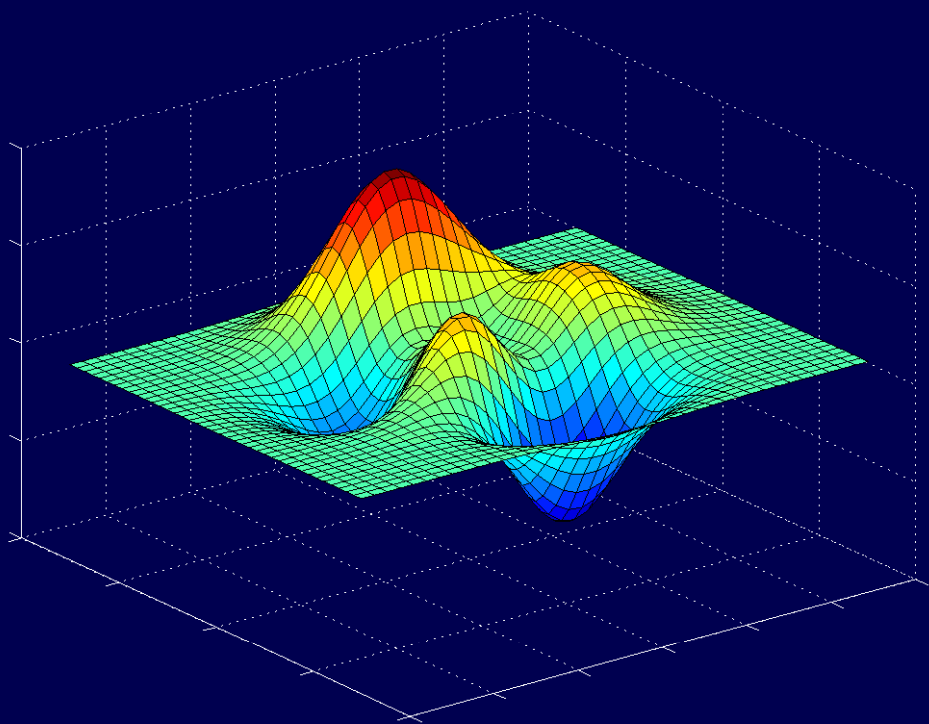
Determine a surface S of optimal photoconsistency by minimizing

$$E(S) = \int_S \rho \, dA$$

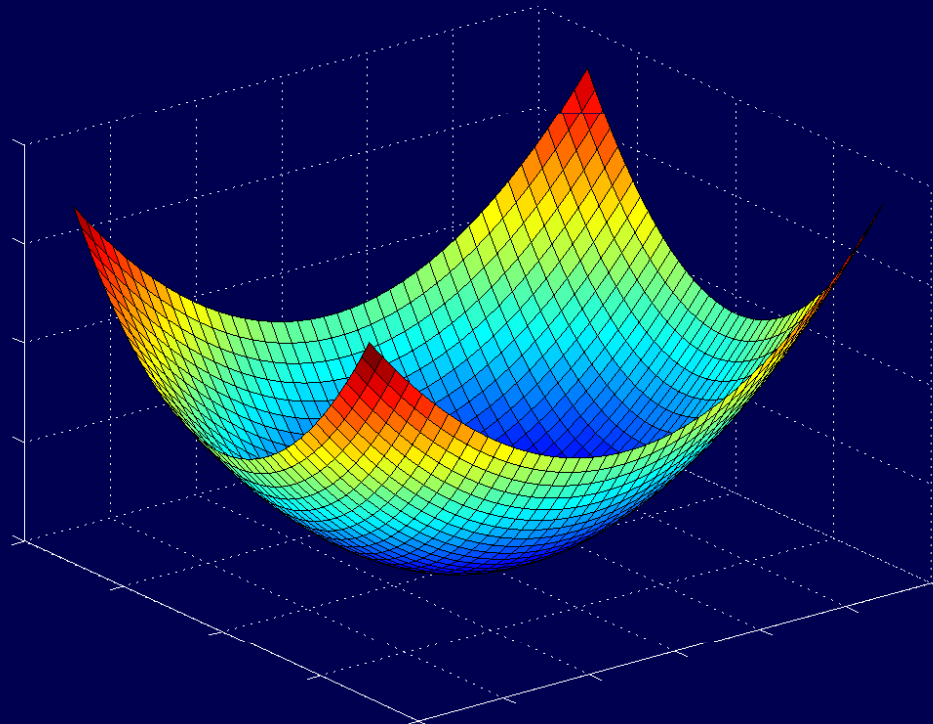
Kolev, Klodt, Brox, Cremers, Int. J. of Computer Vision '09:

Theorem: Globally optimal surfaces can be computed via convex relaxation.

Solutions via Energy Minimization

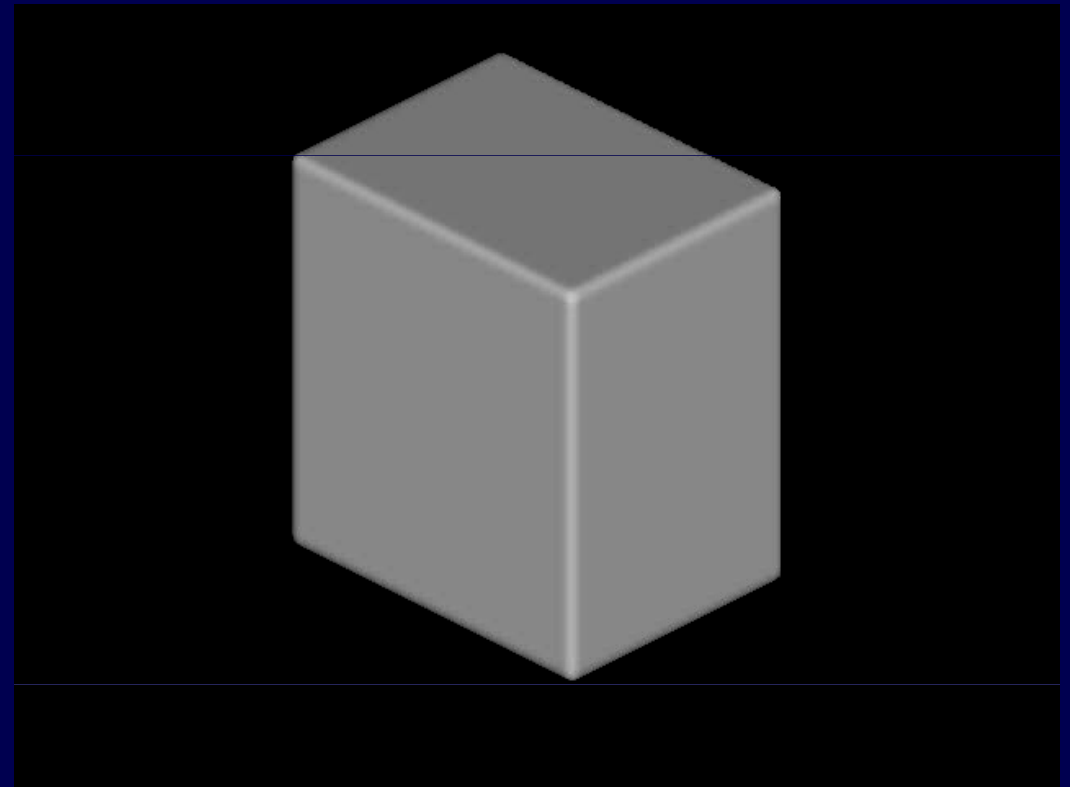


Non-convex energy



Convex energy

3D Reconstruction



Kolev et al., Int. J. of Computer Vision 2009

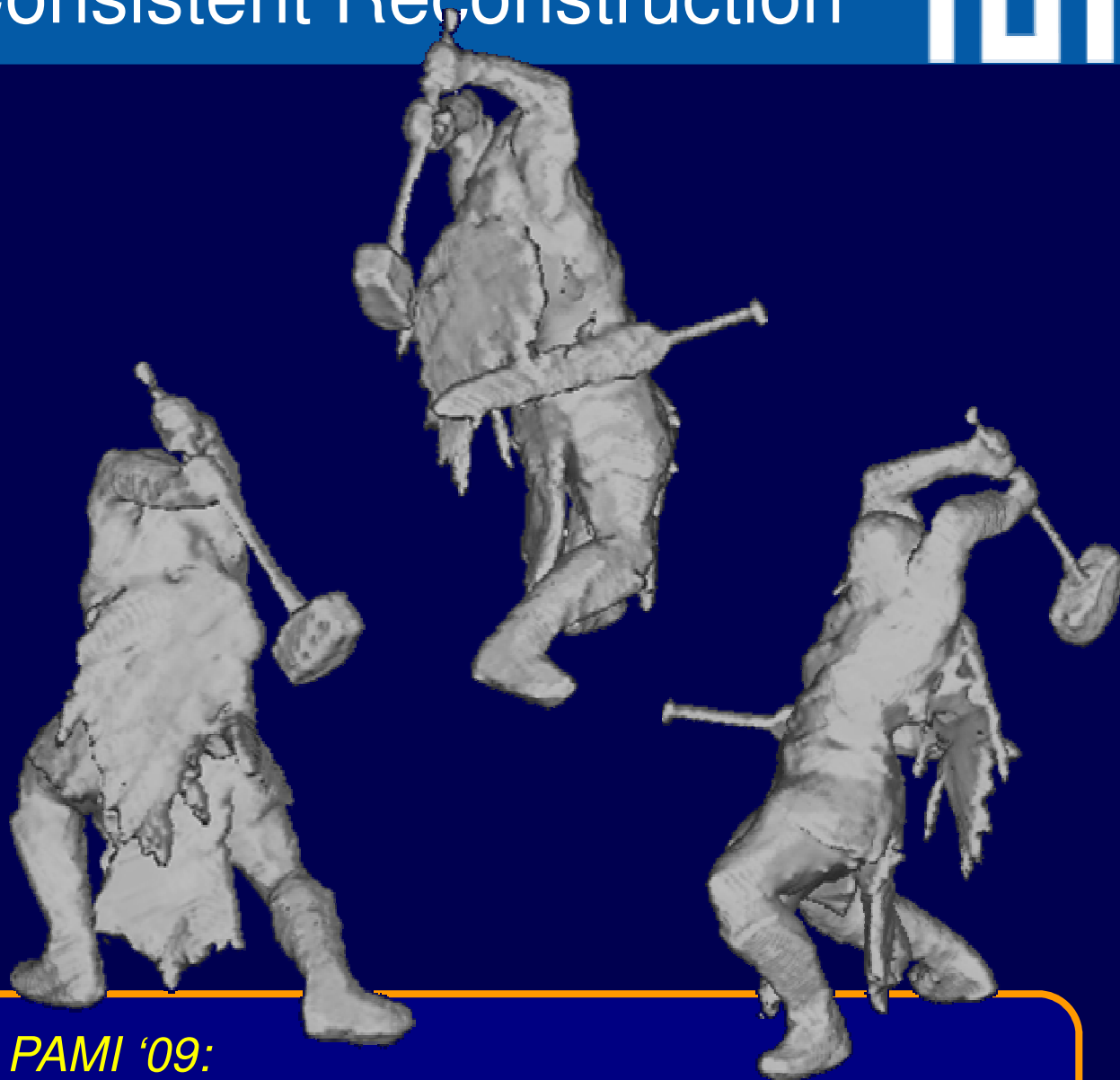
Textured 3D Reconstruction



*Goldlücke, Cremers, ICCV '09, DAGM '09**

** Best Paper Award*

Silhouette Consistent Reconstruction



Kolev, Cremers, ECCV '08, PAMI '09:

Theorem: Provably silhouette-consistent reconstructions can be computed by convex optimization over convex domains.



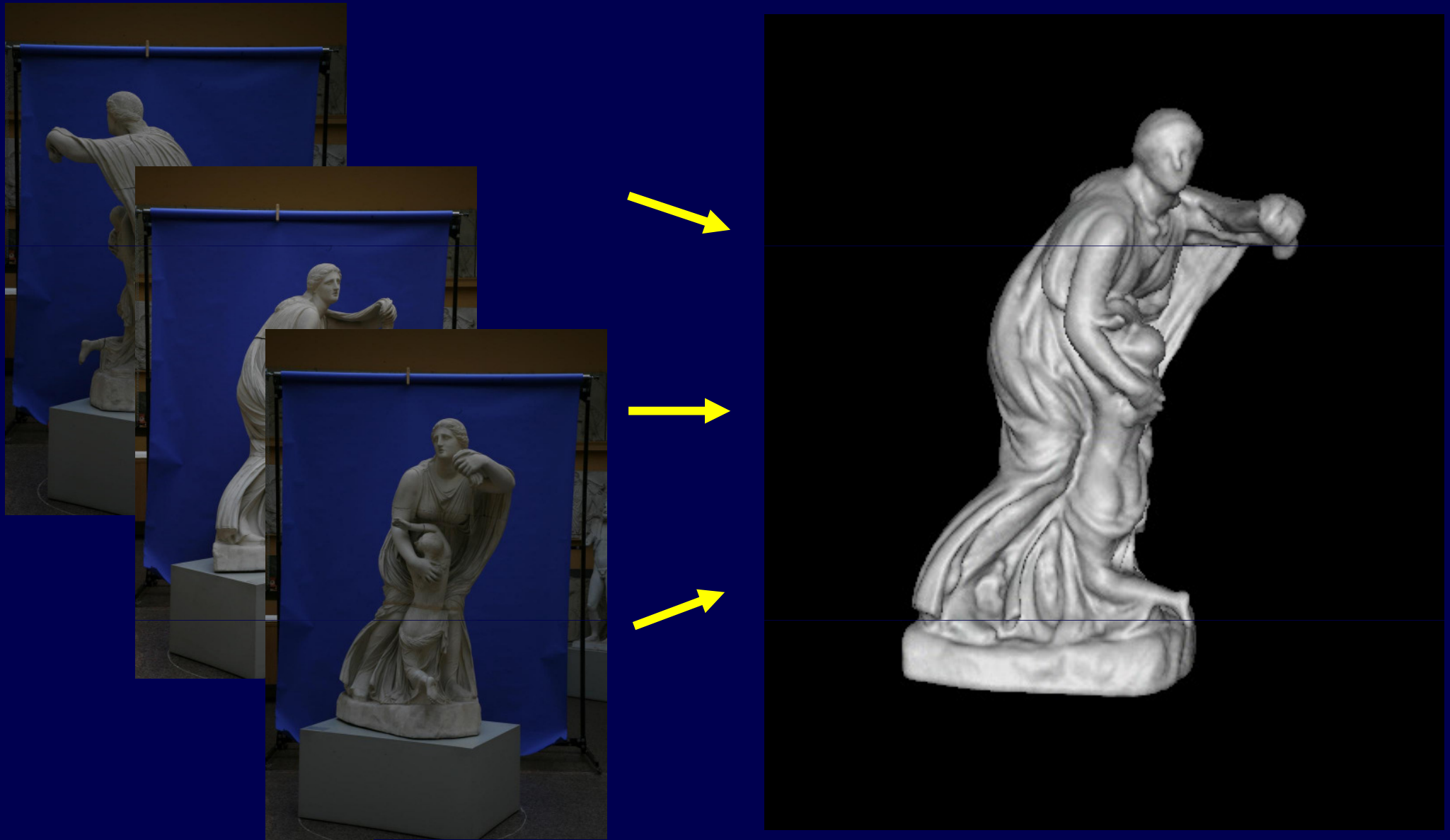
Reconstructing the Niobids Statues



Kolev, Cremers, ECCV '08, PAMI '12



Reconstructing the Niobids Statues



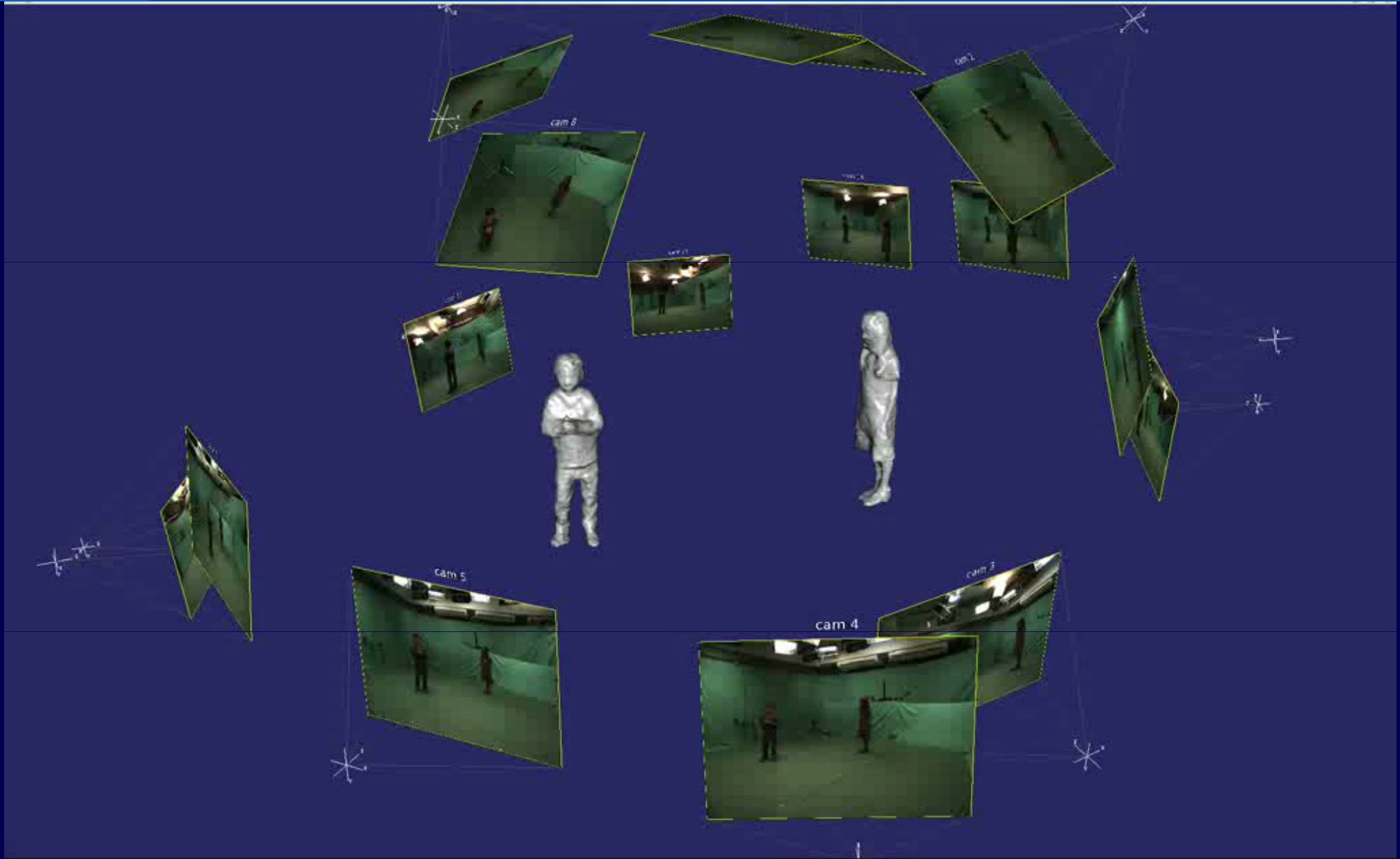
Kolev, Cremers, ECCV '08, PAMI '12

Reconstructing the Niobids Statues



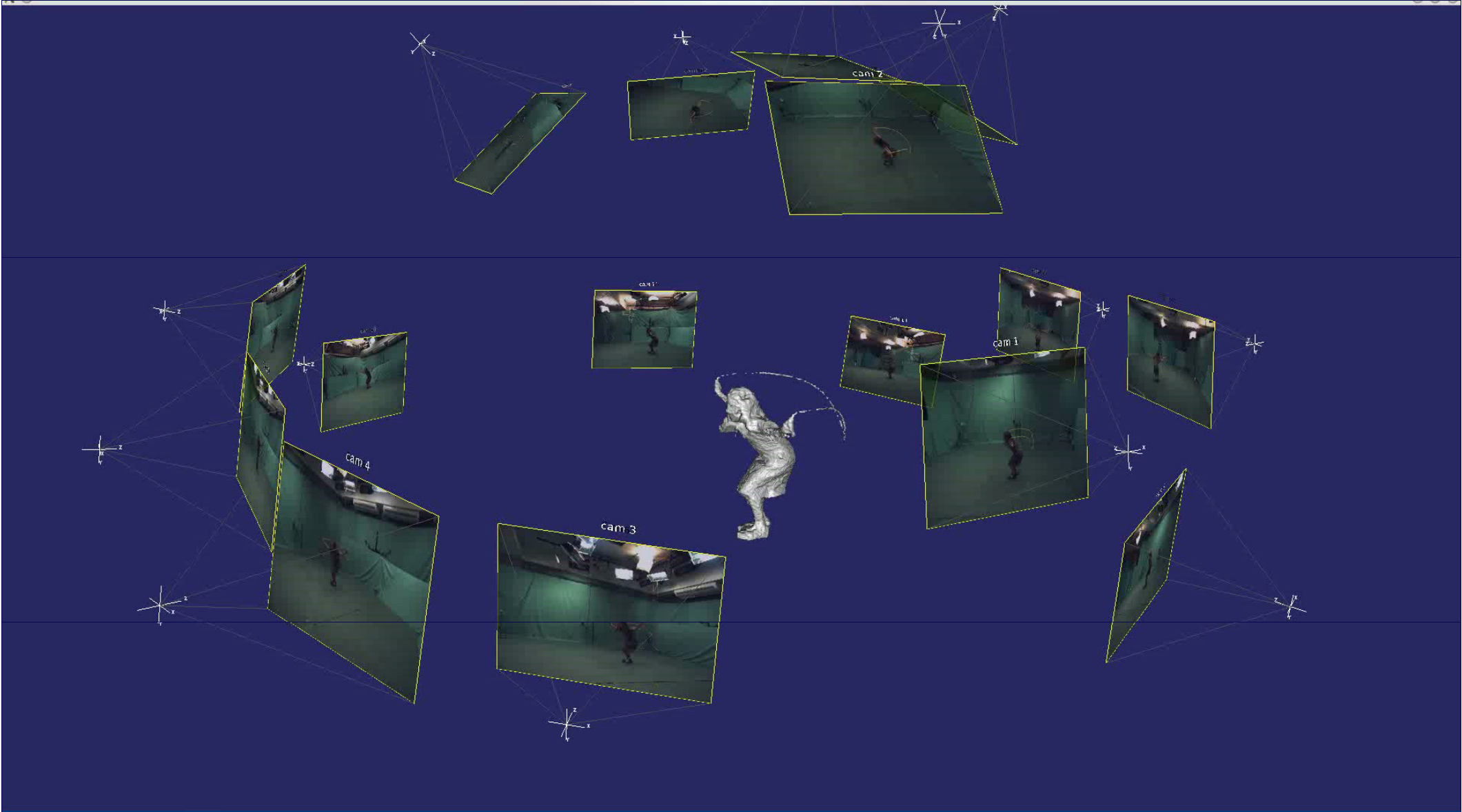
Kolev, Cremers, ECCV '08, PAMI '12

Action Reconstruction



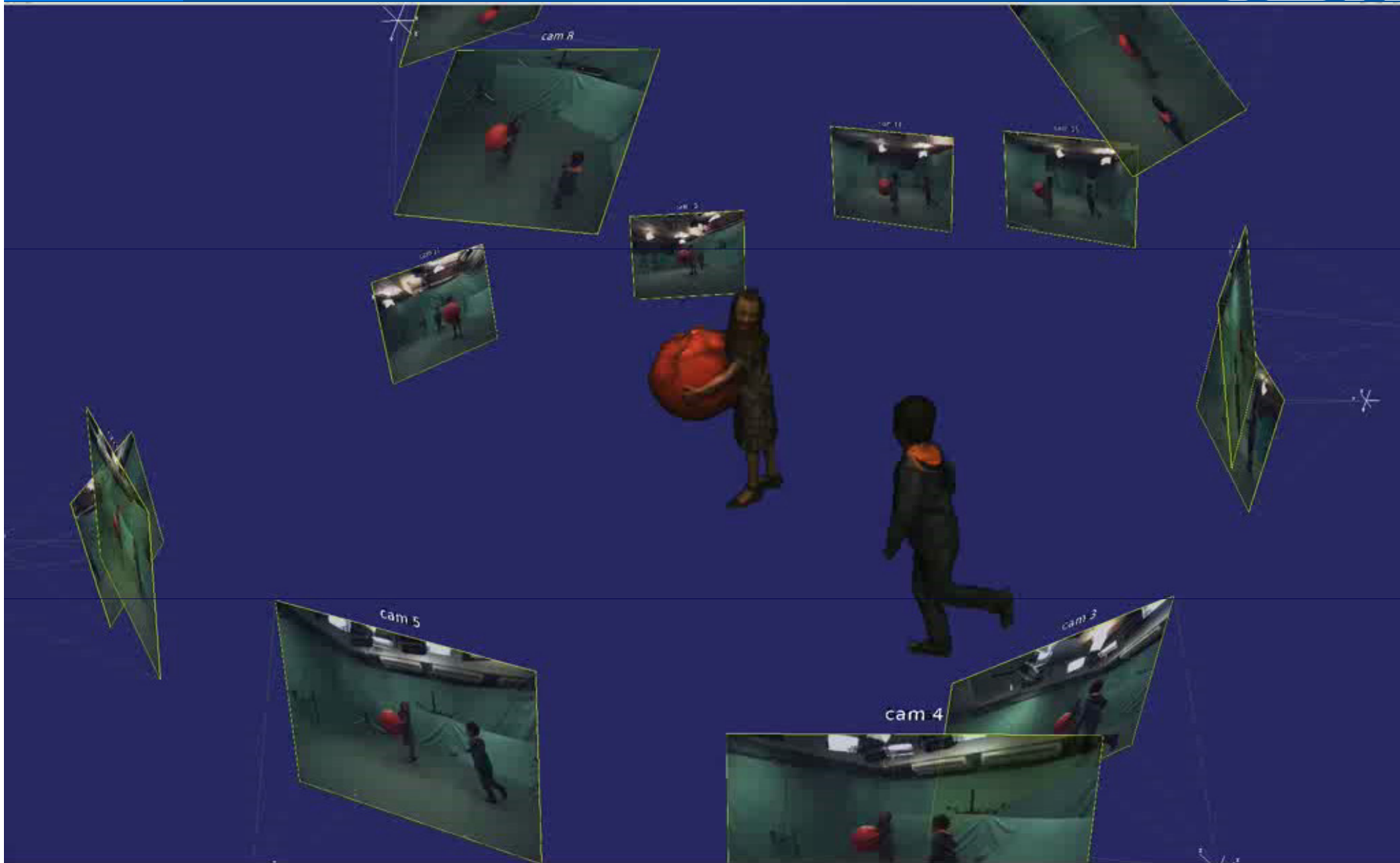
Oswald, Cremers, ICCV '13 4DMoD Workshop

Action Reconstruction



Oswald, Cremers, ICCV '13 4DMoD Workshop

Action Reconstruction



Action Reconstruction



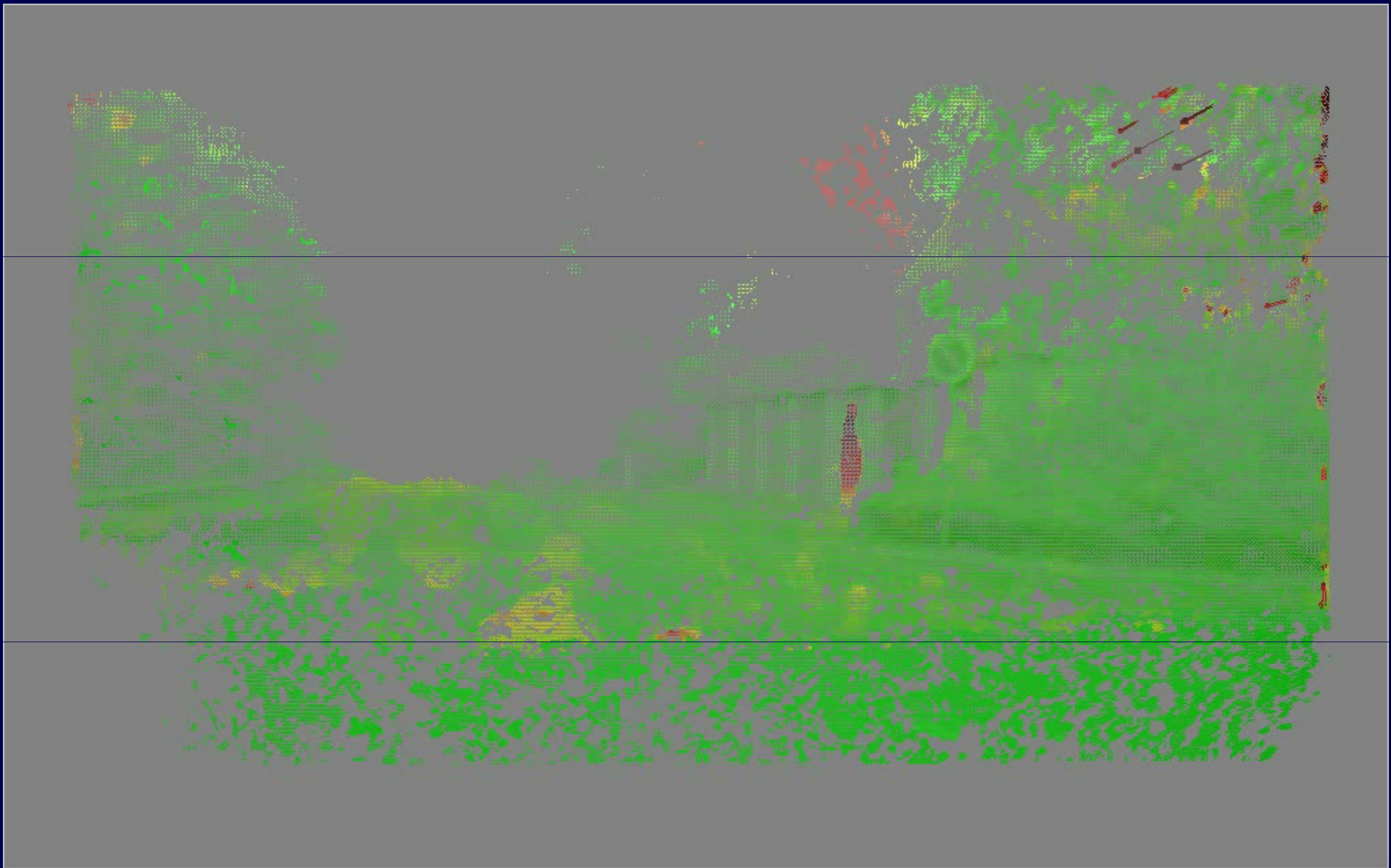
Application: Driver Assistance



Wedel, Cremers, "Scene Flow", Springer 2011

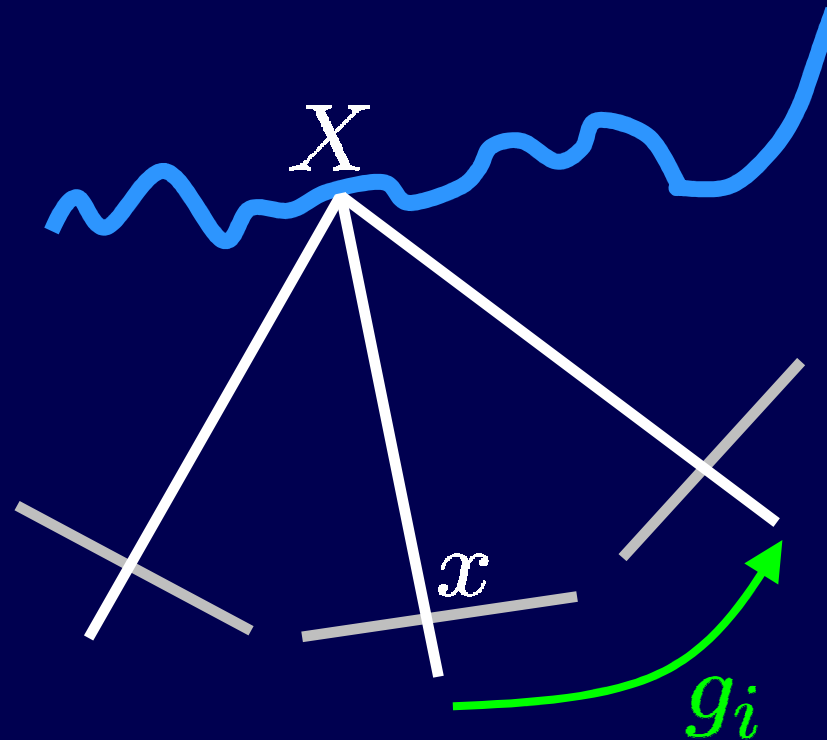


Wedel, Cremers, "Scene Flow", Springer 2011



Wedel, Cremers, "Scene Flow", Springer 2011

Realtime 3D Reconstruction



Stuehmer, Gumhold, Cremers, DAGM '10



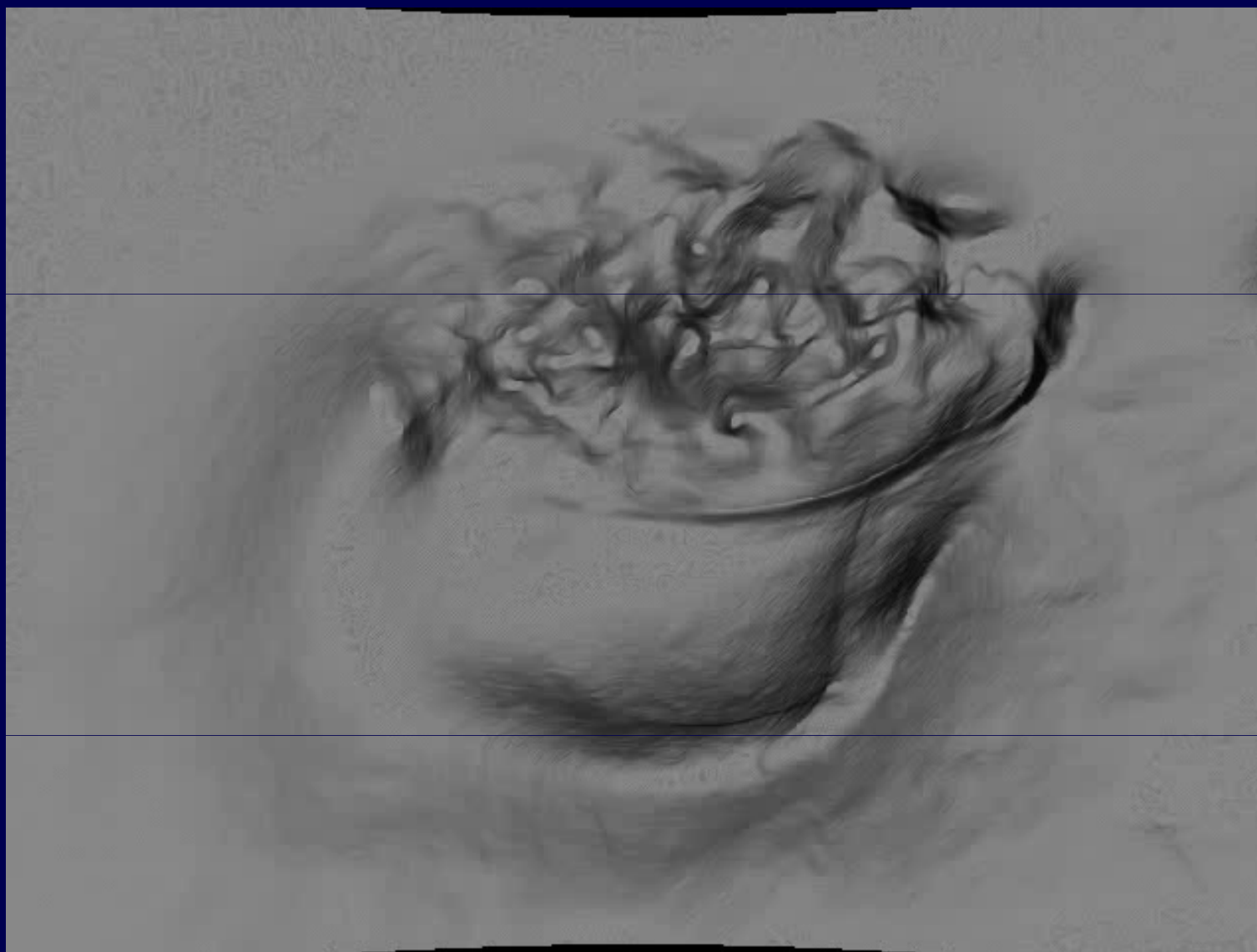
Dense geometry from hand-held camera



Stuehmer, Gumhold, Cremers, DAGM '10

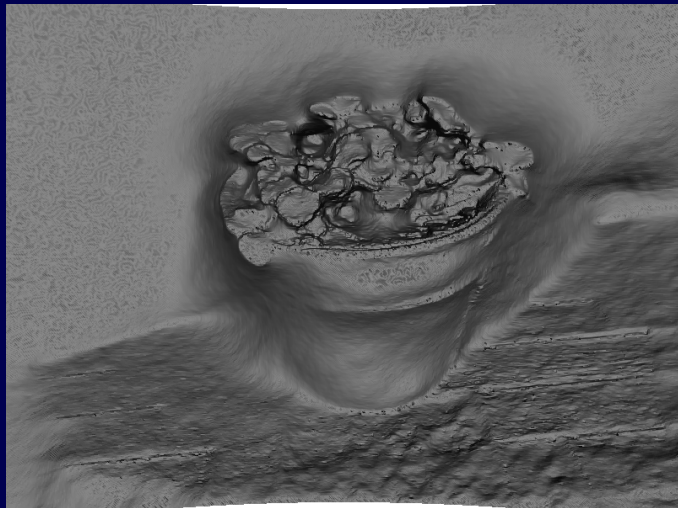


Dense geometry from hand-held camera

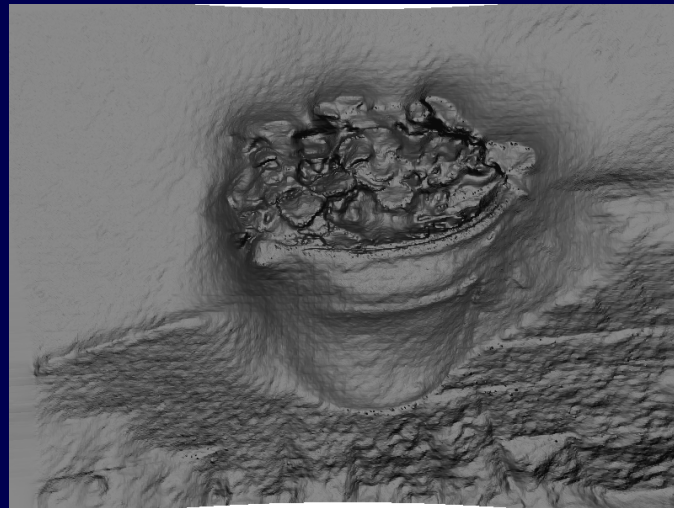


Stuehmer, Gumhold, Cremers, DAGM '10

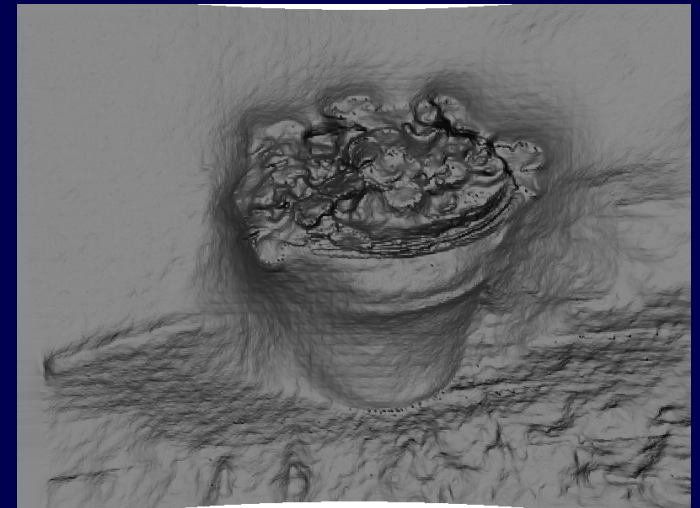
Realtime 3D Reconstruction



1.8 fps



11.3 fps



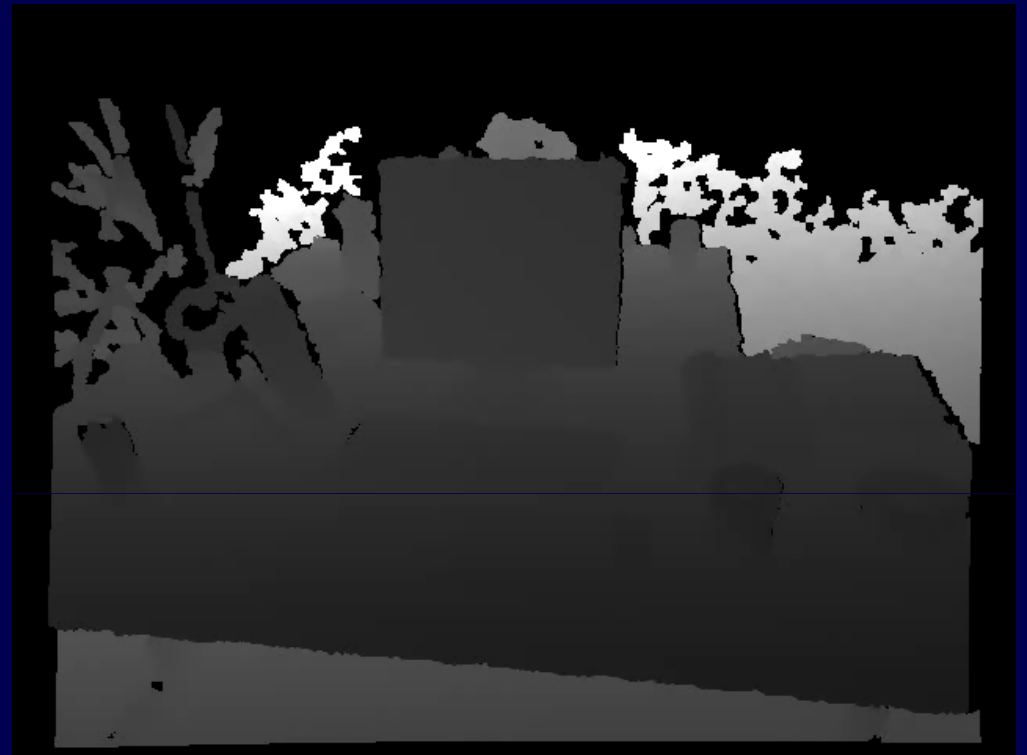
24 fps

Stuehmer, Gumhold, Cremers, DAGM '10

RGB-D Cameras

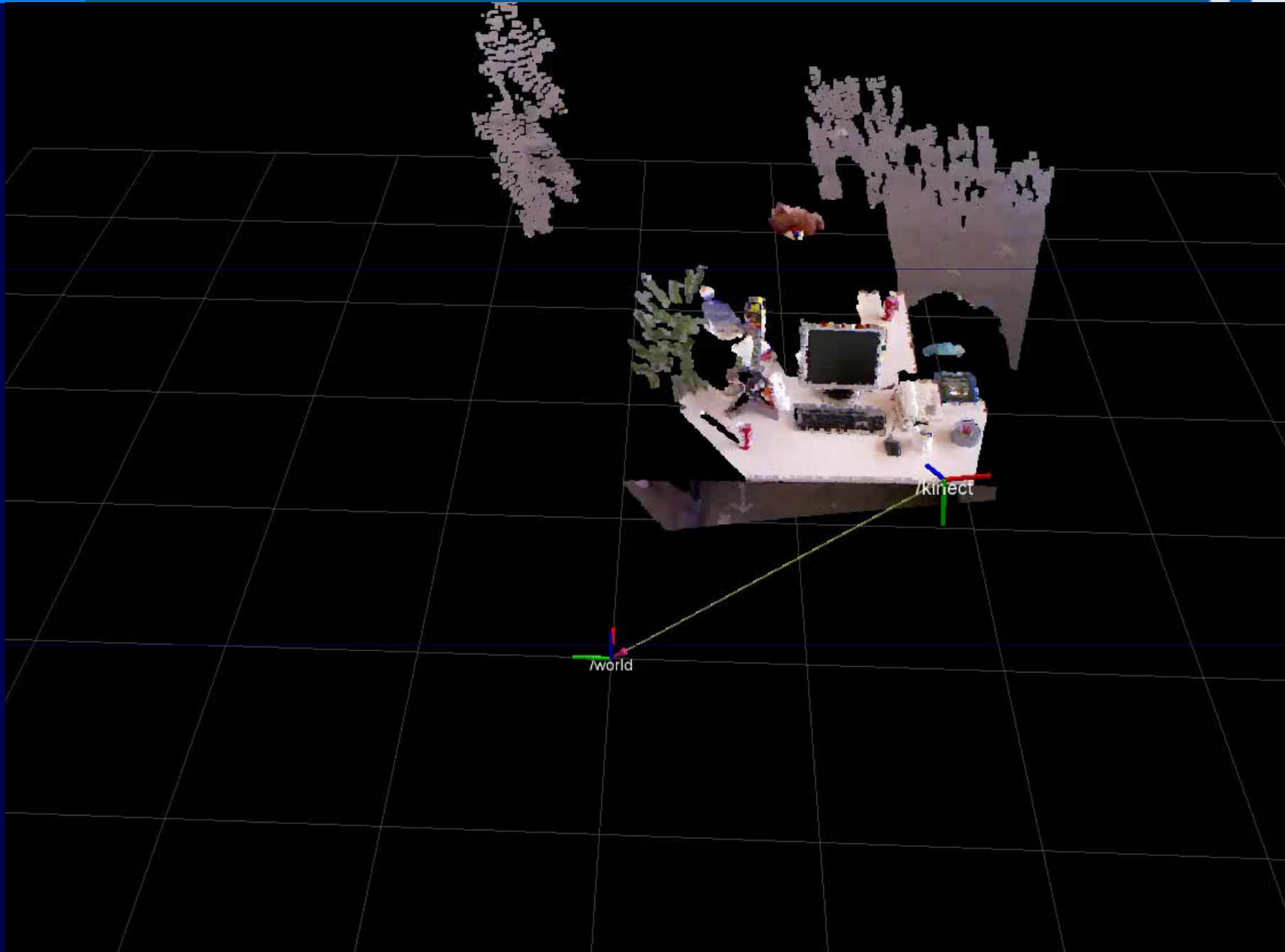


Color input



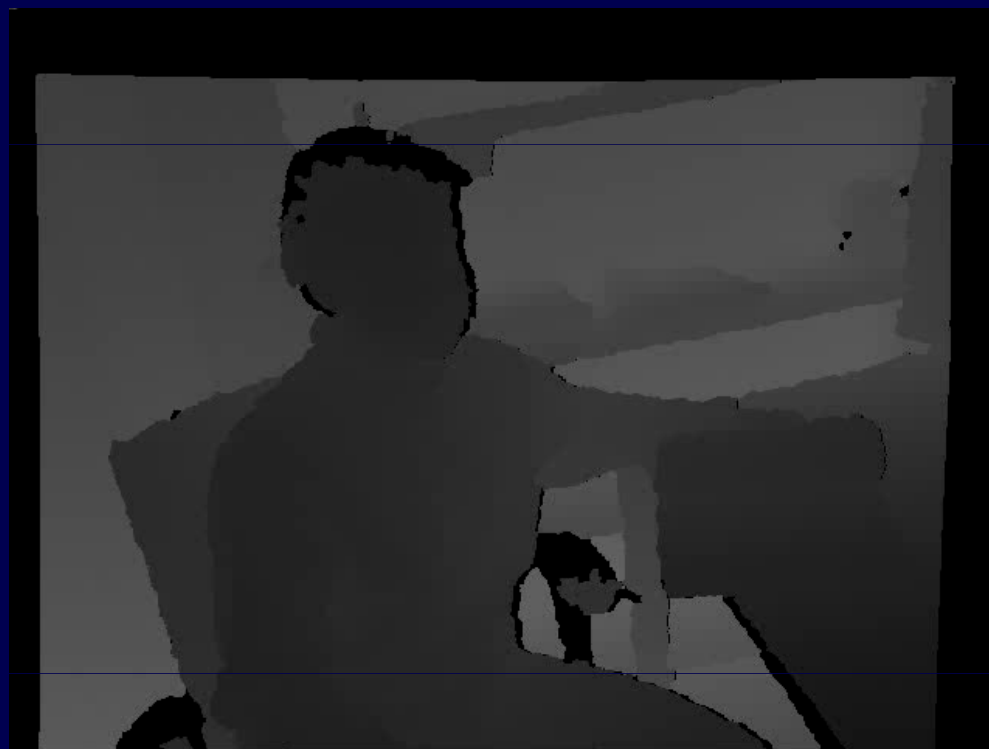
Depth input

Accurate Camera Tracking





Color input

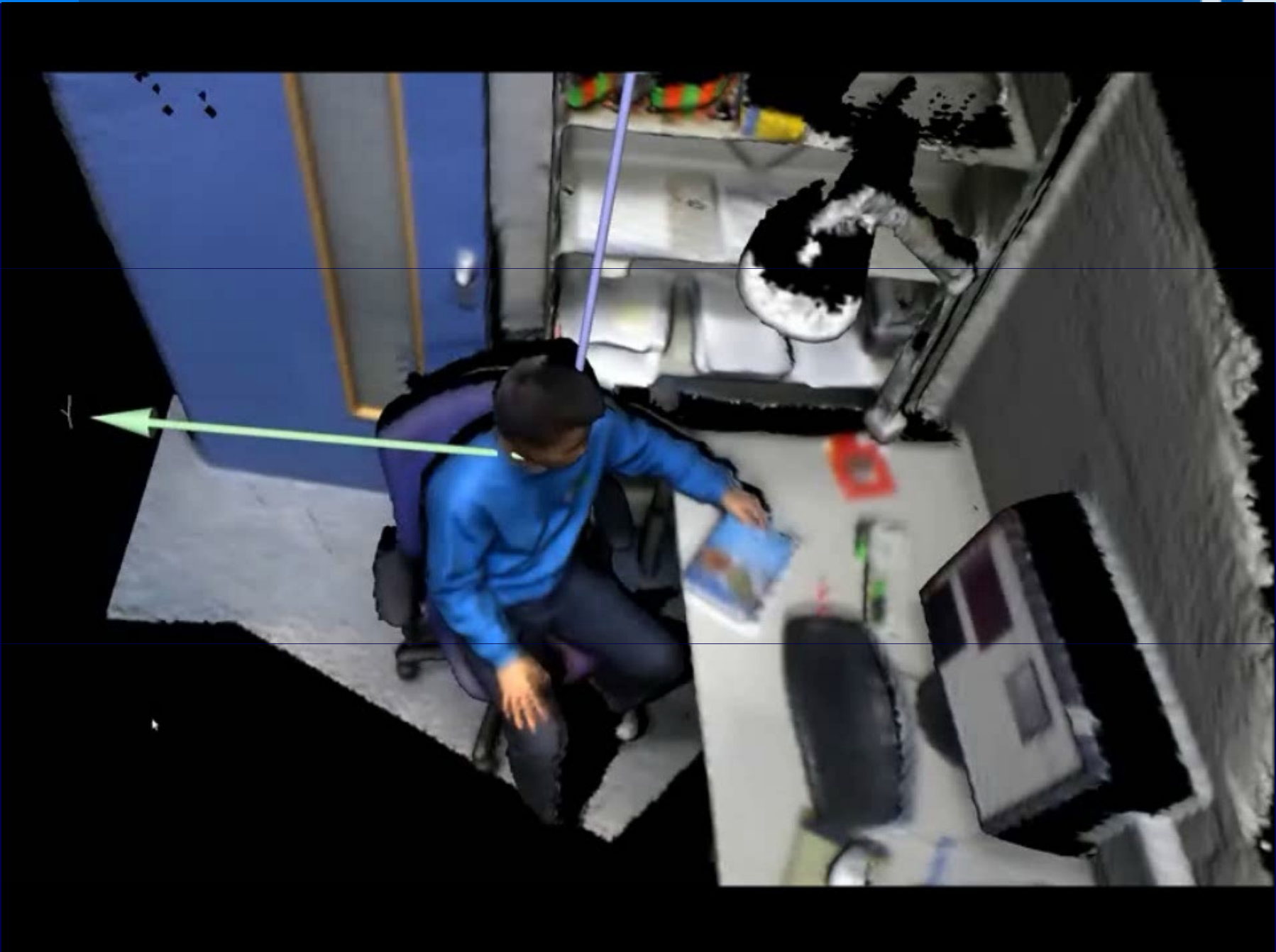


Depth input

Fuse geometry: *Curless, Levoy '96, Newcombe et al. '11*



Realtime 3D Modeling



CopyMe3D: Scanning and Printing Persons in 3D

Jürgen Sturm, Erik Bylow, Fredrik Kahl, Daniel Cremers

**German Conference on Pattern Recognition (GCPR)
September 2013**



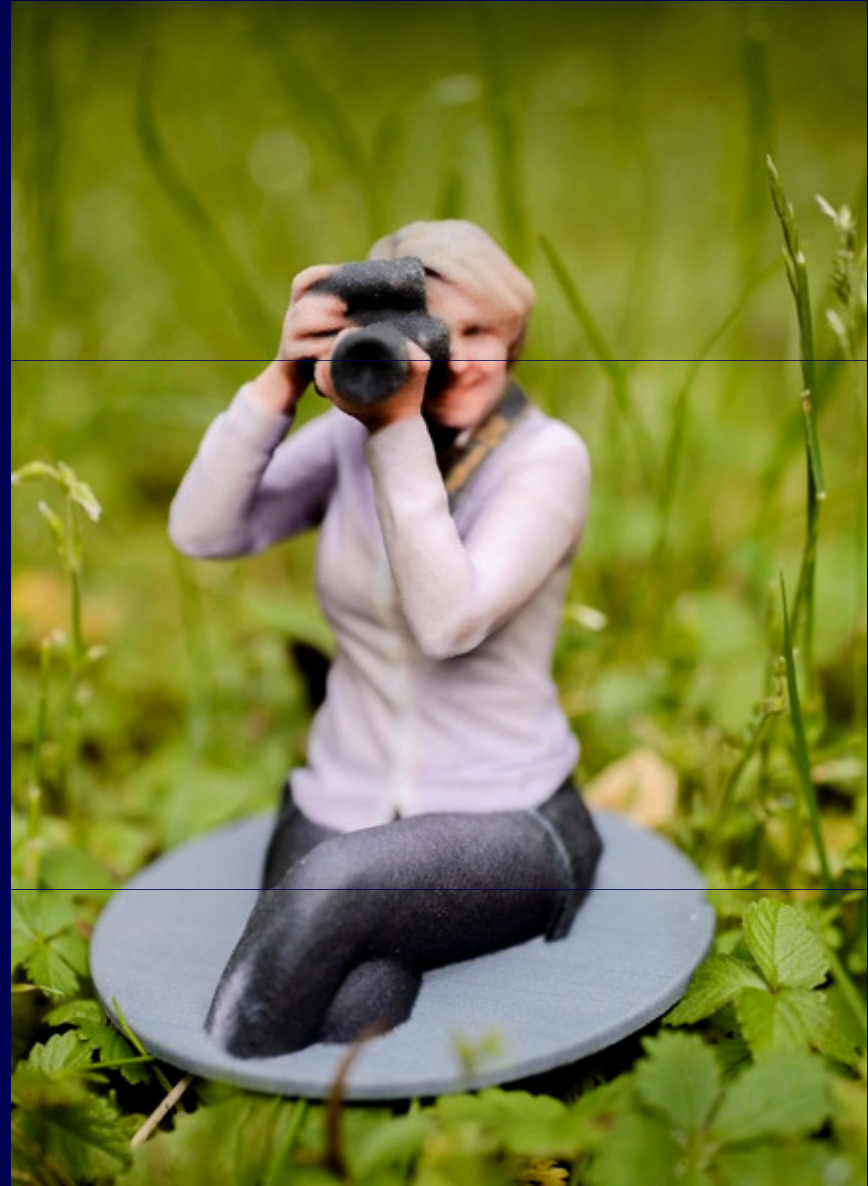
Computer Vision Group
Department of Computer Science
Technical University of Munich



Download demo @ <http://www.fablitec.com>



Realtime 3D Modeling



Download demo @ <http://www.fablitec.com>

Realtime 3D Modeling



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Realtime 3D Modeling



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Realtime 3D Modeling



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Download demo @ <http://www.fablitec.com>

Autonomous Quadcopters



Engel et al. IROS '11

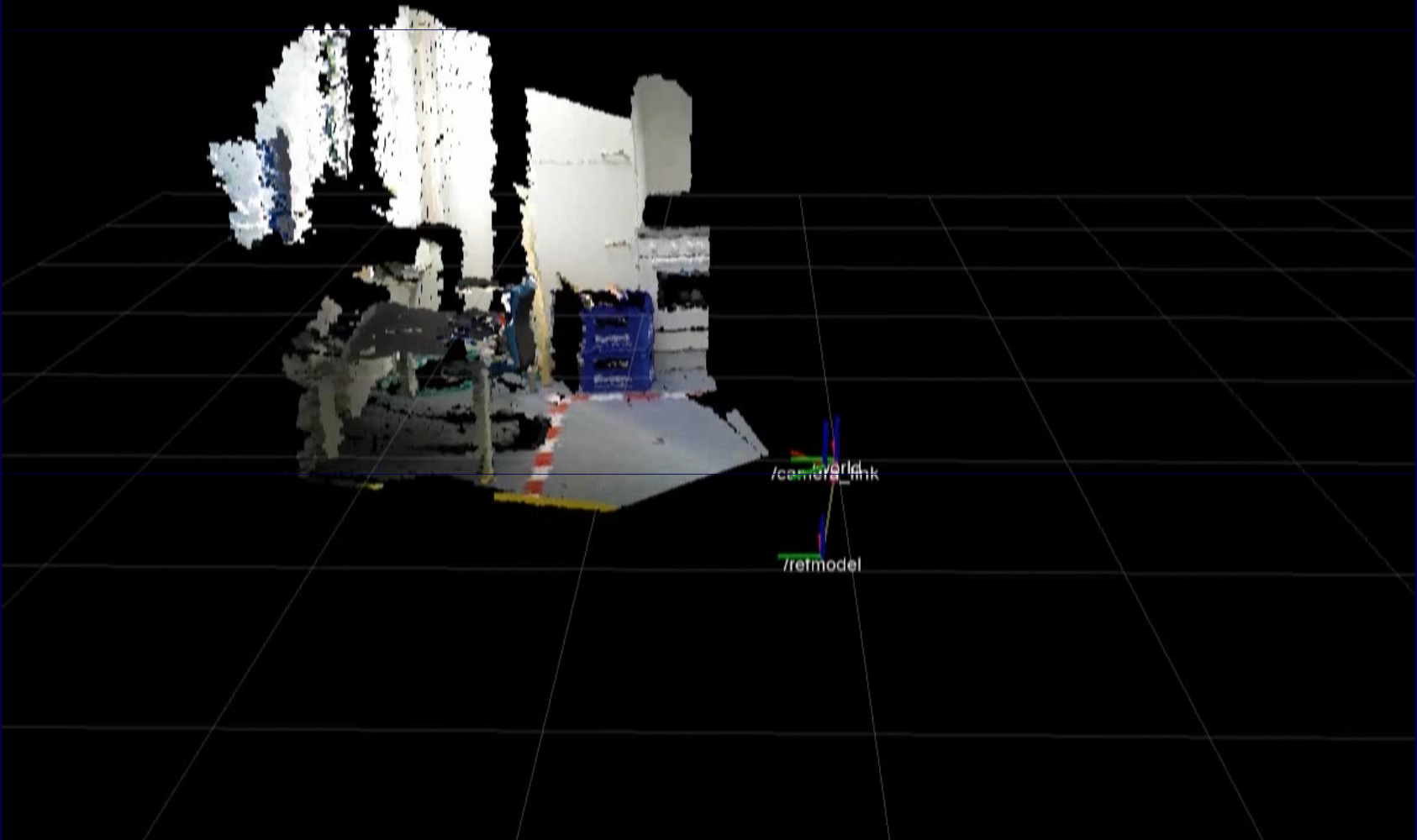
Reconstruction on the Fly

4x

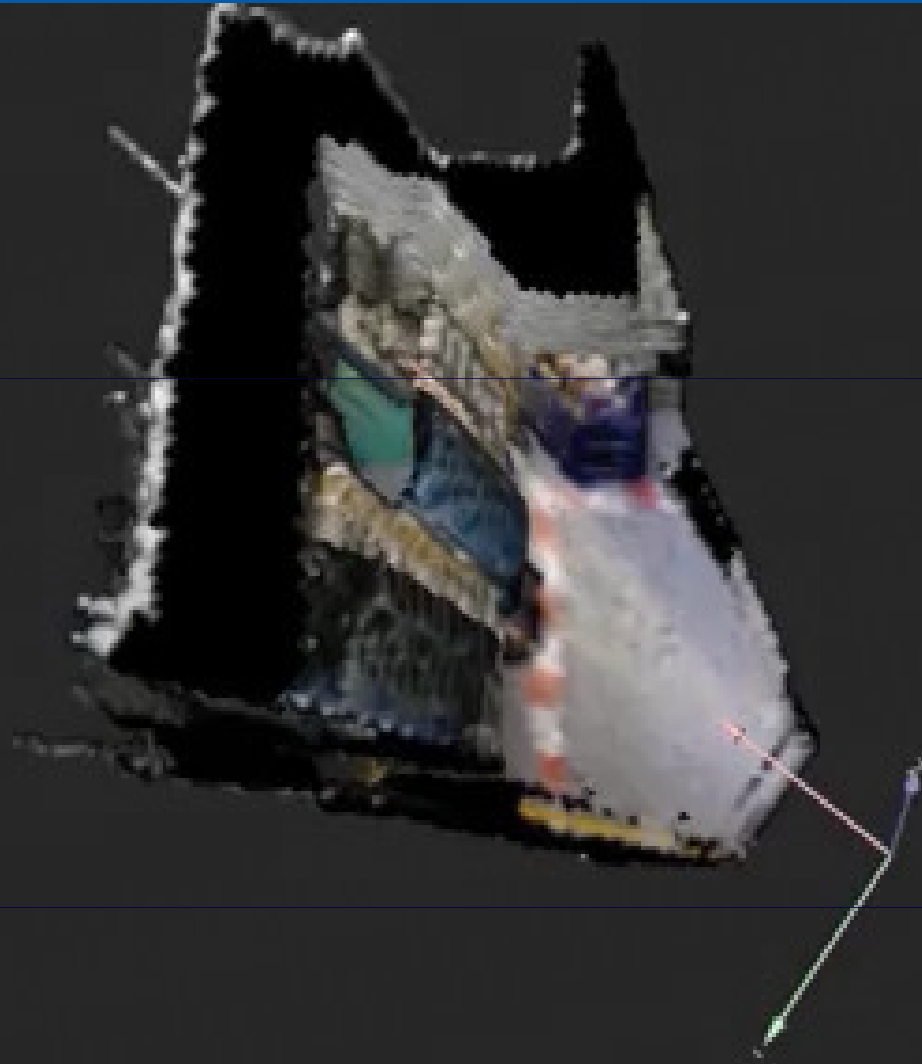


Reconstruction on the Fly

4x



Reconstruction on the Fly

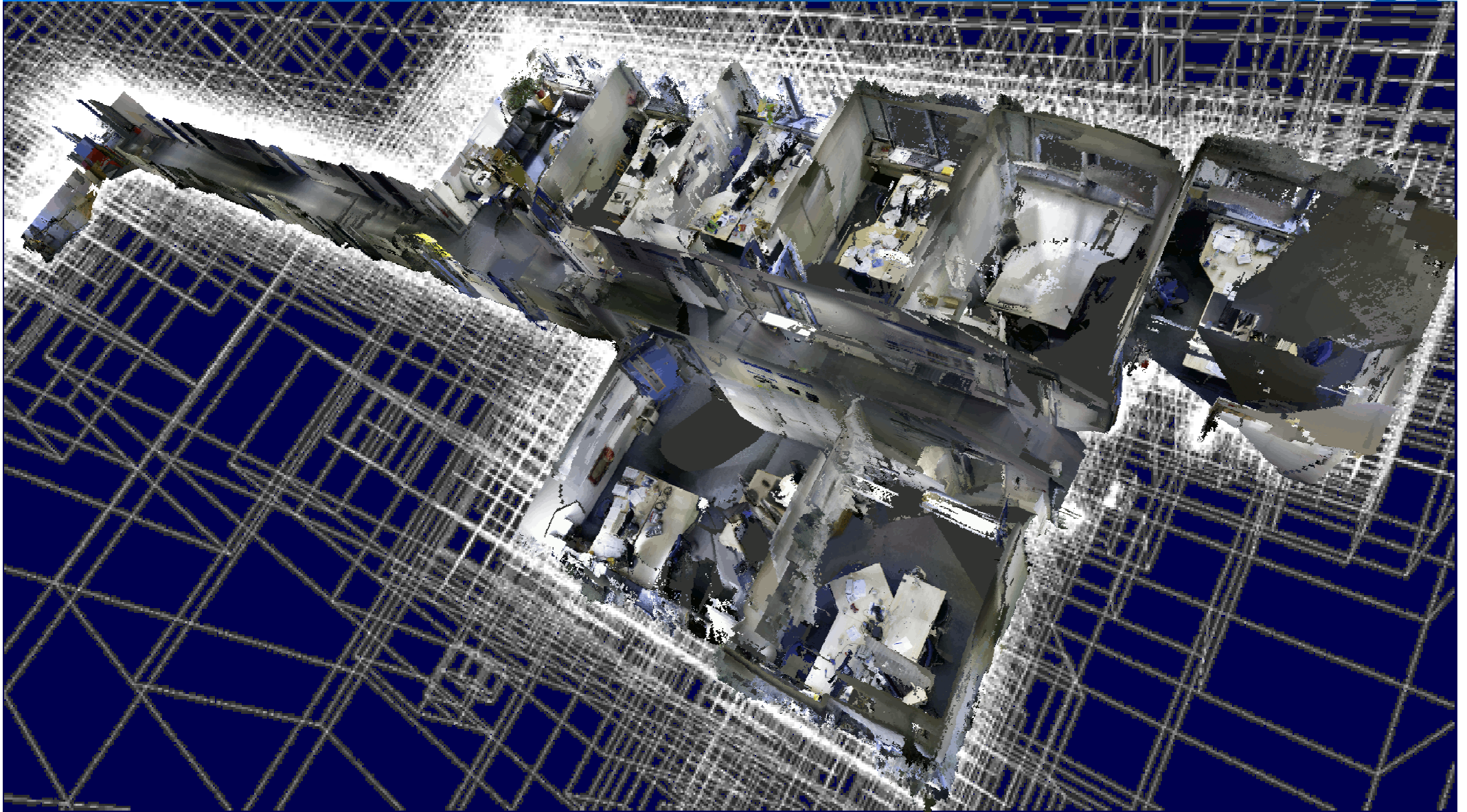


Large Scale: Loop Closure

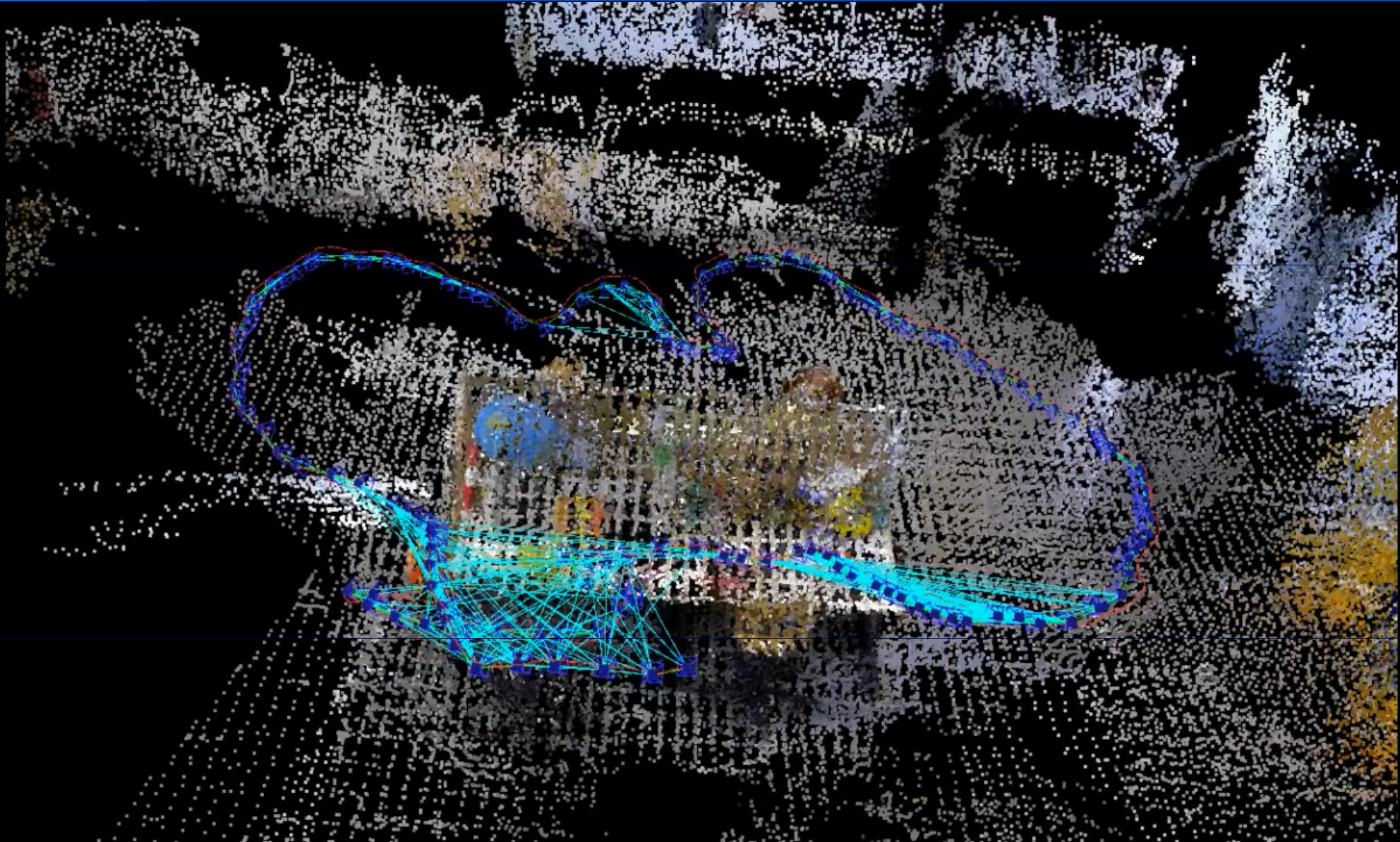
RGB-D dataset 'fr3/office'

Kerl, Sturm, Cremers ICRA '13

Large Scale: Octrees

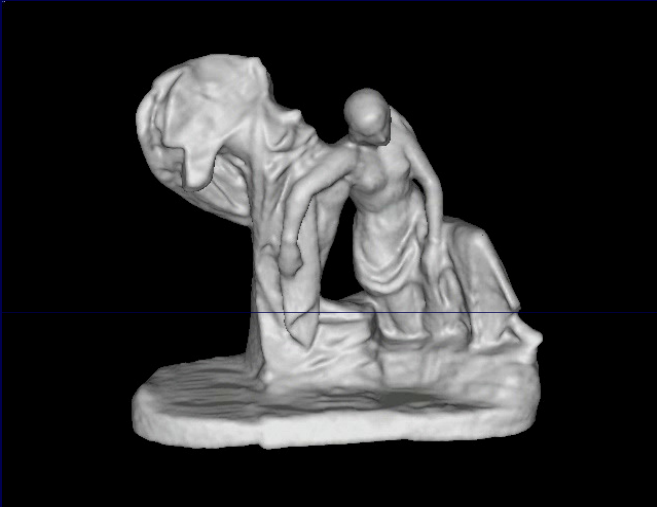


Steinbrücker, Kerl, Sturm, Cremers ICCV '13



Steinbrücker, Kerl, Sturm, Cremers ICCV '13

Summary



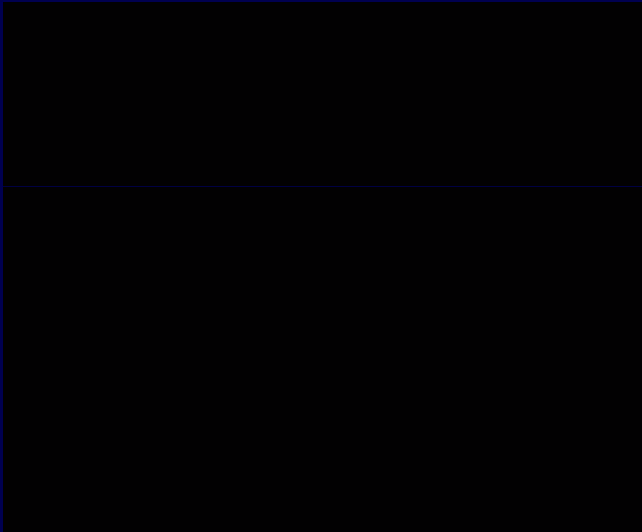
multiview reconstruction



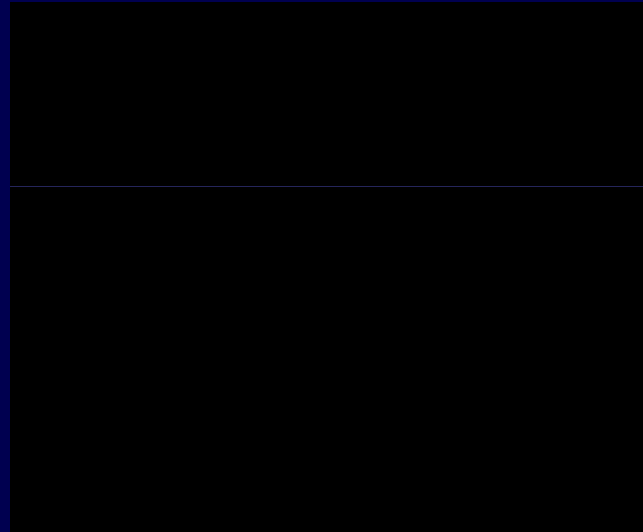
super-res. textures



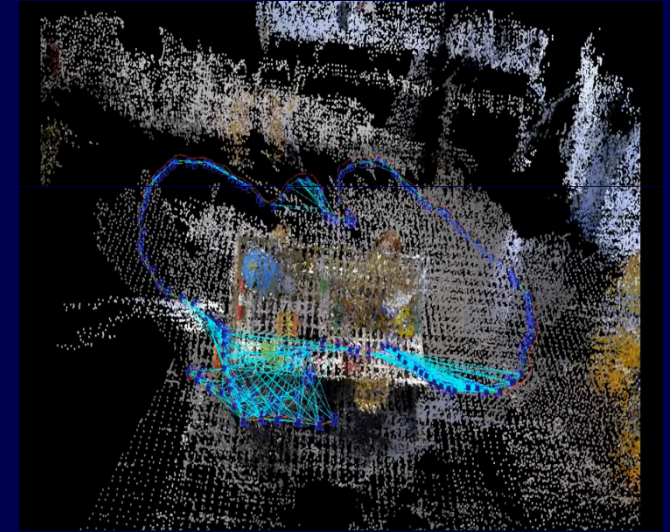
action reconstruction



RGB-D modeling



reconstruction on the fly



large scale reconstruction