

Multiple View Geometry

Prof. Dr. Daniel Cremers

Chair for Computer Vision & Pattern Recognition

Departments of Computer Science & Mathematics, TUM



Exercises: Robert Maier & Rui Wang



Reconstructing the World from Images

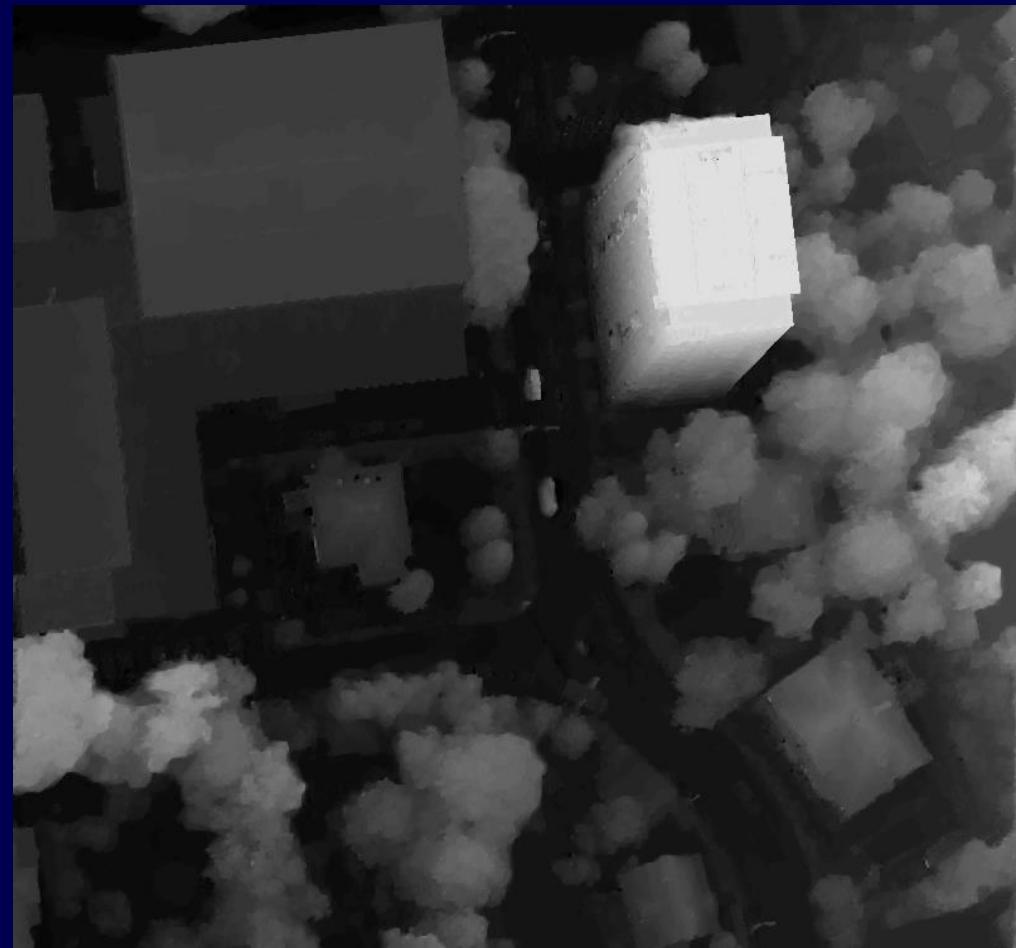
Some Recent Developments



Reconstruction from Aerial Images



One of two input images

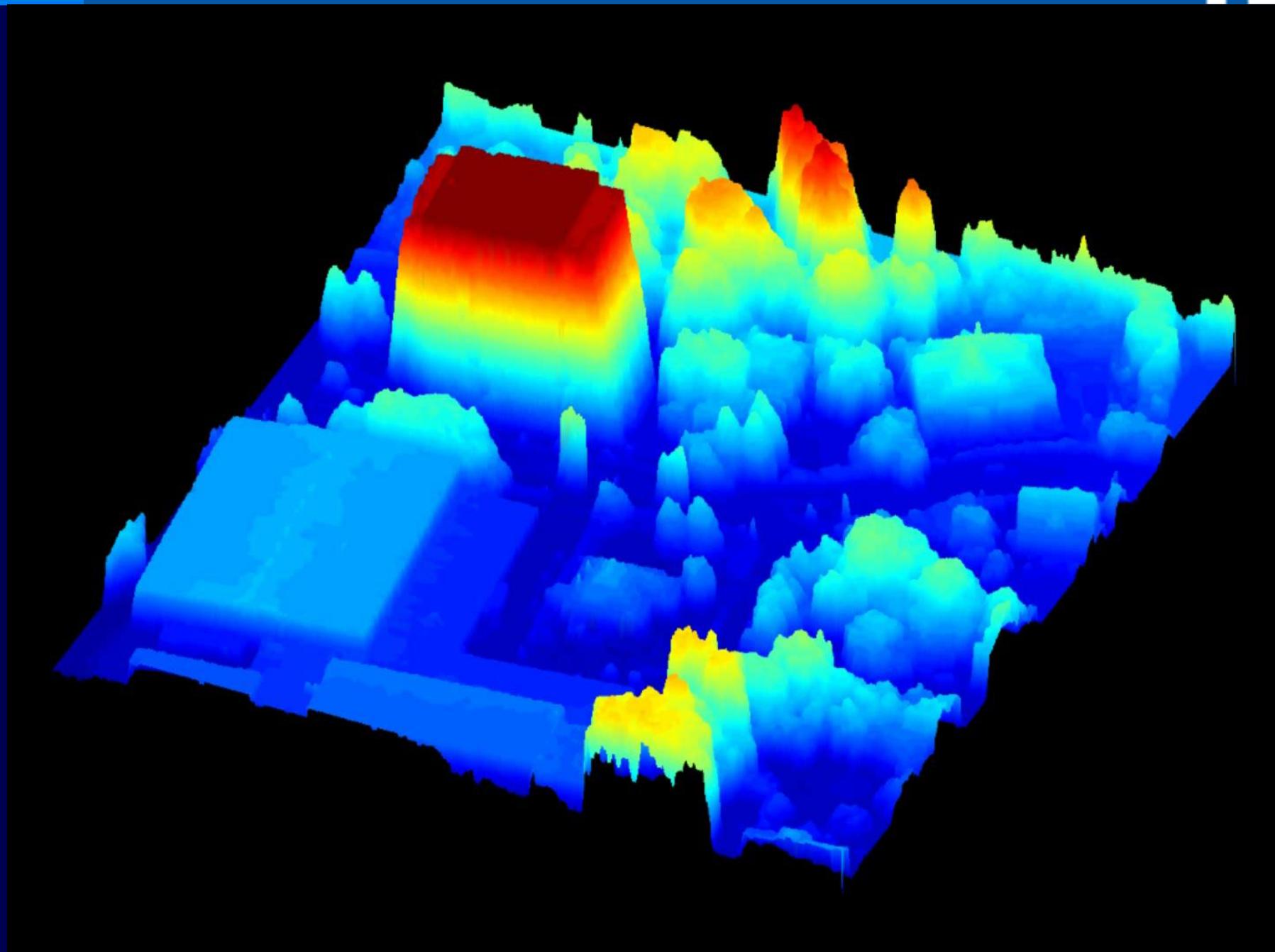


Depth reconstruction

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



Reconstruction from Aerial Images





Application: Driver Assistance



Wedel, Cremers, "Scene Flow", Springer 2011



Multiple View Reconstruction

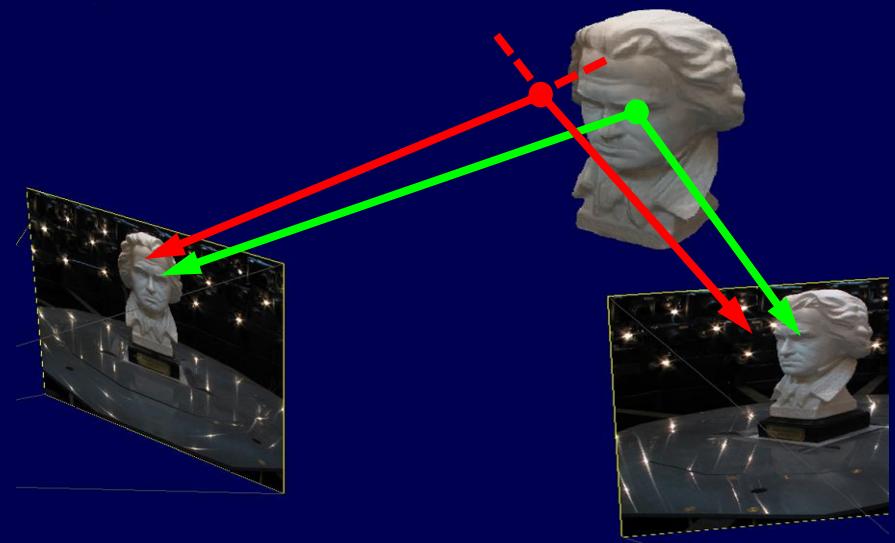




Solutions via Energy Minimization

Photoconsistency function:

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



Determine a surface S of optimal photoconsistency by minimizing

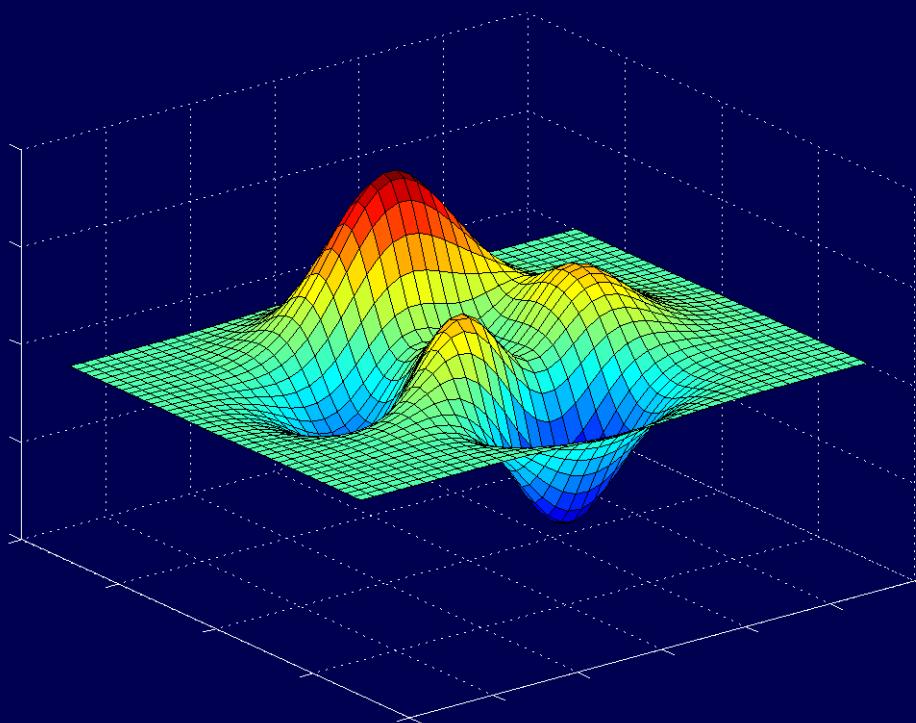
$$E(S) = \int_S \rho \, dA$$

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

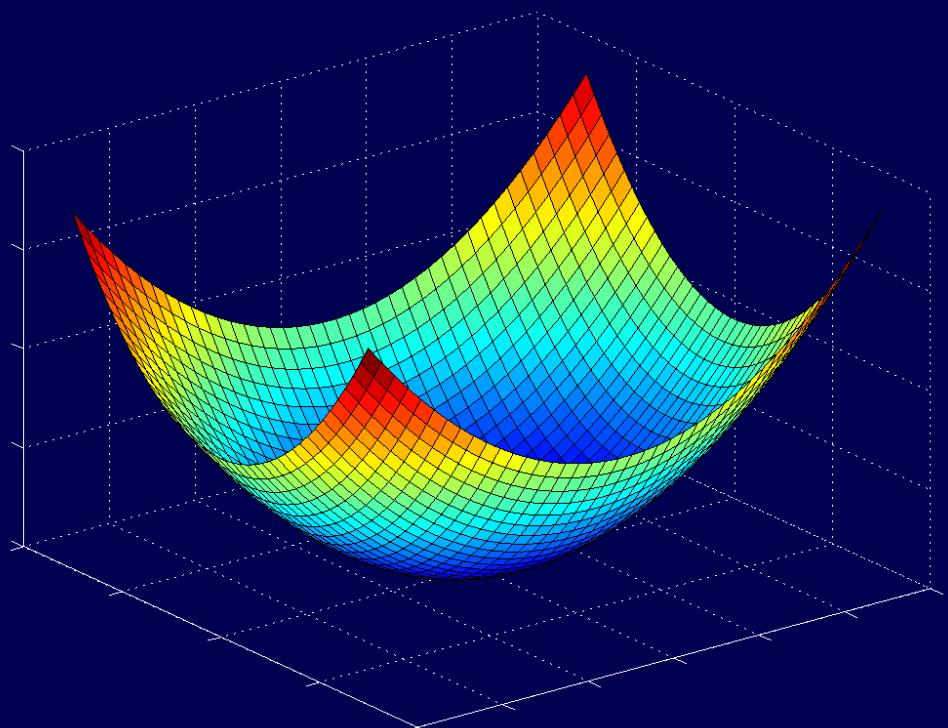
Theorem: Globally optimal surfaces can be computed via convex relaxation.



Solutions via Energy Minimization



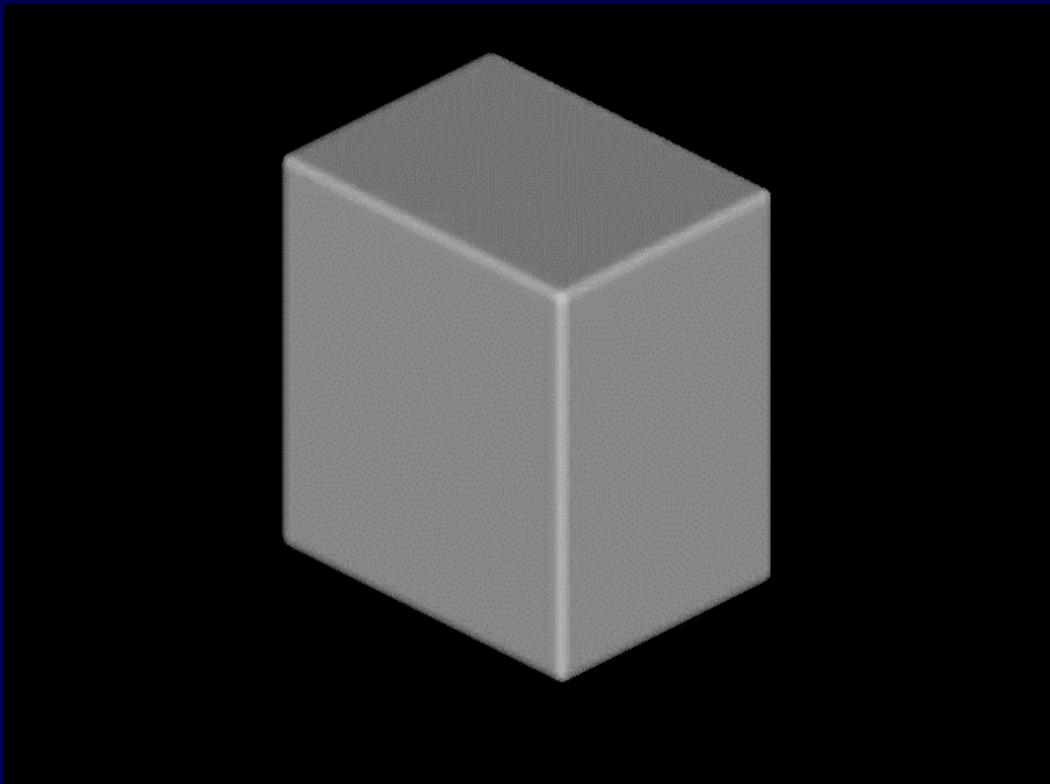
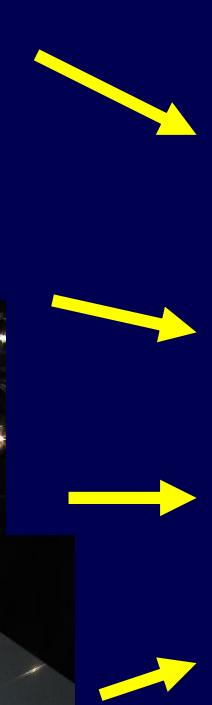
Non-convex energy



Convex energy



3D Reconstruction



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



Textured 3D Reconstruction

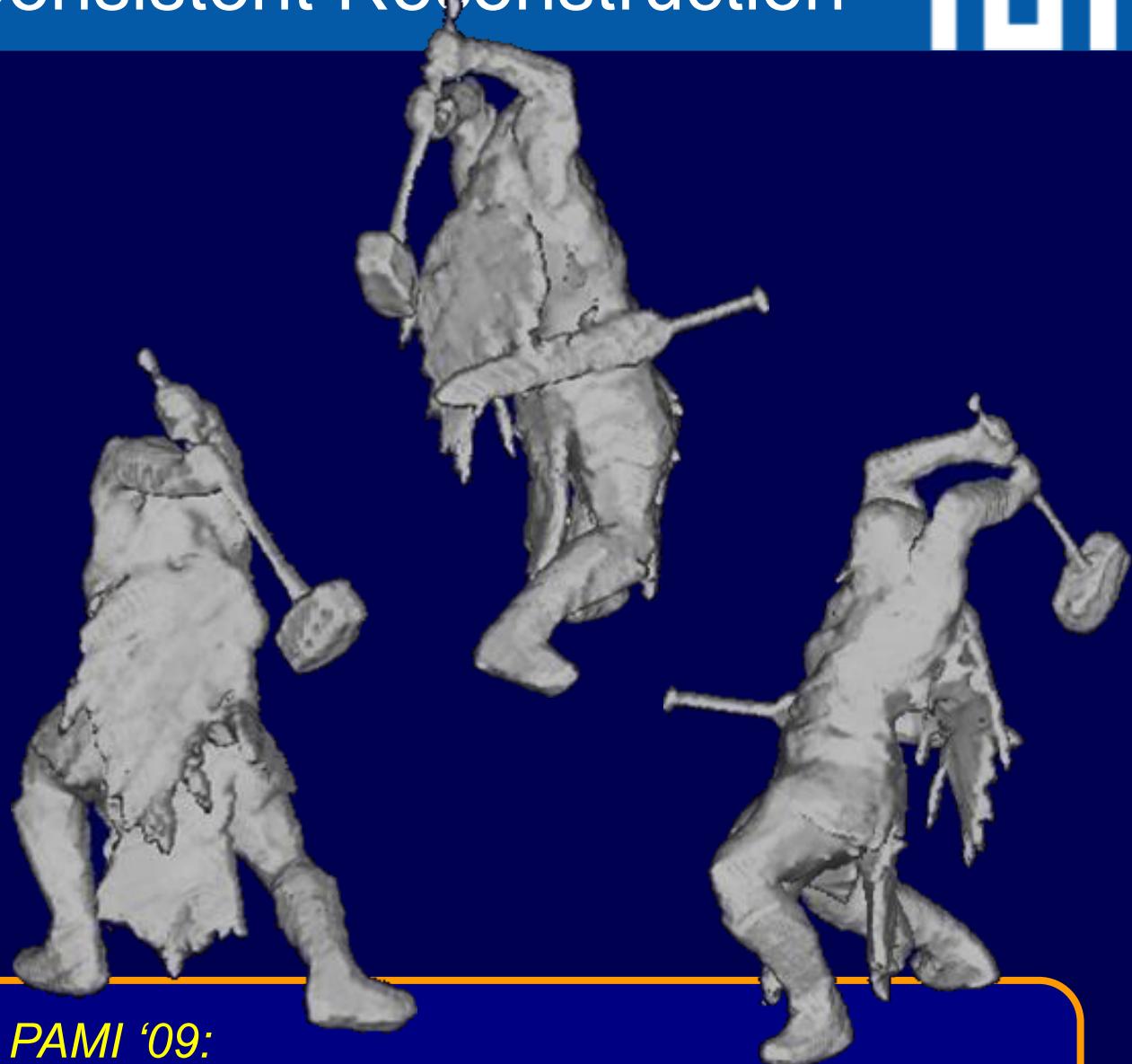


*Goldlücke, Cremers, ICCV '09, DAGM '09**

* *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.



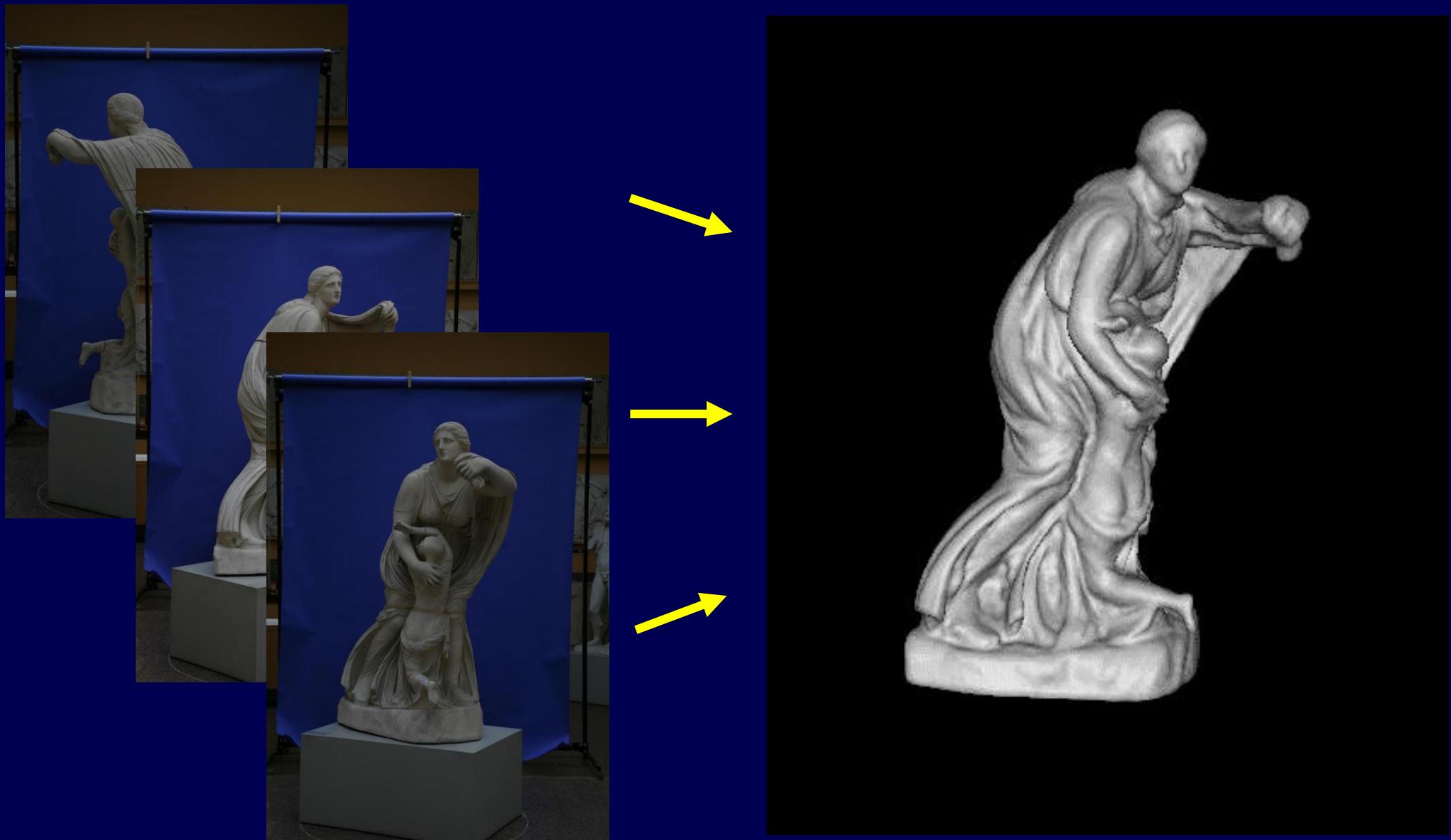
Reconstructing the Niobids Statues



Kolev, Cremers, ECCV '08, PAMI '12



Reconstructing the Niobids Statues



Kolev, Cremers, ECCV '08, PAMI '12



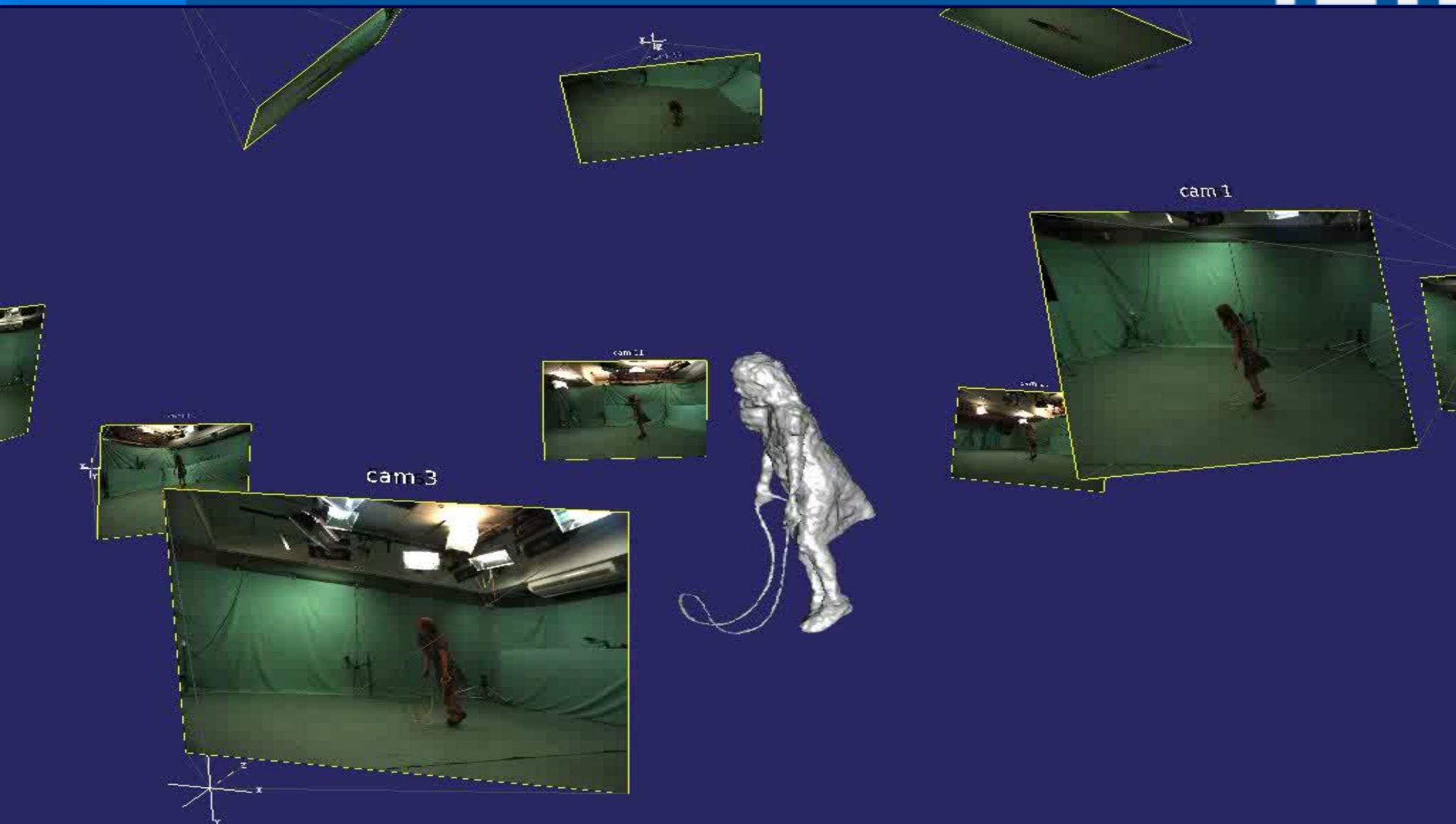
Reconstructing the Niobids Statues



Kolev, Cremers, ECCV '08, PAMI '12



Reconstructing Dynamic Scenes



Oswald, Stühmer, Cremers, ECCV '14

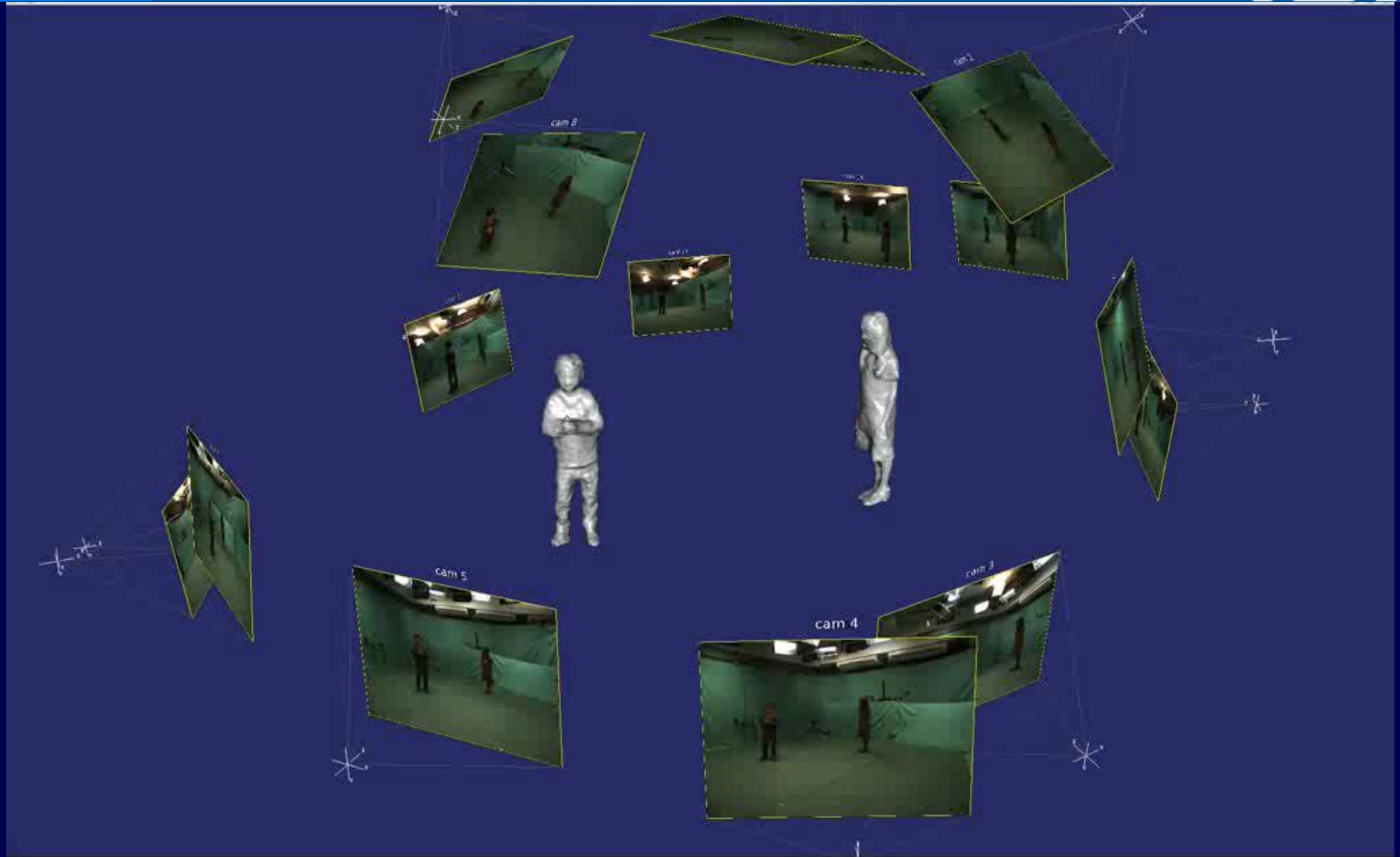


Toward Free View-Point Television





Action Reconstruction



Oswald, Cremers, ICCV '13 4DMoD Workshop



Action Reconstruction





Application: Driver Assistance

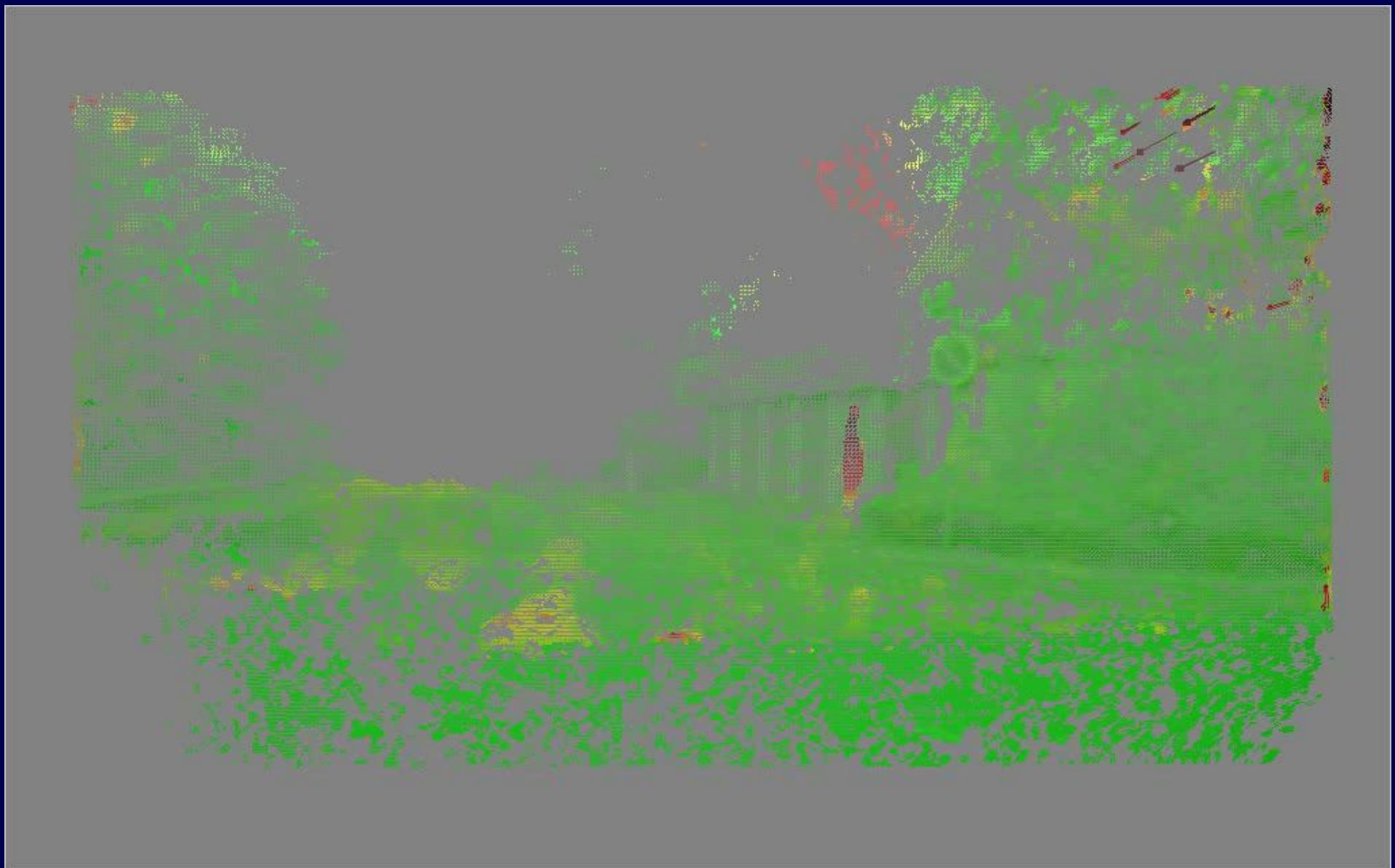


Original left image





Application: Driver Assistance



Wedel, Cremers, "Scene Flow", Springer 2011



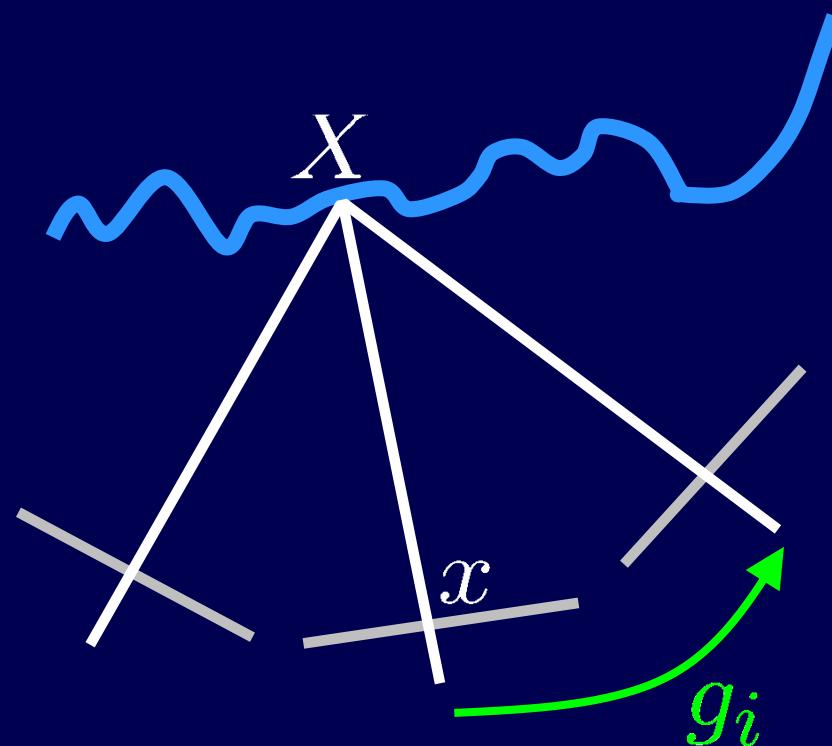
Application: Driver Assistance



Wedel, Cremers, “Scene Flow”, Springer 2011



Realtime 3D Reconstruction



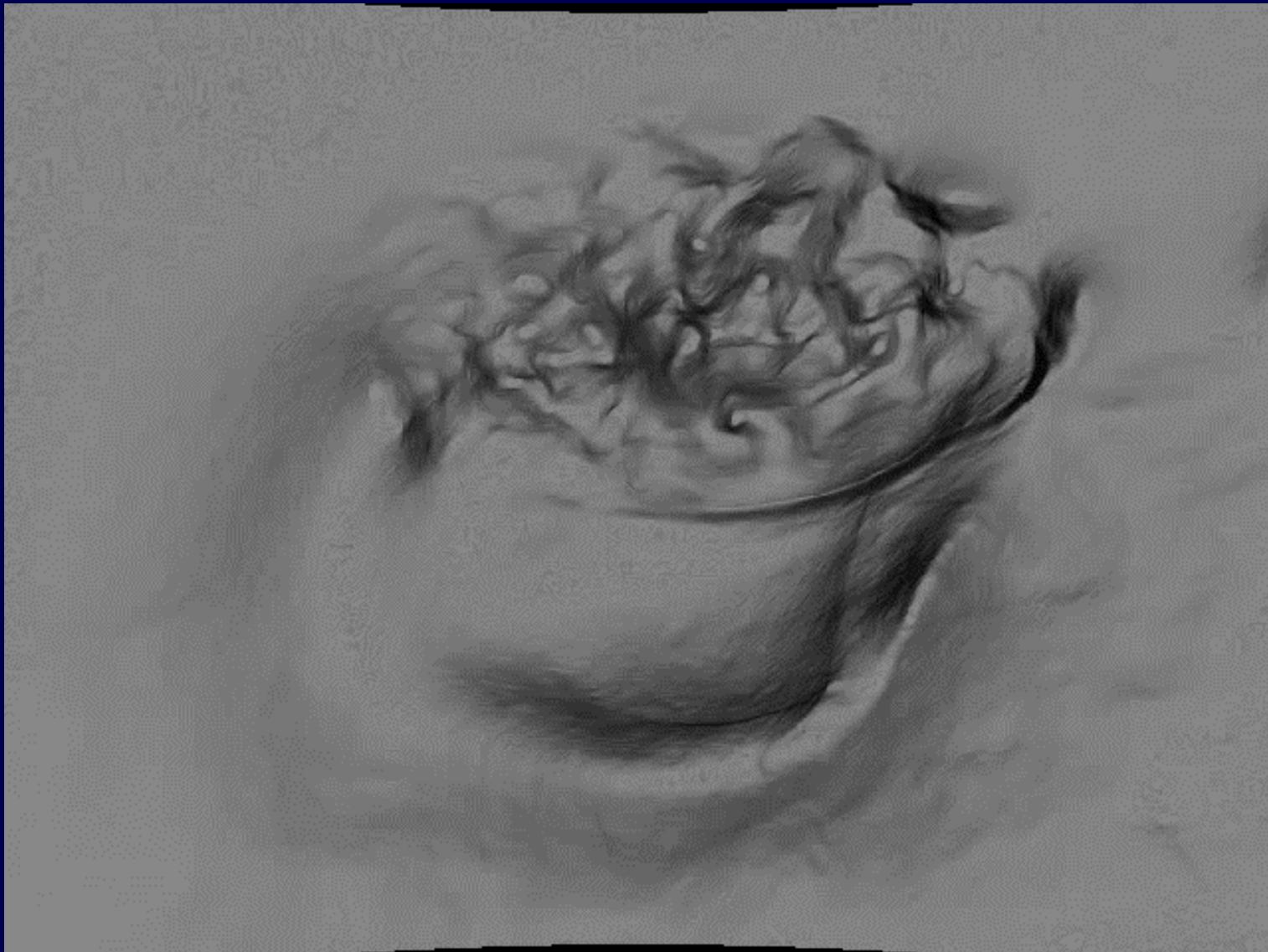
Stuehmer, Gumhold, Cremers, DAGM '10



Dense geometry from hand-held camera



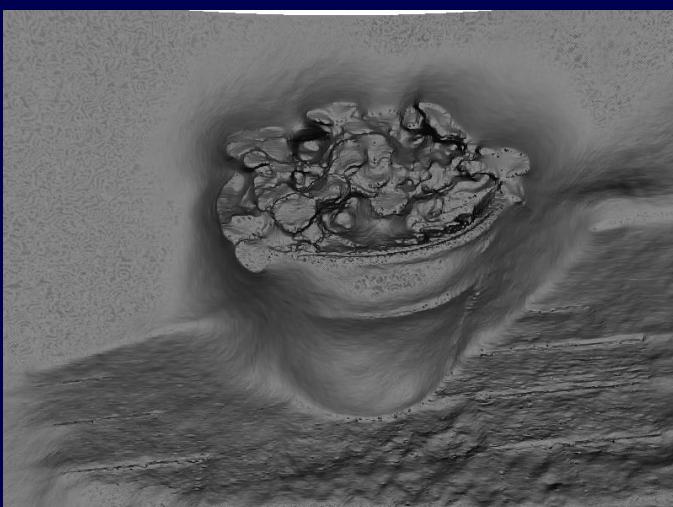
Stuehmer, Gumhold, Cremers, DAGM '10



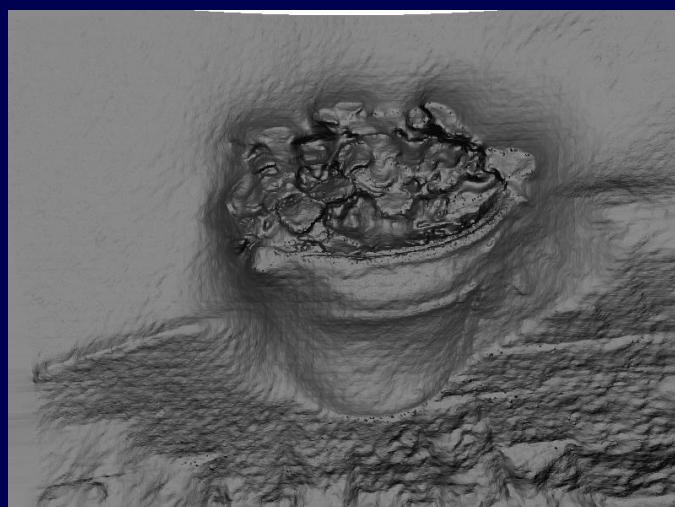
Stuehmer, Gumhold, Cremers, DAGM '10



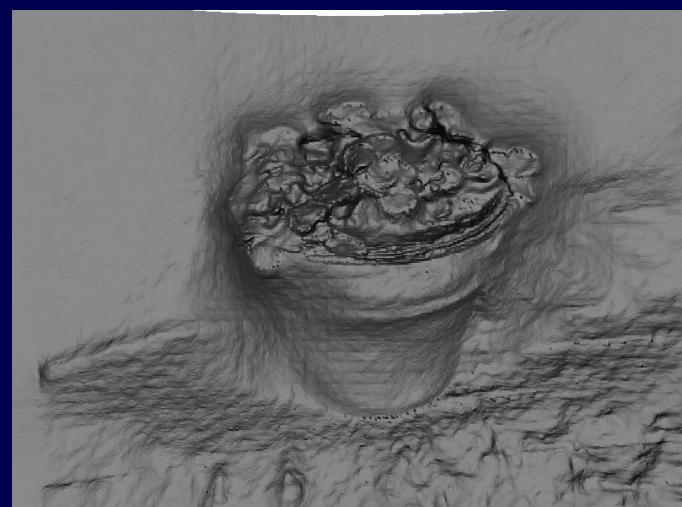
Realtime 3D Reconstruction



1.8 fps



11.3 fps



24 fps

Stuehmer, Gumhold, Cremers, DAGM '10

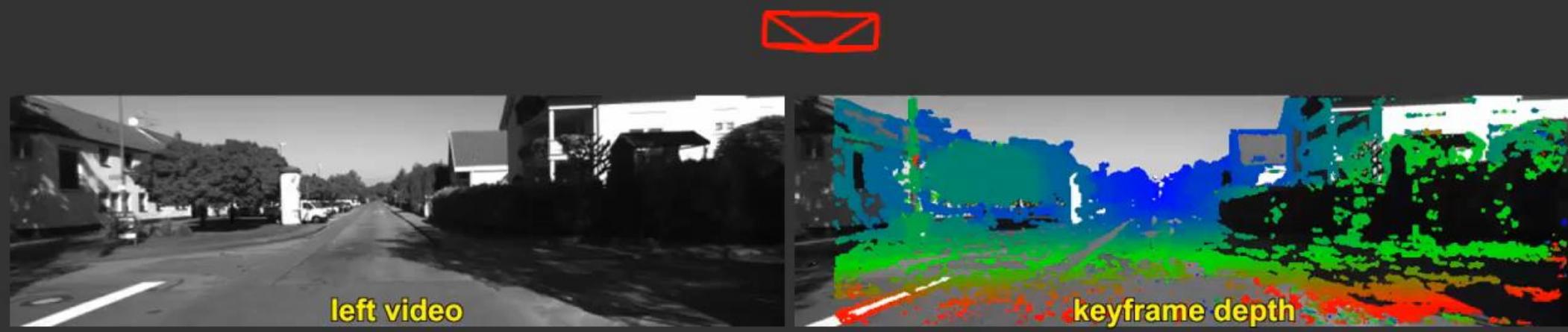
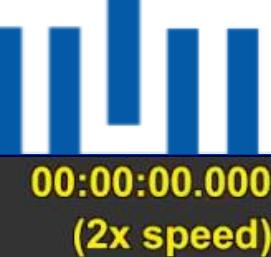


LSD SLAM



Engel, Schöps, Cremers, ECCV 2014: Large-Scale Direct Monocular SLAM

Realtime Stereo LSD SLAM



Engel, Stückler, Cremers, IROS '15



Autonomous Quadrocopters



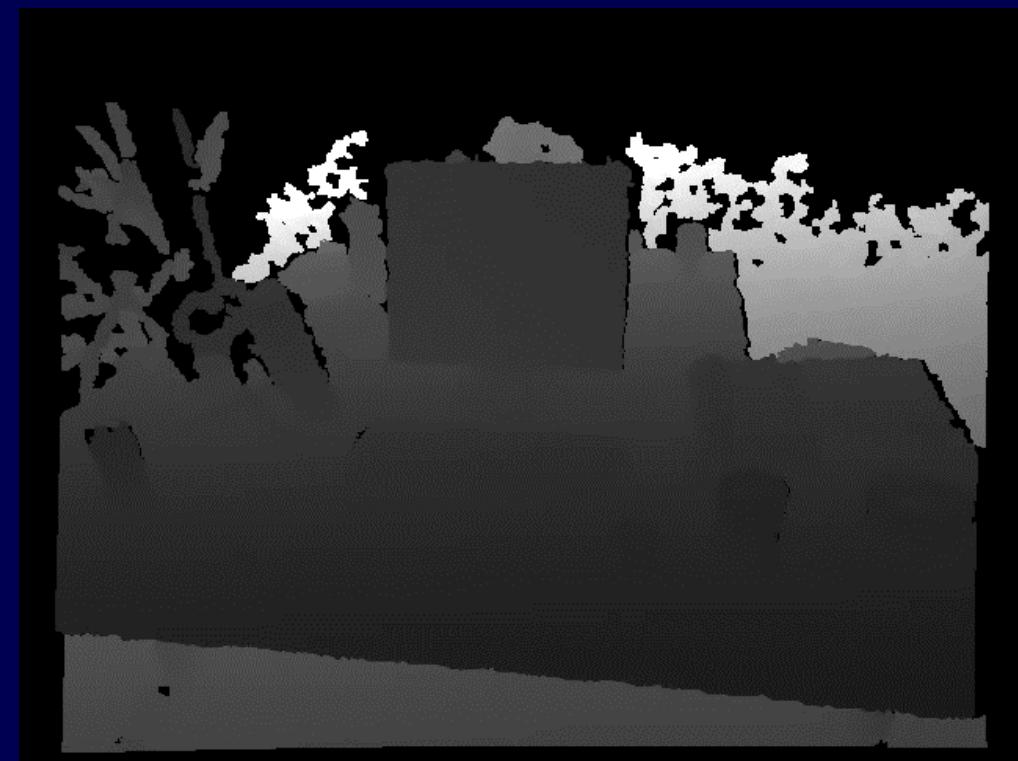
Engel et al. IROS '11



RGB-D Cameras



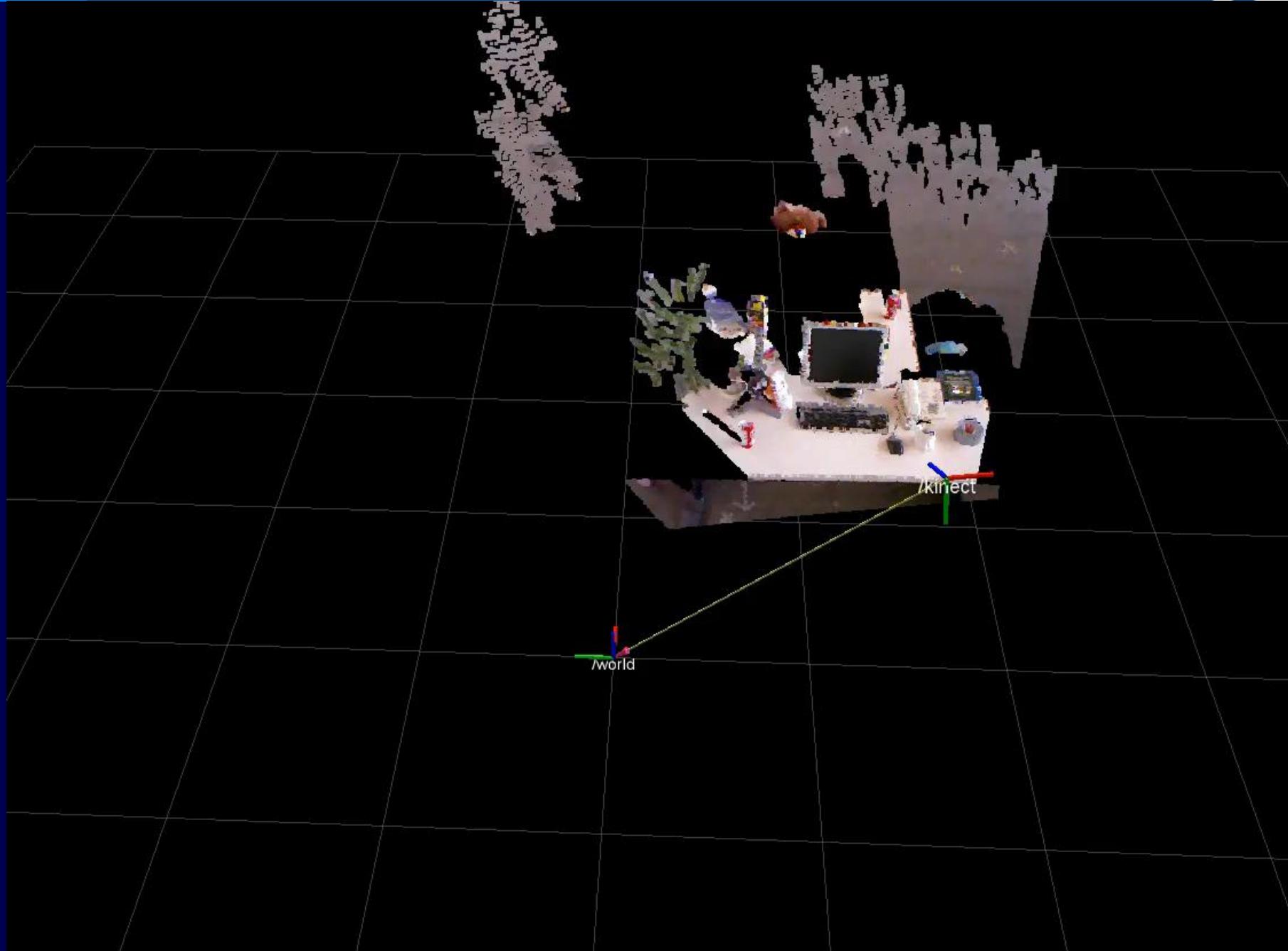
Color input



Depth input



Accurate Camera Tracking

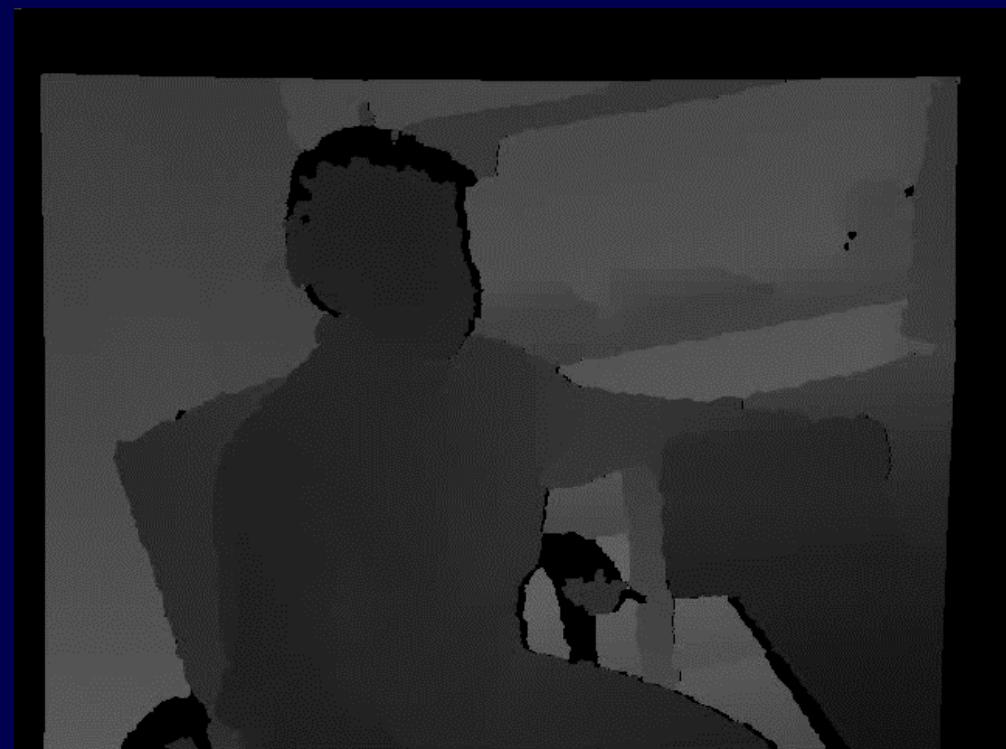




Realtime 3D Modeling

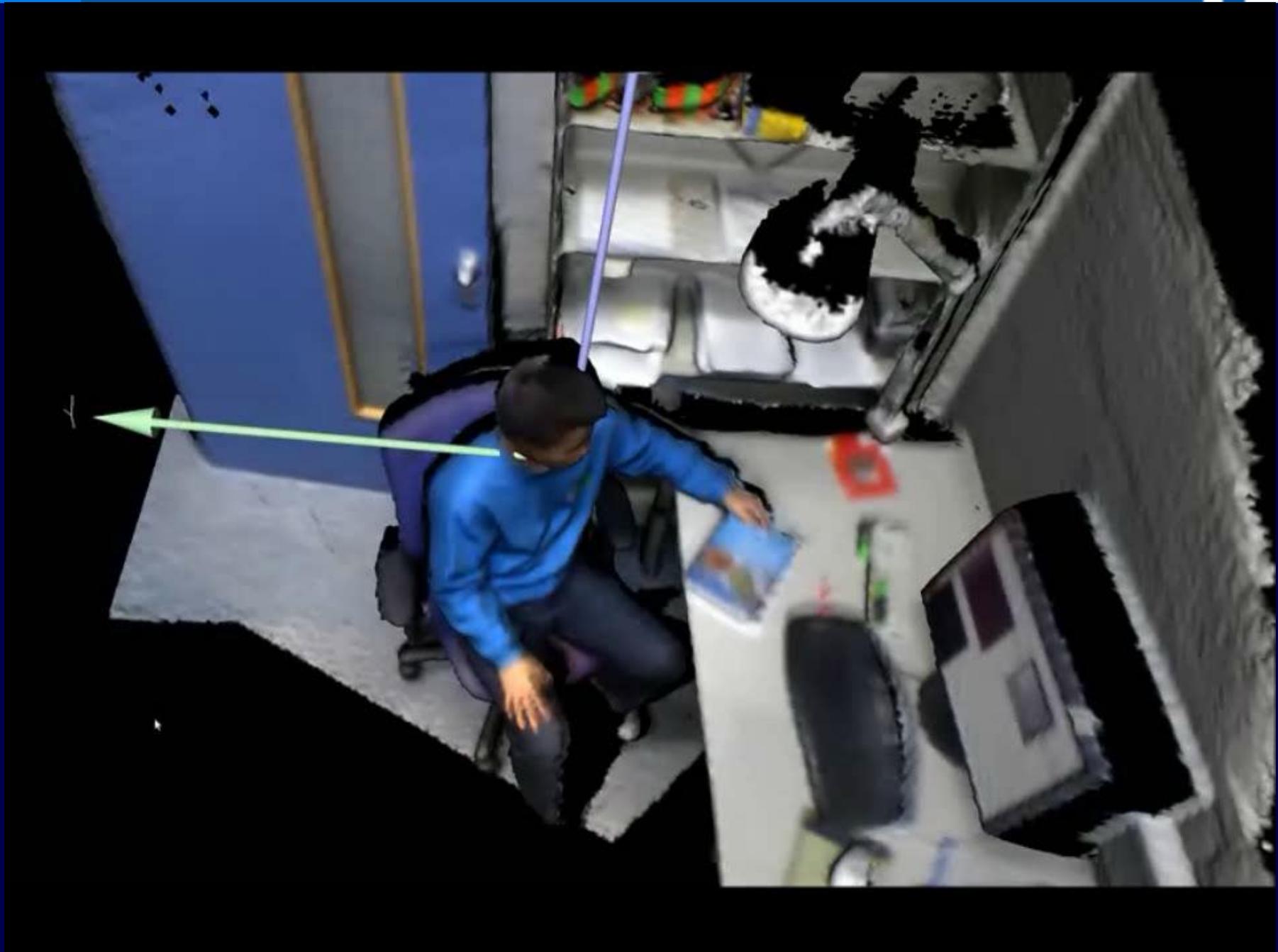


Color input



Depth input

Realtime 3D Modeling





Realtime 3D Modeling



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



Realtime 3D Modeling



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Realtime 3D Modeling



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Reconstruction on the Fly



Bylow, Sturm, Kerl, Kahl, Cremers RSS '13



Large Scale: Loop Closure

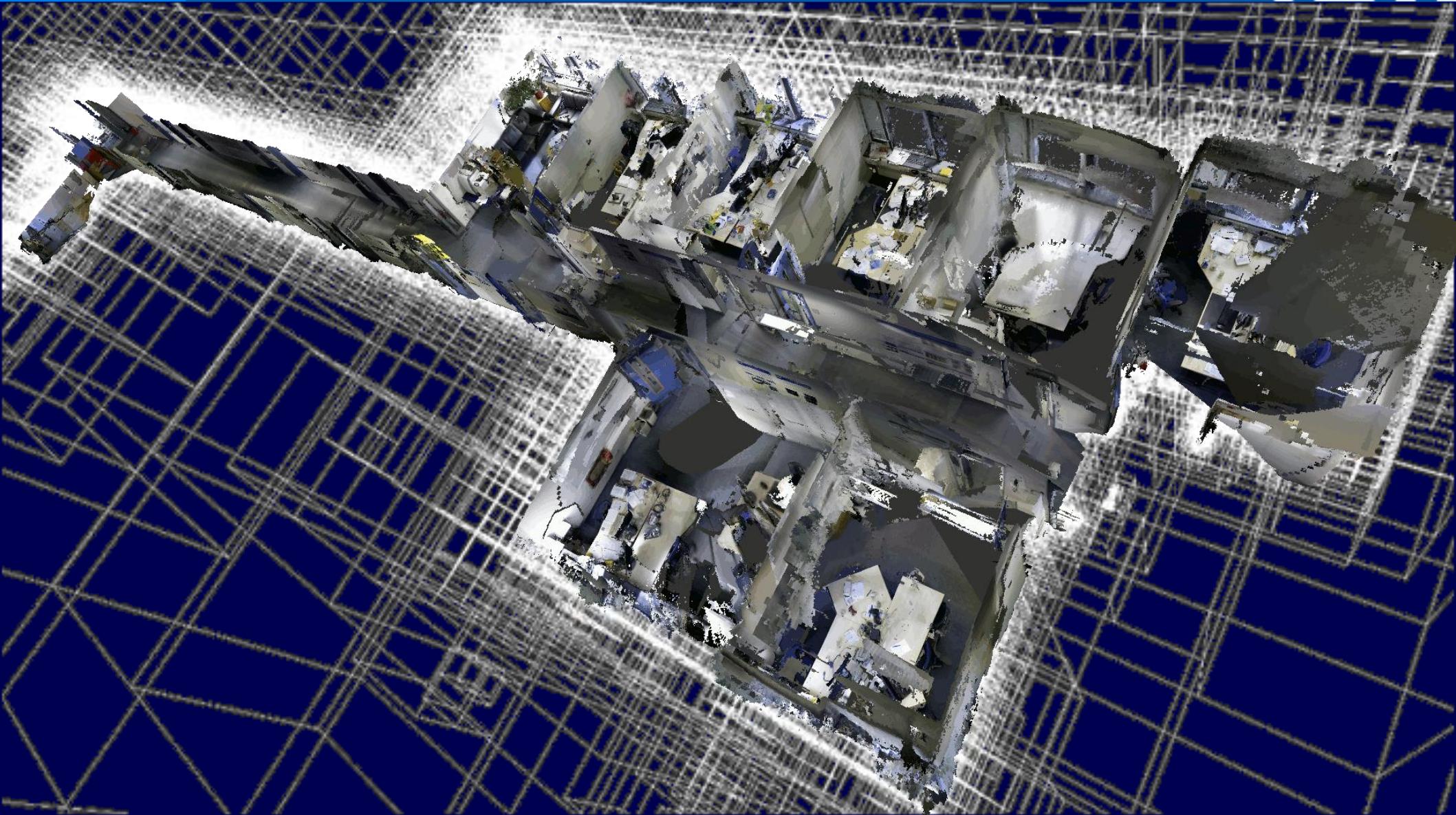


RGB-D dataset 'fr3/office'

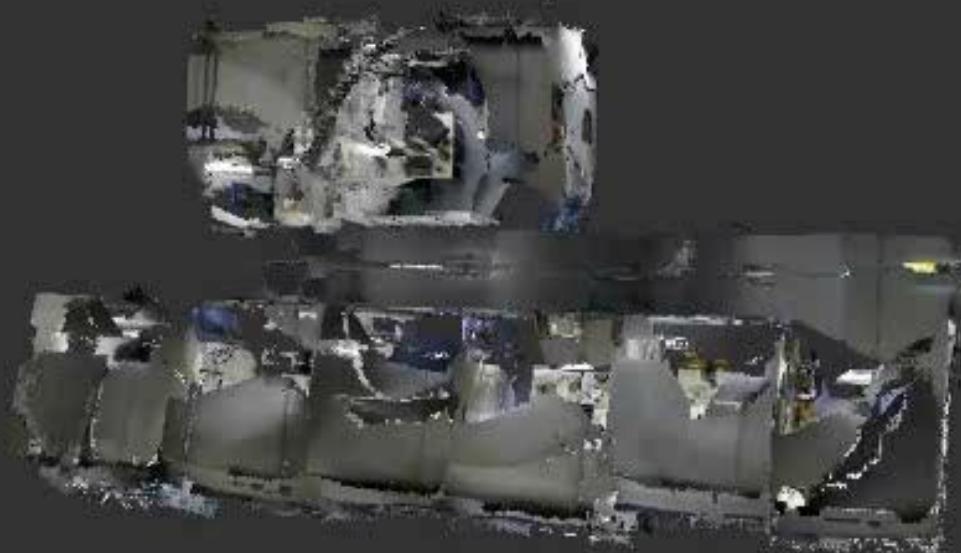
Kerl, Sturm, Cremers ICRA '13



Large Scale: Octrees



Steinbrücker, Kerl, Sturm, Cremers ICCV '13



Large-Scale Reconstruction

Steinbrücker, Kerl, Sturm, Cremers ICCV '13, ICRA '14



Summary



multiview reconstruction



super-res. textures



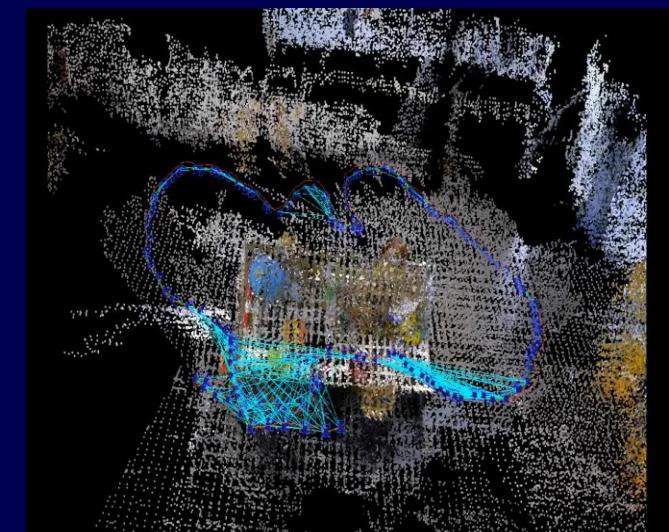
action reconstruction



visual SLAM



RGB-D modeling



large scale reconstruction