

ACCURATE MULTI-VIEW 3D RECONSTRUCTION

Tyleček R., Šára R. - Czech Technical University, Prague
{tylcr1, sara}@cmp.felk.cvut.cz

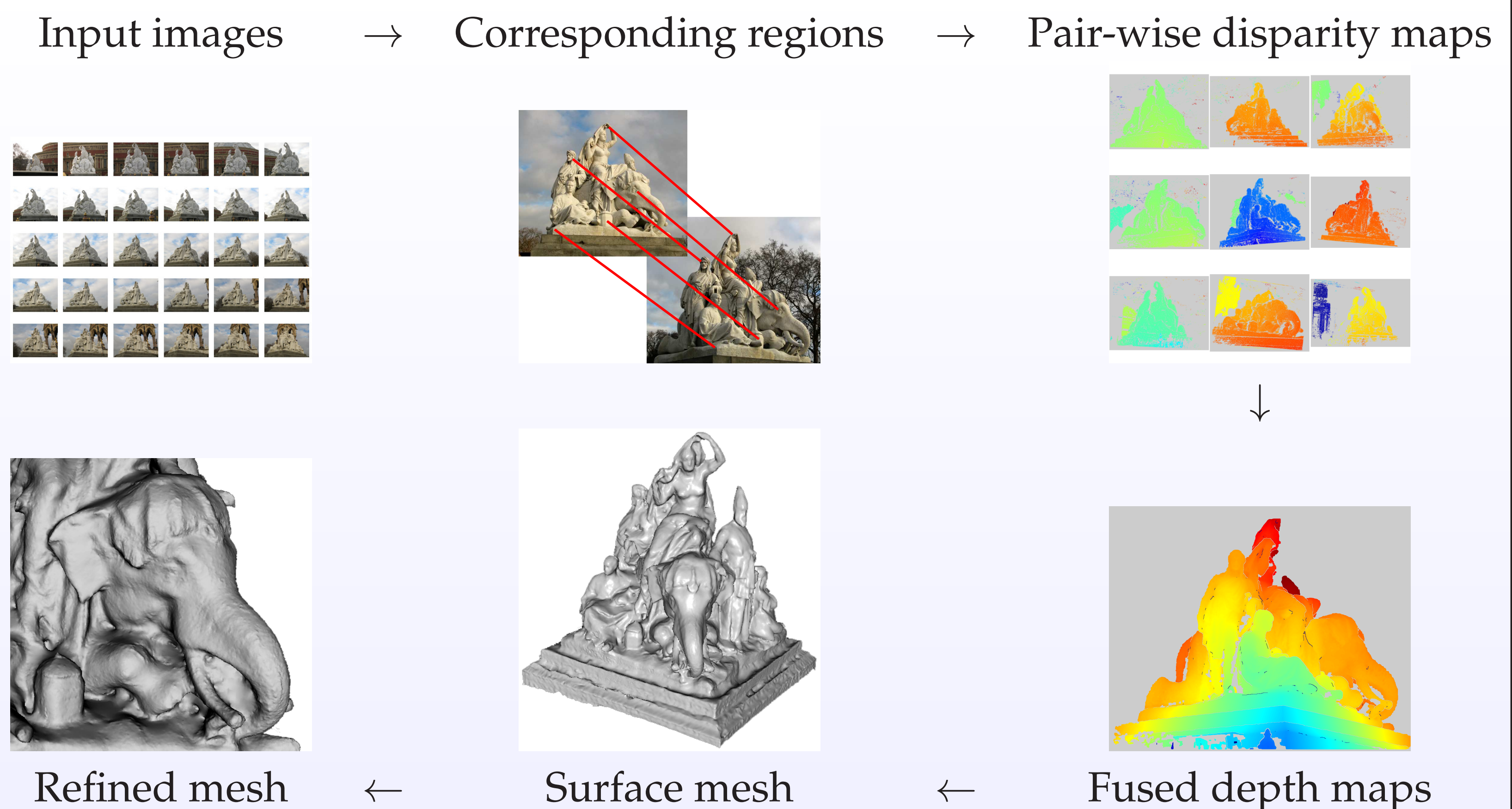


Abstract

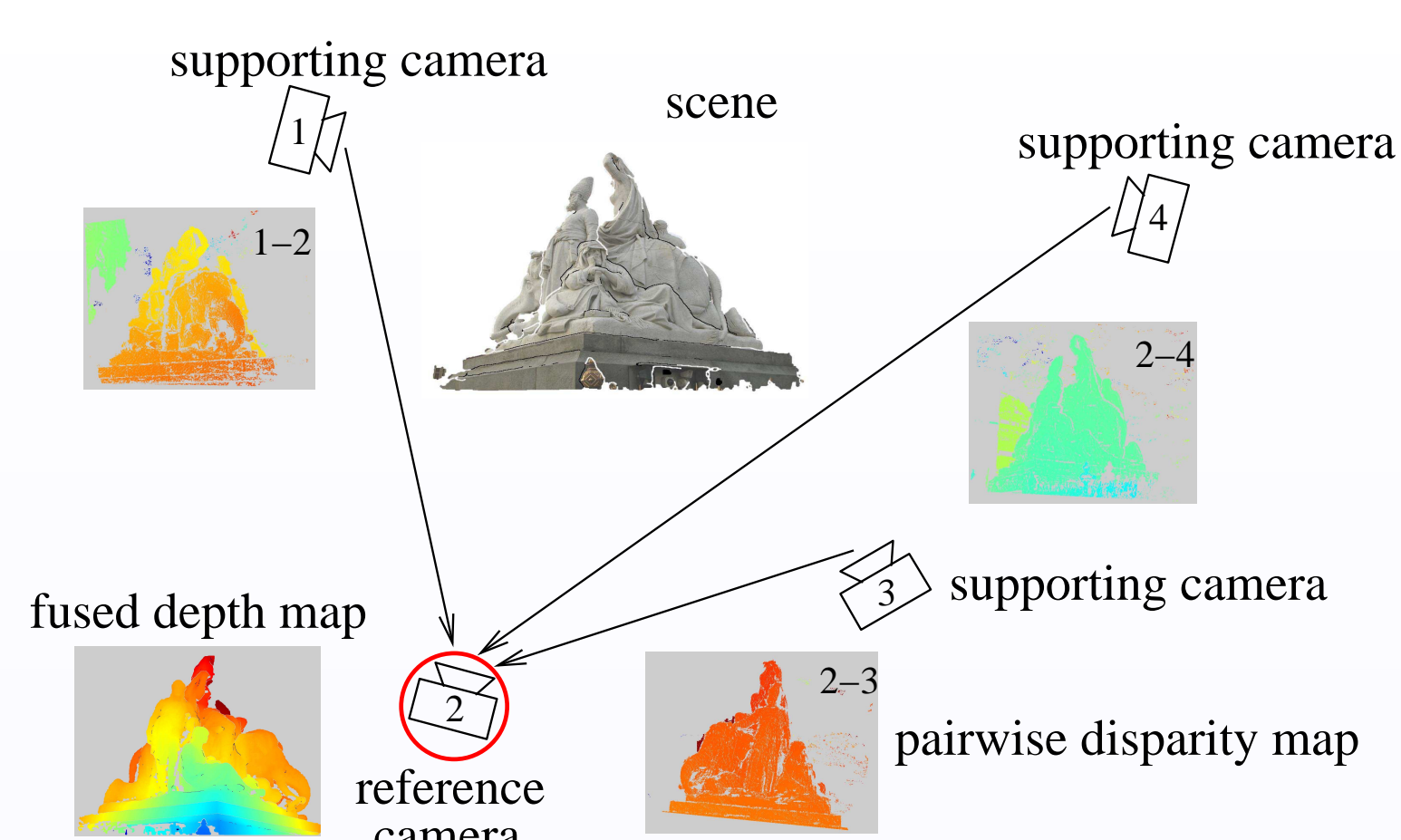
We present a pipeline for accurate 3D reconstruction from multiple images, where we address the problem of inaccurate camera calibration and propose method adjusting the camera parameters in a global structure-and-motion problem, which is solved with a depth map representation that is suitable to large scenes.

Subsequently we refine the output triangular mesh both geometrically and radiometrically. We propose surface energy which includes contour matching in photoconsistency, and use coarse-to-fine strategy to find its minimum with a gradient method. High quality results are demonstrated on large and standard datasets.

Reconstruction Pipeline for High Accuracy

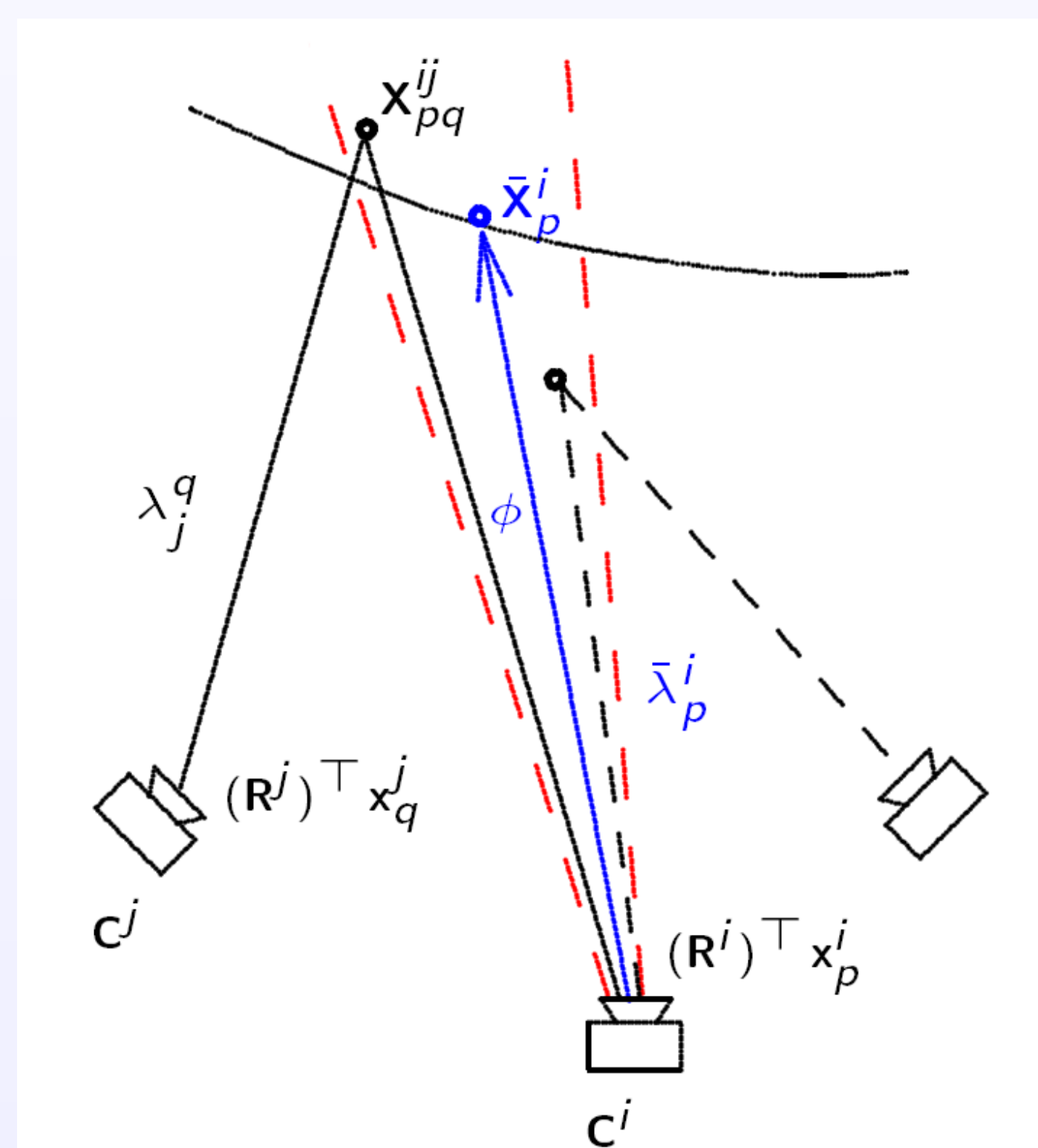


Depth Map Fusion [1]



We solve a global problem of joint estimation of depths $\bar{\lambda}$ and camera registration \mathbf{C} with a system of projective constraints built on correspondences:

$$\mathbf{R}^j (\mathbf{C}^i - \mathbf{C}^j) + \bar{\lambda}_p^i \mathbf{R}^j \mathbf{R}^{i\top} \mathbf{K}^{i-1} \mathbf{x}_p^i = \lambda_p^j$$



Refinement of Surface Mesh [2]

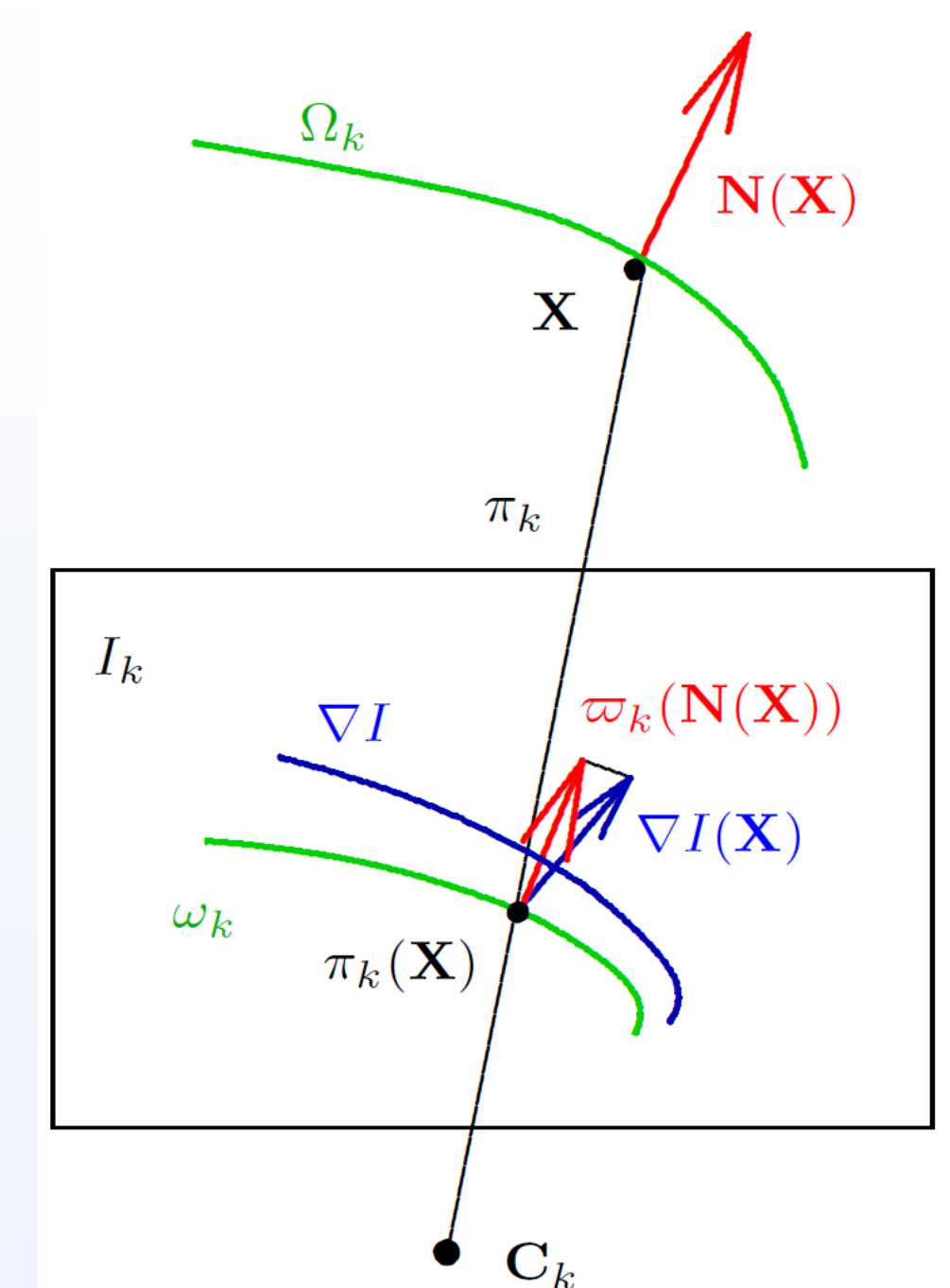
We use iterative surface flow to minimize energy

$$E_{\Omega}(S) = \int_S (\phi_I(\mathbf{X}) - \alpha \phi_C(\mathbf{X})) dA \quad (1)$$

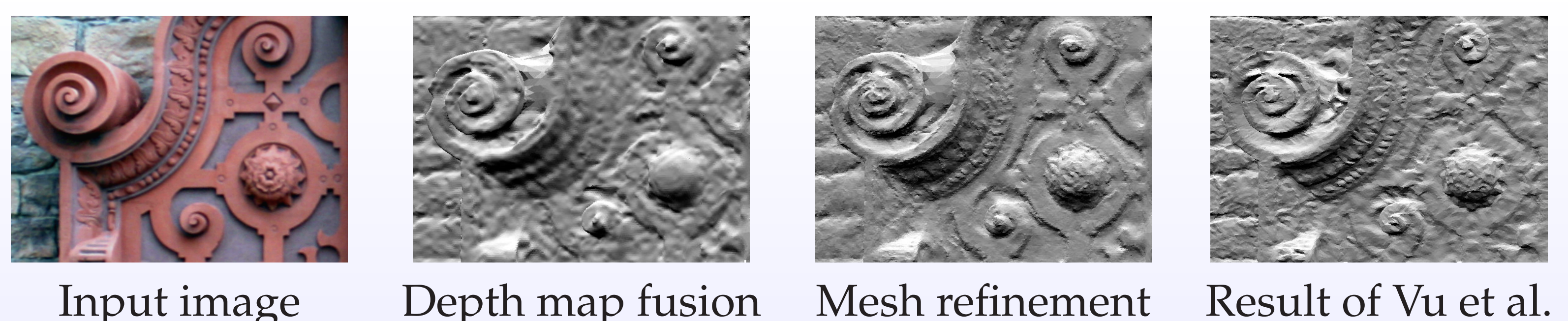
combining stereo $\phi_I(\mathbf{X})$ and contour matching:

$$\phi_C(\mathbf{X}) = \frac{1}{|\Omega(\mathbf{X})|} \sum_{k \in \Omega(\mathbf{X})} \left| \left\langle \nabla I(\pi_k(\mathbf{X})), \varpi_k(\mathbf{N}(\mathbf{X})) \right\rangle \right| \quad (2)$$

to match projection ω_k of contour generators Ω_k on a smooth surface S with local maxima of image gradient ∇I (apparent contours), taking into account their orientation.



Results on Standard Datasets [4]



References and Acknowledgements

- [1] R., Tyleček, R., Šára, Depth Map Fusion with Camera Calibration Refinement, in *Proc. Computer Vision Winter Workshop*, February 2009
 - [2] R., Tyleček, R., Šára, Refinement of Surface Mesh for Accurate Multi-View Reconstruction, in *International Journal of Virtual Reality*, March 2010
 - [3] M., Kazhdan, M., Bolitho, H., Hoppe, Poisson surface reconstruction, in *Proc. Eurographics*, 2006
 - [4] Ch., Strecha, Multi-view stereo evaluation, in cvlab.epfl.ch/~strecha/multiview/denseMVS.html
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