Master in
Computer Vision
Barcelona

Module: 3D Vision
Project: 3D recovery of urban scenes
Session 4

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Session 3

Goal: Reconstruction from two images (known internal parameters)

Mandatory tasks:

- Triangulation with the homogeneous algebraic method (DLT)
- Compute the camera matrices from the Fundamental matrix and K
- Recover the 3D points by triangulation
- Compute the reprojection error
- Depth map computation by a local method (SSD cost)
- Depth map computation by a local method (NCC cost)

Optional task:

- Improve the matching cost by using bilateral weights
- Depth map computation by belief propagation
- Depth map computation by plane sweep

Session 3

Language: MATLAB

Provided functions: lab4.m, euclid.m, apply_H_v2.m, fundamental_matrix.m, ransac_fundamental_matrix.m, ncc_cost.m, normalise2dpts.m, optical_center.m

lab4.m is the guided file with the different steps of the lab session.

fundamental_matrix.m, ransac_fundamental_matrix.m are part of the solution of lab 3.

To Do:

- Complete the code in lab4.m as indicated in the same file
- Write the functions triangulate.m and stereo_computation.m
- In the slides, comment the results as asked in lab4.m

Session 3

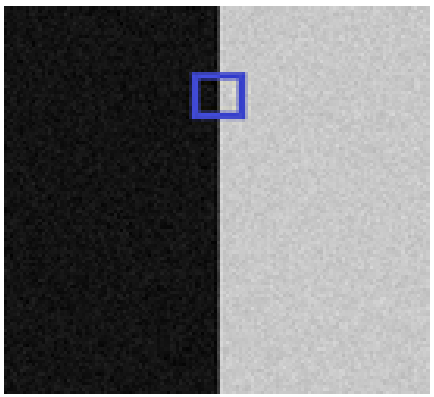
Optional part: Improve the disparity computation by using weights based on color similarity and spatial distance (as those used in the bilateral filter) using the reference paper below.

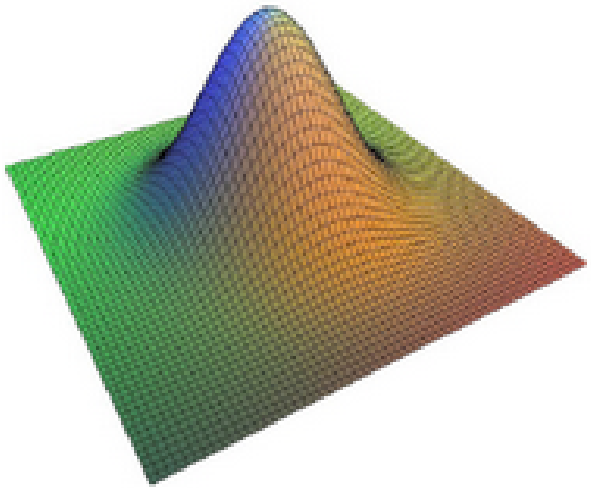
Adaptive Support-Weight Approach for Correspondence Search

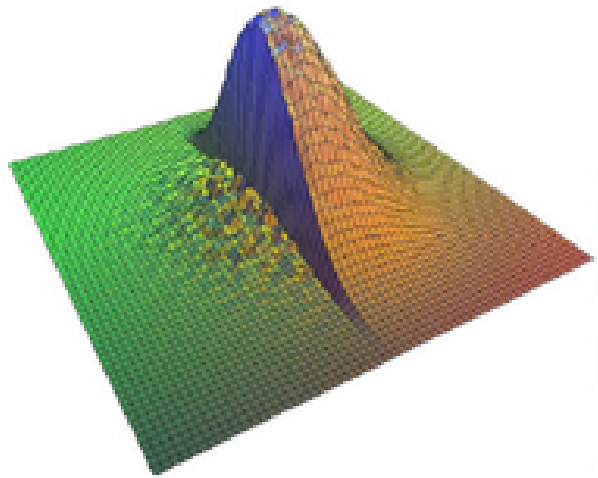
Kuk-Jin Yoon, *Student Member, IEEE*, and
In So Kweon, *Member, IEEE*

IEEE TRANSACTIONS ON PATTERN ANALYSIS AND MACHINE INTELLIGENCE, VOL. 28, NO. 4, APRIL 2006

Session 3







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Weights based on color similarity and spatial distance.

$$w(p,q) = \exp\left(-\frac{|I(p)-I(q)|}{\gamma_c} - \frac{||p-q||_2}{\gamma_p}\right)$$

Modified **cost function**:

$$C(p,\tilde{p}_d) = \frac{\sum_{q\in N_p,\tilde{q}_d\in N_{\tilde{p}_d}} w(p,q)w(\tilde{p}_d,\tilde{q}_d)c(q,\tilde{q}_d)}{\sum_{q\in N_p,\tilde{q}_d\in N_{\tilde{p}_d}} w(p,q)w(\tilde{p}_d,\tilde{q}_d)}$$

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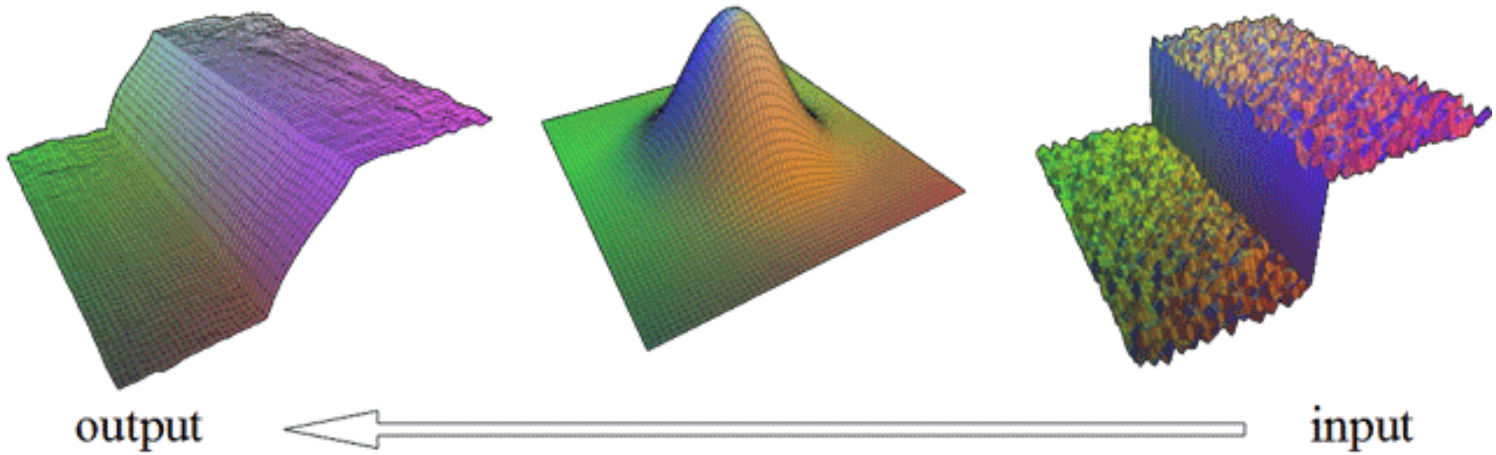

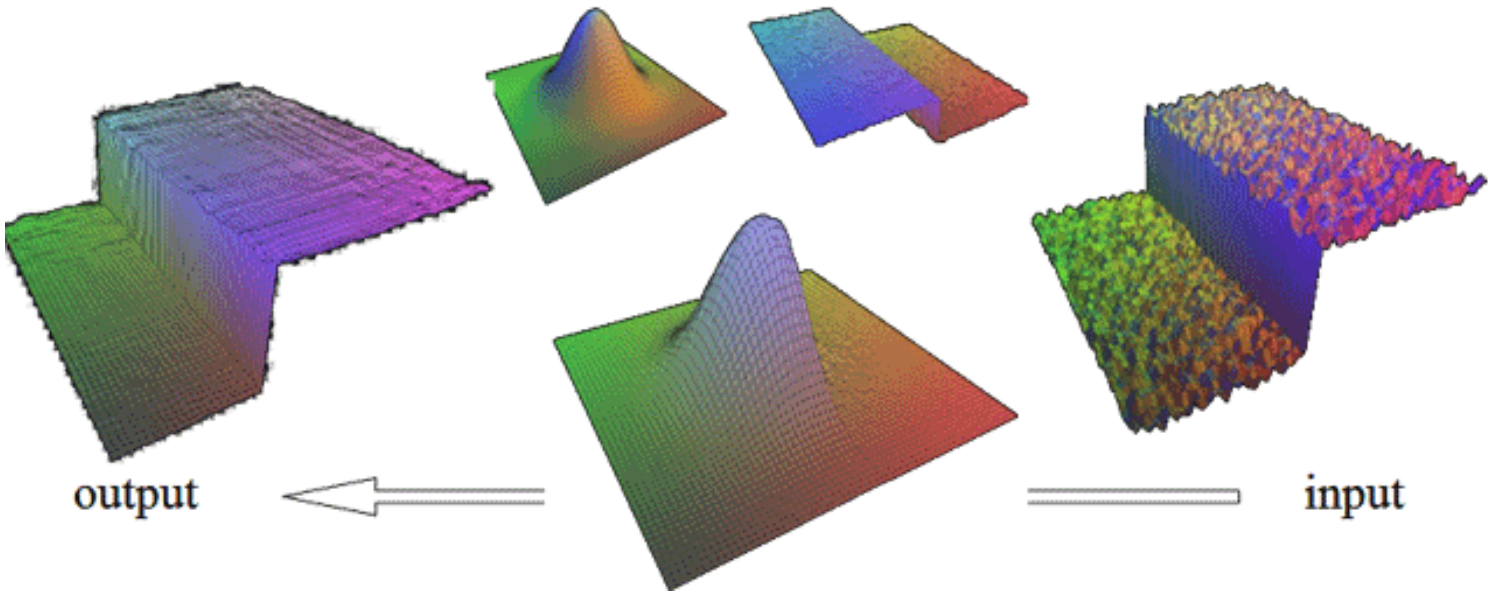

Evaluation

To deliver **before 9am of the day before** the next lab session:

- **Code deliverable:**
  - READY TO BE LAUNCHED on the provided images
- **Short document (around 10 pages):**
  - Results
  - Problems and comments

Evaluation

Grading:

- Report: **1.5 points**
- Triangulate function: **2 points**
- P, P' from F and K: **1 point**
- Reprojection error: **0.5 points**
- Depth map with SSD: **3 points**
- Depth map with NCC: **1 point**
- Depth maps with facade images: **1 point**
- Optional 6 (bilateral weights): **+1 point**
- Optional 7 (belief propagation): **+2 points**
- Optional 8 (plane sweep): **+2 points**