Research Log - Week 06

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July 28, 2016

June 20, 2016

Holding off on reading any more of [Scharstein2002] [1](*Have completed up to end of page 5*): May be too advanced for me and of little use; Compares methods, but does not go into enough detail about how to implement them. Instead reading [Scharstein1999] [2] which may be more my level.

Started reading in *Correspondance problem* section of [Scharstein1999] [2]. **SUMMARY:** Matching can be done via *Fearure based correspondacne* and *Area based correspondance*.

Feature based correpondance finds locally unique or identifiable pixels (i.e. Corners or edge gradients), matchingbetween images occurrs between these reduced set of points. Advantages are only a few points are necessary. Disadvantages are that disparity calculations are confined to these points, so interpoint disparity have to be calculated through interpolation and may not be accurate.

Area based correspondance occurrs over *regions in the image* instead of points used in feature correspondance. Advantages are a denser (and therefore more accurate) disparity map, but require assumptions about local disparity.

June 21, 2016 Continued reading [Scharstein1999] [2].

SUMMARY: 3 general methods are being differentiated:

- **Image Synthesis based on Stereo**: Uses stereo mathods for image creation.
- **Image Interpolation**: Similar to *Image Synthesis based on Stereo*, except mages generated must be on baseline, and baseline must be parallel to image planes.
- **Information from Many Images**: Includes image stitching and panoramic mosaicing.

Other sections involve summaries of various papers and methods published under each of the 3 categories.

Got further clarification on steps for coorespondance matching for *feature-based correspondance*.

1. **Preprocessing**: Color correction between stereo images for conconsitancy, and image warping through rectification so features occur at (approximatley) same horizontal distance reducing search area to the scanline.
2. **Cost Calculation**: Per-pixel cost calculation done as either a *square difference* or *absolute difference*.
3. **Aggregation**: The summing of the cost calculations over the window in question.
4. **Comparison / Calculation**: Window on feature trying to be matched is kept fixed.Window in corresponding image is moved along the scanline for a comparison of potential window aggregates. Correspondance with minimum aggregate (in difference of costs) is selected as the corresponding point in the image being scanned.
5. **Sup-pixel Calculation**: Not yet read. Could be smoothing.

Read up to section 2.2.5 *Disparity Selection* (PDF page 49, Numbered page 35). Stopped to read up on using Dynamic Programming to increase consistancy of stereo points and disparity, including following sourceses:

- `http://www.robots.ox.ac.uk/~az/lectures/opt/lect2.pdf`
- `http://www.cs.umd.edu/~djacobs/CMSC426/PS7.pdf`

June 22, 2016 Continued reading [Sharstein1999] [2]. I'm still unclear about the process (and use of) *Sub-Pixel Disparity Computation* mentioned in section 2.2.6.

I moved onto Chapter 3 (View Synthesis) and have been reading on *three-view rectification*. Read all of Section 3.1 (*Geometry*) (up to but not including PDF page 60, Numbered page 47).

SUMMARY: A new image I_3 is synthesisized from images I_1 and I_2, by estabishing reference frame containing camera centers $\mathbf{C_3}$, $\mathbf{C_1}$, and $\mathbf{C_2}$ respectively. The unit-length is established as the difference between camera centers $\mathbf{C_1}$ and $\mathbf{C_2}$. The positions are set along the x-axis such that $\mathbf{C_1} = [0,0,0]^\top$ and $\mathbf{C_2} = [1,0,0]^\top$. The xy-plane is oriented such that it contains $\mathbf{C_3} = [a,b,0]^\top$ (for some constants a and b).Images I_1 and I_2 are *horizontally rectified* (such that pixel-features occur at the same vertical position), through an *affine warp* to images I_1' and I_2' which occur in the xy-plane at $z = 1$. The synthetic image I_3 is produced from the horizontally rectified image I_3' which also occurs in the $z = 1$ plane.

Question for Kamangar: How can the homography matrix $\mathbf{H}_i = [\mathbf{R}_i|\mathbf{S}_i|\mathbf{O}_i - \mathbf{C}_i]$ be calculated if the vectors $\mathbf{R}_i$, $\mathbf{S}_i$, and $\mathbf{O}_i$ are unknown. How can they be determined from available information?

June 24, 2016 Added additional material to thesis document for *Epipolar constraint* section.

June 25, 2016 Added additional text to thesis document in *Epipolar constraint* and *Fundamental matrix* sections.

Reading up on on *homographies* and *rectification* for [Scharstein1999] [2] and for derivation of *Fundamental matrix* for thesis document.

References

[1] Daniel Scharstein and Richard Szeliski. A taxonomy and evaluation of dense two-frame stereo correspondence algorithms. *Int. J. Comput. Vision*, 47(1-3):7–42, April 2002.

[2] Daniel Scharstein. *View Synthesis Using Stereo Vision*. Springer-Verlag, Berlin, Heidelberg, 1999.