Assignment 4:

Stereo Matching

Computer Vision

National Taiwan University

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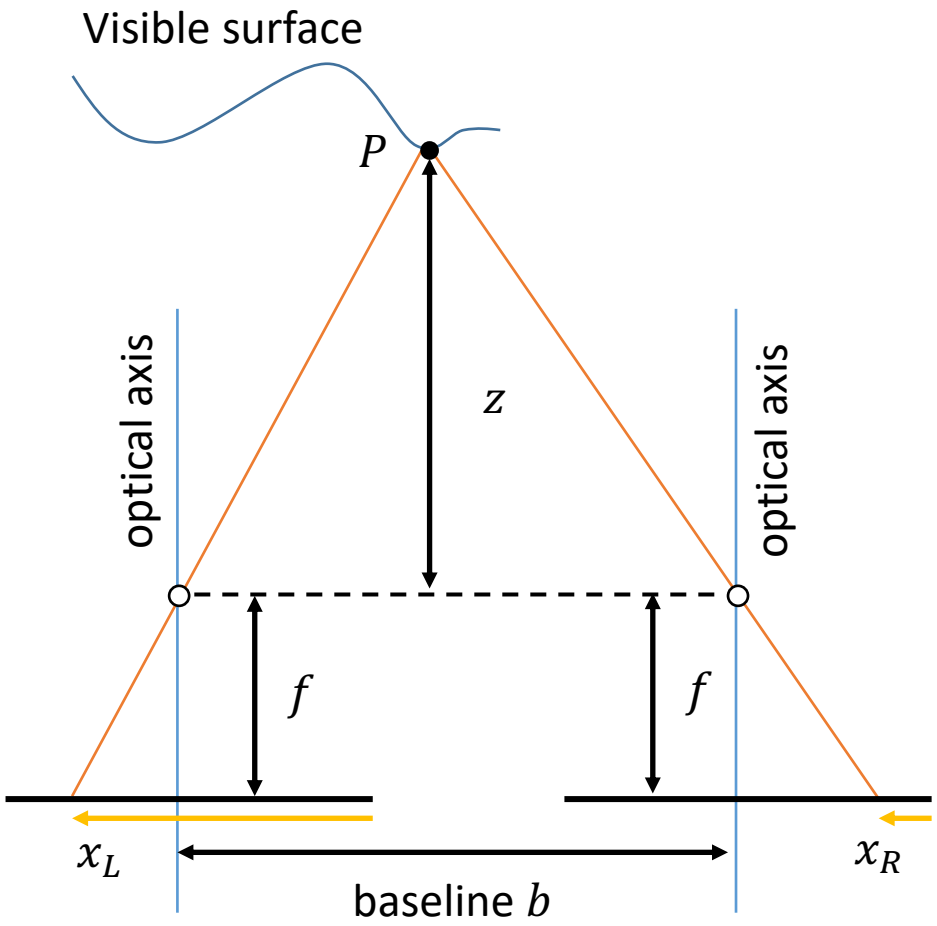
Part 1: Depth from Disparity

- Let $d = x_L - x_R$
- Prove

$$d = \frac{f \cdot b}{z}$$

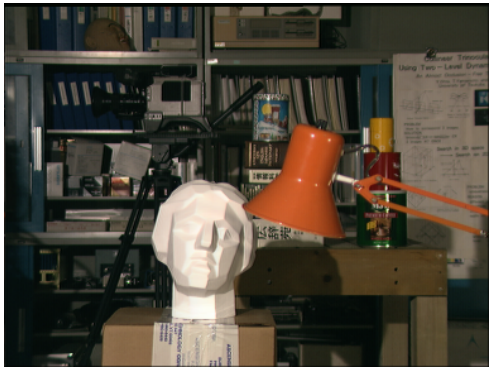
(hint: similar triangles)



Part 2: Disparity Estimation

- Compute disparity maps of the **left image** for the four standard test pairs from Middlebury v2
- Evaluation metric: bad pixel ratio (error threshold = 1)

Tsukuba



Max disp = 15
Scale factor = 16

Venus

Max disp = 20
Scale factor = 8

Teddy

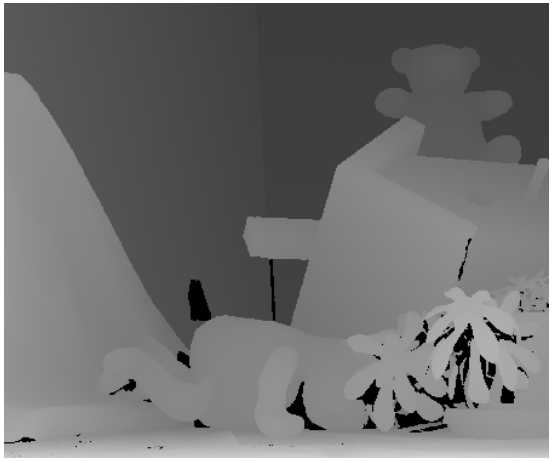
Max disp = 60
Scale factor = 4

Cones

Max disp = 60
Scale factor = 4

Part 2: Description

- Max disp : the maximum possible disparity
- Scale factor : for visualization purpose



- Bad pixel ratio , error_threshold
  - GT_valid : pixels in GT that aren't zero
  - Bad_pixel : | GT – output | > error_threshold in GT_valid
  - Bad pixel ratio = # of Bad_pixel / # of GT_valid

Part 2: Description

- Typical pipeline

```python
def computeDisp(Il, Ir, max_disp):
    h, w, ch = Il.shape
    labels = np.zeros((h, w), dtype=np.float32)
    Il = Il.astype(np.float32)
    Ir = Ir.astype(np.float32)
    # >>> Cost computation
    # TODO: Compute matching cost from Il and Ir

    # >>> Cost aggregation
    # TODO: Refine cost by aggregate nearby costs

    # >>> Disparity optimization
    # TODO: Find optimal disparity based on estimated cost. Usually winner-take-all.

    # >>> Disparity refinement
    # TODO: Do whatever to enhance the disparity map

    return labels.astype(np.uint8)
```

- You can also use other methods !
  - Except for deep learning

Part 2: Regulations

- Implement your code in computeDisp.py
- Evaluate using eval_stereo.py
  - We will run ***python3 eval_stereo.py*** to test your function for grading
  - Do not edit this file !
  - If you only pass the score using your own eval_stereo.py will not get any points
- Do not use deep matching costs
- If runs longer than 30 minutes will only get 70 % score for part 2
- Materials [link]

Part 2: Regulations

- packages:
  - You can not use library that directly help compute disparity.
  - You can use any library to help generate sub-results (ex. median filters, bilateral filters, box filters,….).
  - If you are not sure whether some libraries are permitted, you need to ask TA (FB Q&A or e-mails).

Grading (Total 15 %)

- Part2: 10%

Table. Score vs. bad pixel ratio

Score	Tsukuba	Venus	Teddy	Cones
10	< 8	< 5	< 18	< 15
8	>= 8	>= 5	>= 18	>= 15
3	>= 9	>= 7	>= 24	>= 20
0	>= 10	>= 10	>= 30	>= 25

  - Ranking according to your avg. score among the class
    - (Bonus) If top 10(+1%)
- Report : 1%(Part1) + 4% = 5%

Report

- Your student ID and name
- Part 1
  - Write down your proof.
- Part 2
  - Explain your algorithm in terms of the standard 4-step pipeline.
    (cost computation, cost aggregation, disp. optimization, disp. refinement)
  - Show your output disparity maps in the report.
  - Show your bad pixel ratio of each disparity maps in the report.
  - Your reference papers or websites.

Submission

- Code: *.py (Python 3.5+)
- A PDF report (StudentID.pdf, ex. R07654321.pdf)
- Put all above files in a directory named StudentID and compress to a zip file named StudentID.zip
  - Other compression format (ex: rar, tar.gz….) are **NOT** allowed
  - e.g. R07654321.zip
- Your grade will be multiplied by 0.8 if you have any format error.
- Submit to CEIBA
- Deadline: 12/25 11:00 pm