Problem Session 1

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Logistics

• When & Where
  • Lectures: Mondays & Wednesdays 4:30-5:50pm, Skilling Auditorium
  • Problem sessions: Friday, 3:30-4:20pm, Gates B01
  • TA Office hours: Mondays before class (3:20-4:20pm), Packard 106
  • Prof. Office hour: Wednesdays before class (3:20-4:20pm), Packard 236

• Problem sessions:
  • Explanation of HW and hints
  • Opportunity to ask questions!
Logistics

• Requirements & Grading:
  • 6 assignments: 40% total
  • Midterm: 20% (week 8, instead of class)
  • Major final project: 40%

• HW:
  • Published on Wednesday and due on Friday the week after at noon.
  • Submission with Gradescope (code 9Z5B3M)
  • No late-days. 30% penalty if you submit 24h after submission deadline.
  • Solutions to tasks should be on separate pages and include text, images and code
Logistics

• Resources:
  • Class website: http://stanford.edu/class/ee367/
  • SCPD – Videos of lectures and problem sessions (https://mvideox.stanford.edu/Course/865)
  • Gradescope – Submit HW and view your grade (9Z5B3M)
    • SCPD students also submit to Gradescope (no need to go through SCPD for homework)
  • Piazza – Class forum (piazza.com/stanford/winter2017/ee367)

• Packard 021: Room with computers with Matlab (+ optimization and image processing toolboxes).
  • If you want to use it, ask TAs for door key code

• Remote Access to machines with Matlab using Microsoft Remote Desktop
  • Username: win\SUNetID
  • Password: your Leland Password
  • Device Name: rm021-1.stanford.edu through rm021-20.stanford.edu

• Emails: ee367-win1617-students@lists.stanford.edu, ee367-win1617-staff@lists.stanford.edu
Task 1 & 2: Create a pinhole camera

• A simple camera without a lens, effectively a light-proof box with a small hole in one side.

• Also known as camera obscura, or "dark chamber“ (Latin)

Optimal pinhole diameter:

$$d = 2\sqrt{f\lambda}$$

\(f\): distance from pinhole to image plane  
\(\lambda\): wavelength of light
Task 1 & 2: Create a pinhole camera
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During the Renaissance, pinhole cameras were used to draw realistic views (perhaps used in Vermeer’s paintings)
Task 1 & 2: Create a pinhole camera

- Pinhole
- Camera lens goes here
- Image is created here
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Task 3: Create a hybrid image

A hybrid image is an image that is perceived in one of two different ways, depending on viewing distance


http://cvcl.mit.edu/hybrid_gallery/gallery.html
Task 3: Create a hybrid image

→ Contrast sensitivity changes with frequency

For medium frequency you need less contrast than for high or low frequency to detect the sinusoidal fluctuation.
Task 3: Create a hybrid image

Low spatial frequencies of first image + High spatial frequencies of second image = Image with an interpretation that changes with viewing distance
Task 3: Create a hybrid image

• dpi = dots per inch, defines the physical size of a pixel on paper
• Pixels per degree, depends on the distance

\[ \frac{\delta}{2D} = \tan\left(\frac{\theta}{2}\right) \]

\[ \delta = 2D \tan\left(\frac{\theta}{2}\right) \]

To obtain the pixels per degree, \( \theta = 1^\circ \).
Calculate \( \delta \) → How many pixels are in \( \delta \)?
Task 3: Create a hybrid image

• Peak of the contrast sensitivity function (CSF) is at 5 cycles per visual degree

Peak contrast is at 5 \( \frac{\text{cycles/degree}}{\text{pixels/degree}} \rightarrow \frac{5}{\text{cycles/pixel}} \rightarrow ? \frac{\text{cycles/mm}}{\text{pixels/mm}} \)

* A function of \( D \), see previous slide
Task 3: Create a hybrid image

- **Image frequency**
  - Physical frequency, e.g. cycles per mm, on the page
  - Frequency compared to the maximal (Nyquist) frequency
  - Maximal frequency in units of \( \text{cycles/pixel} \) is 0.5

Nyquist frequency = \( \frac{1}{2} \times \text{pixel size [cycles/mm]} = \frac{1}{2} \text{ [cycles/pixel]} \)
Task 3: Create a hybrid image

High-pass and low-pass filters

Helpful Matlab functions: meshgrid, fft2, fftshift, ifft2,
Task 3: Create a hybrid image

Result
Fun additions

• Stereoscope at OMCA (Oakland museum of CA – free every first Sunday)

• Blur visual cues: https://www.youtube.com/watch?v=Wf4_bcrJ864