National Tsing Hua University
Department of Electrical Engineering
EE6620 Computational Photography (計算攝影學), Spring 2020

Instructor: **Chao-Tsung Huang (黃朝宗)**
Office: DELTA R929
Email: chaotsung@ee.nthu.edu.tw

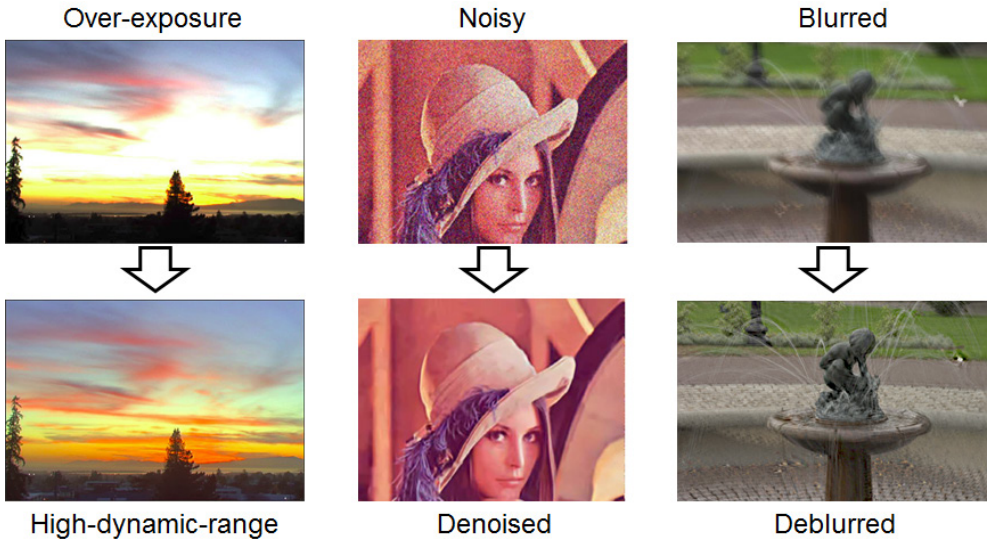
Prerequisites: Linear algebra, probability, digital signal processing (better), Python (better)

Course Description

Computational photography studies problems about image capture and processing that uses digital computation. For pictures captured by traditional photography, it can alleviate some common problems, e.g. image noise in low-light condition, blurred images for long exposure time, over-exposure under sunlight. In addition to quality improvement, it can also generate novel pictures for different applications, such as 360-degree image/video, free-viewpoint 3D TV, digital refocusing, and video frame interpolation. This course covers from image formation basics to advanced techniques as follows:

Part I – Image formation: photometric formation, digital camera, color space, HDR;
Part II – Optimization-based processing: denoising, deblurring, super-resolution, ProxImaL;
Part III – Convolutional networks: basics and related image processing applications, GAN;
Part IV – Selected topics: realistic rendering and light-field processing.

We will focus on how to model each real-world problem in mathematics (mostly linear algebra and probability) and then introduce classical and/or state-of-the-art solutions accordingly.



Teaching Method

Lectures are given every week at DELTA 211R. There will be **three** programming homework assignments in **Python** and **one** term project for exercising how to convert interesting ideas to practical implementations.

Evaluation

Homework (60%) – each assignment 20%
Term Project (40%) – details will be declared later

Grading Rules:

1. One original work deserves only one credit. For example, if five students deliver the same (or very similar) programs for homework, the grades will be averaged by five. If the original work deserves 100 points, each one will get only 20 points. Rebuttal is allowed.
2. For homework, the grading equation for late delivery is
   New grade = (original grade)x$0.9^{(\text{delievery date} - \text{due date})}$
3. For term project, no late delivery is allowed.

Syllabus

Week	M3M4	W3	Lecture (台達211)	HW out	HW due
1	2/17	2/19	Overview: Syllabus and Introduction		
2	2/24	2/26	Photometric image formation and digital camera		
3	3/2	3/4	Color Space		
4	3/9	3/11	High dynamic range; Python tutorial	1	
5	3/16	3/18	Image denoising		
6	3/23	3/25	Image deblurring		
7	3/30	4/1	Optimization-based image processing	2	1
8	~~4/6~~	4/8	Super-resolution		
9	4/13	4/15	Convolutional Neural Networks (CNN)		
10	4/20	4/22	CNN-based super-resolution	3	2
11	4/27	4/29	CNN-based image processing applications **Project Annoucement**		
12	~~5/4~~	~~5/6~~	*No class (ICASSP)*		
13	5/11	5/13	Generative adversarial networks (GAN)		3
14	5/18	5/20	Realistic rendering: view synthesis, refocusing, frame Interpolation		
15	5/25	5/27	Video magnificaiton; Phase-based signal processing **Interim Presentation**		
16	6/1	6/3	Light-field signal processing		
17	~~6/8~~	~~6/10~~	*No class (project)*		
18	6/15		**Final Presentation**		

Textbook

None. (lecture notes will be given before each class)

References

1. Richard Szeliski, *Computer Vision: Algorithms and Applications*, Springer 2010.
2. Selected papers [references will be given in lecture notes].

Course Link

iLMS

Teaching Assistant

TBD