National Tsing Hua University
Department of Electrical Engineering
EE6650 Video Signal Processing（視訊處理）, Spring 2015

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Prerequisites: Probability, Linear Algebra, Signals and Systems

Course Description

Digital video is everywhere nowadays and already accounts for more than 60% of all consumer internet traffic as of 2013. Almost all of the videos you watch on your devices are through a complex flow: light-to-electron conversion, color space transformation, image/video processing, and finally data compression. Students will learn about these technologies in this course and will have a good understanding about the videos you are always watching.

This course offers a graduate-level introduction to the fundamentals of video signal processing. It covers video basics, color space, motion estimation, stereo 3D, and especially video coding. Both theoretical backgrounds and practical image/video coding formats will be introduced.

Teaching Method

Lectures are given with slides which will be available before each lecture. There will be four programming homework assignments and one term project. Oral presentation will be required for the project. For encouraging participation, several *Do-You-Know* Easter Eggs will be given.

Evaluation

Homework (60%) – each assignment 15%
Term Project (40%) – details to be given on April 28th

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, C/C++ is recommended. Otherwise, your grade will be multiplied by 85%.
3. For homework, the grading equation for late delivery is
$$\text{New grade} = (\text{original grade}) \times 0.9^{(\text{delievery date} - \text{due date})}$$
4. For term project, no late delivery is allowed.

Syllabus

Date	Topic	HW out	HW due
24 Feb	**L1: Introduction and Overview**		
26 Feb, 3/5/10 Mar	**L2: From Light to Your Eyes - Human Visual System and Color Space**	1	
12/17 Mar	**L3: Hybrid Video Coding and Motion Estimation**		
19/24/26 Mar	**L4: Stereo 3D Applications and Disparity Estimation**	2	1
31 Mar, 2/7 Apr	**Fundamentals of Video Coding (L5~L8)** **L5: Part I - Entropy and Entropy Coding**		
9/14/16 Apr	**L6: Part II - Predictive Coding and Motion Compensation**	3	2
21/23 Apr	***No Class***		
28/30 Apr, 5 May	**L7: Part III - Transform Coding and Fast DCT Implementation**	4	3
5/7/12 May	**L8: Part IV - Quantization, In-Loop Filter, and Visual Quality Assessment**		
14/19 May	**L9: JPEG Standard**		4
19/21 May	**L11: MPEG-1 (VCD) and MPEG-2 (DVD)**		
26/28 May	**L12: H.264/AVC, Part I - Algorithm and Application** (from Blu-ray to YouTube)		
2/4 Jun	**L13: H.264/AVC, Part II - Rate-Distortion Optimization Framework**		
9/11 Jun	***No Class***		
16/18 Jun	**L14: H.265/HEVC - The Latest Video Coding Standard**		
Project related:			
28 Apr	Project Annoucement		
14 May	Project Team Up		
2 Jun	Project Progress Report		
23 Jun	**Term Project Report and Demo**		

Textbook

None.

References

Lecture notes mainly based on:

- Y. Wang, *et. al.*, *Video Processing and Communications*, Prentice Hall, 2002.
- C. Poynton, *Digital Video and HD: Algorithms and Interfaces, 2nd edition*, Morgan Kaufmann, 2012.
- S. Winkler, *Digital Video Quality: Vision Models and Metrics*, Wiley, 2005.
- C. Shannon, "A Mathematical Theory of Communication," *The Bell System Technical Journal*, 1948.
- R. J. Clarke, *Transform Coding of Images*, Academic Press, 1985.
- E. Richardson, *The H.264 Advanced Video Compression Standard, 2nd edition*, Wiley, 2010.
- M. Tekalp, *Digital Video Processing*, Prentice Hall, 1995.
- Y. Q. Shi, *et. al.*, *Image and Video Compression for Multimedia Engineering*, CRC Press, 2008.
- V. Sze, *et. al.*, *High Efficiency Video Coding (HEVC): Algorithms and Architectures*, Springer 2014.
- Coding standards and selected papers

Course Link

iLMS website