Video Compression
視訊壓縮

Yu-Lun (Alex) Liu
劉育綸

with slides by Wen-Hsiao Peng,
Shao-Yi Chien,
Hsueh-Ming Hang,
and Aggelos K. Katsaggelos

I have their permissions.
So please don't make me famous on Dcard 🙏

Logistics

- 中文授課
- Time:
  - 1:20 pm-3:10 pm, Monday
  - Another one-hour video will be uploaded to E3 before 11:59 am, Thursday
  - Videos will be uploaded on E3 after classes
  - Sometimes (attending conferences, submitting papers, etc.), I will upload the videos to E3 directly without in-person classes (will notify beforehand via E3)
- Classroom: EC016
- 教室預計整修至 10 月底，因此在教室整修完成前以 Google Meet 線上上課

Logistics

- Prerequisites:
  - Signals and Systems
  - Digital Signal Processing
- Reference textbooks (**No need to buy!**):
  - Mathias Wien, High Efficiency Video Coding: Coding Tools and Specification, Springer-Verlag Berlin Heidelberg, 2015.
  - Iain E. Richardson, The H.264 Advanced Video Compression Standard, Wiley, 2nd Edition, 2010.
  - Y. Wang, J. Ostermann, and Y. Q. Zhang, Video Processing and Communications, Prentice-Hall, 2001.

Grading

- 4 homework assignments (C++ / python / MATLAB): 60%
- Paper presentation: 10%
- Final project: 25%
- Attendance (invited talks, will be announced via E3 beforehand): 5%

- No mid-term, final exams
- All the recorded lecture videos will be uploaded on E3 after classes

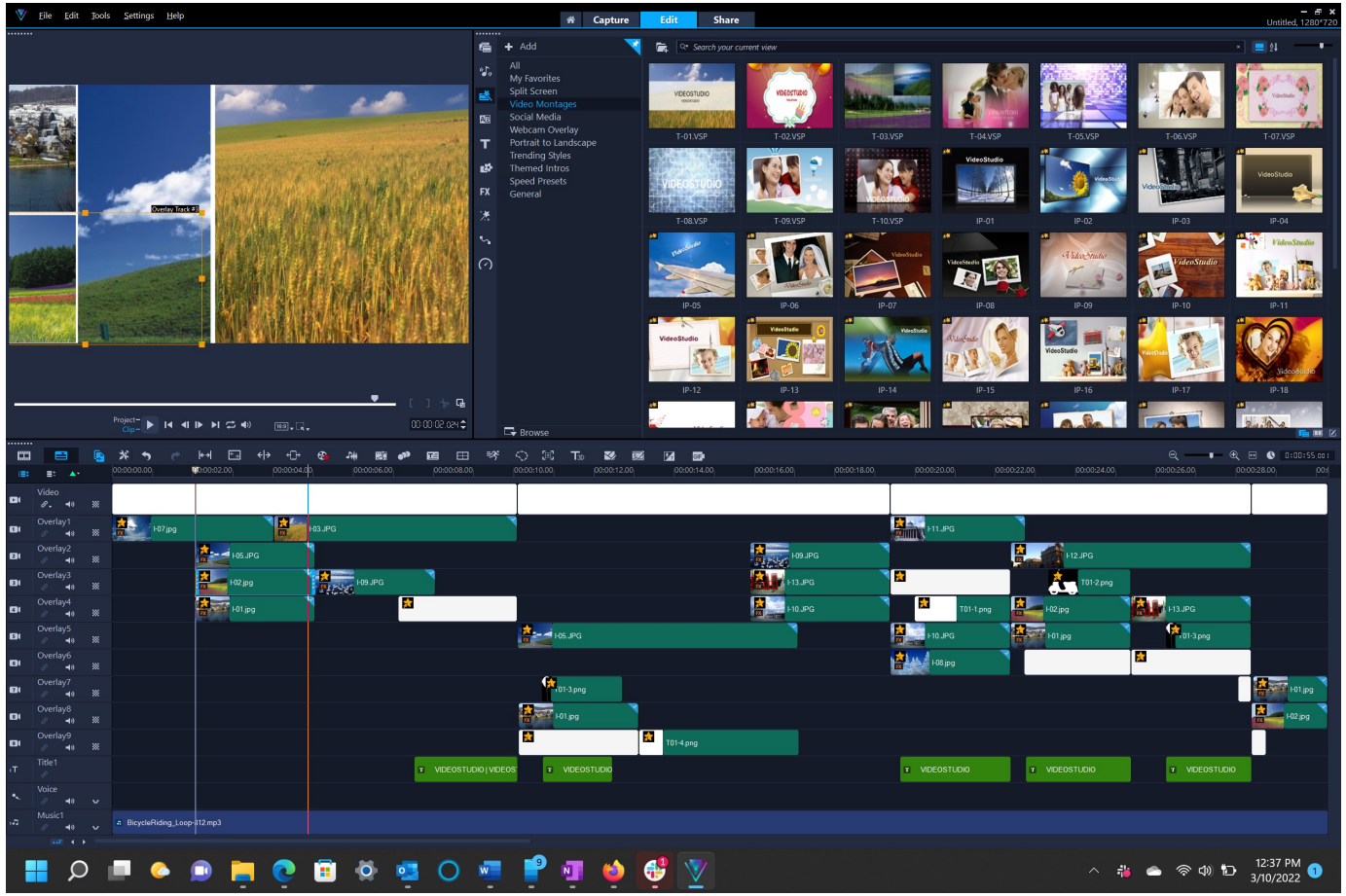
- **Late policy -> zero credit for that specific deliverable**

Week	Date	Topic	Assignments
1	2025-09-01		
2	2025-09-08	Introduction to Image and Video Processing	
3	2025-09-16	Signals and Systems	#1 – Color Transform, due: 2025-09-29 1:19pm
4	2025-09-22	Fourier Transform and Sampling	
5	2025-09-29	教師節補假	
6	2025-10-06	中秋節	
7	2025-10-13	Fourier Transform and Sampling	#2 – 2D-DCT, due: 2025-10-27 1:59pm
8	2025-10-20	Motion Estimation	Final project assigned (group together in fours)
9	2025-10-27	Lossless Compression	#3 – MEMC, due: 2025-11-10 1:59pm
10	2025-11-03	Image Compression	
11	2025-11-10	Video Compression	#4 – Entropy coding, due: 2025-11-24 1:59pm
12	2025-11-17	Learning-based Image/Video Compression	
13	2025-11-24	Paper Presentation	
14	2025-12-01	Guest Lecturer – MEDIATEK Meta NETFLIX	
15	2025-12-08	Guest Lecturer – MEDIATEK Meta NETFLIX	
16	2025-12-15	Final Project Presentation	

This course is NOT about …

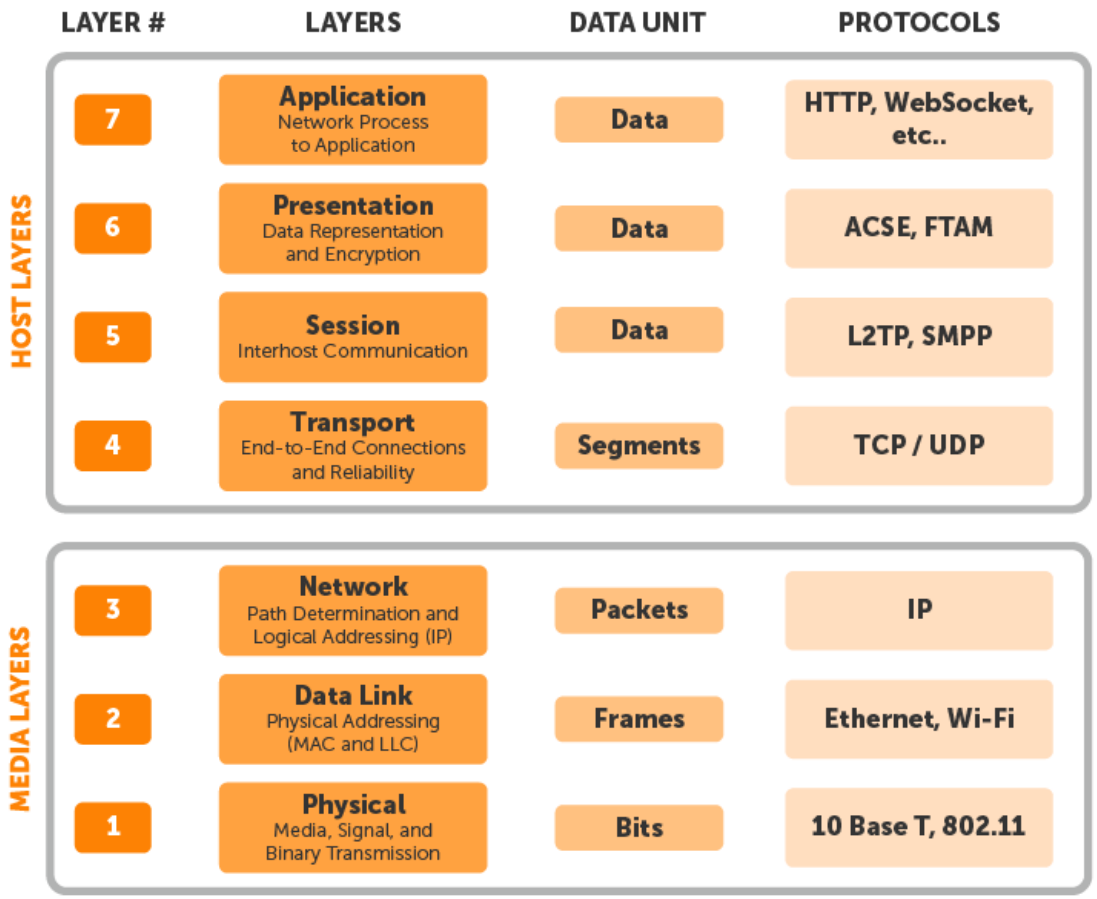
Video production or filmmaking

Video editing software

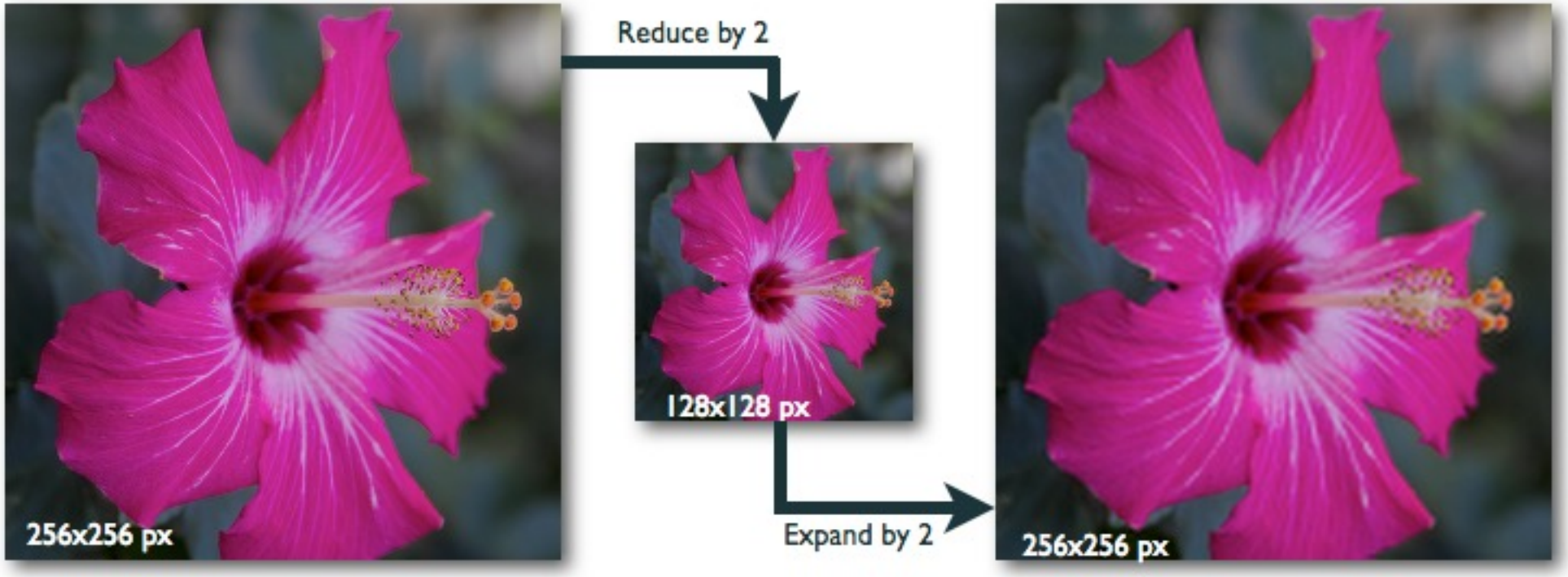


Streaming platform development

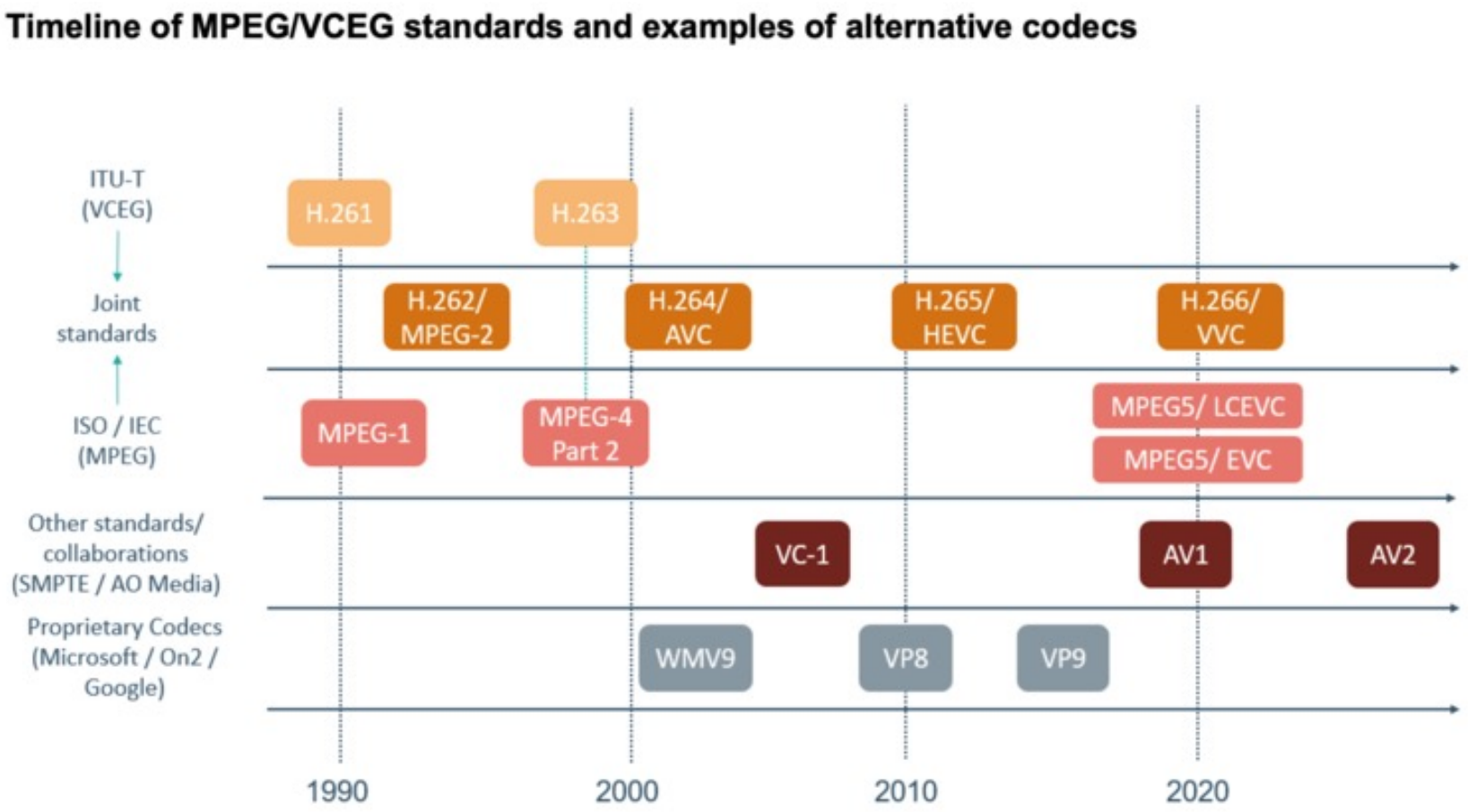
Network protocols for video transmission



Image/Video resizing



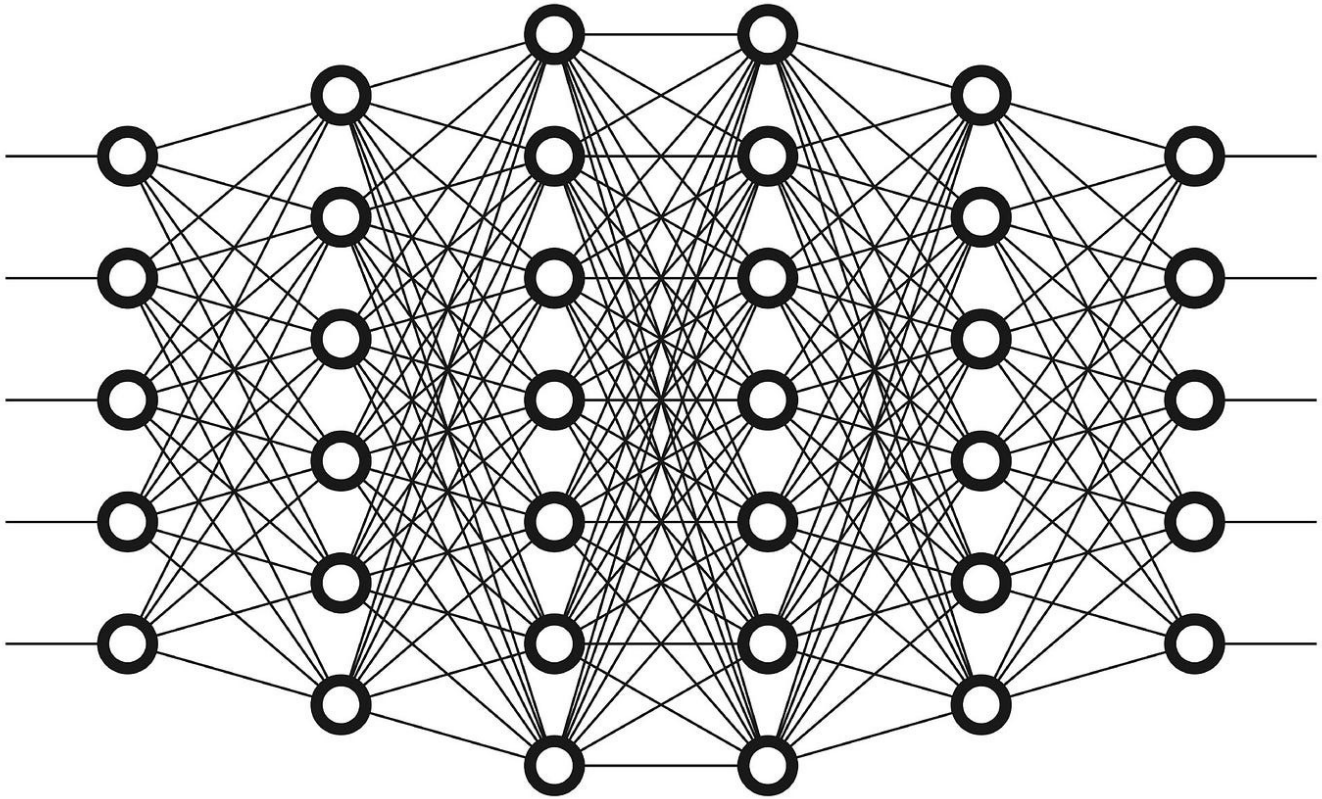
Implementing/Modifying standard software



FFMPEG

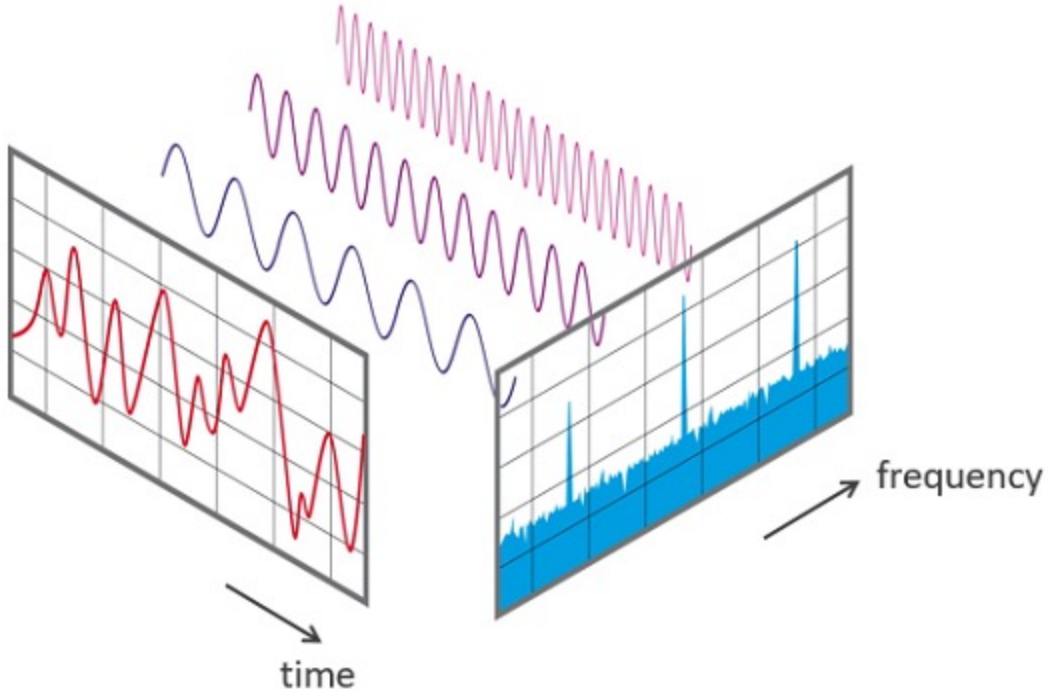
```
┌──(kousekip㉿ako-kaede-mirai)-(02:57pm on 06/08)─┐
└─(something_else)─$ ffmpeg -i FFmpeg_4.4_screenshot.png FFmpeg_4.4_screenshot.webp
ffmpeg version 4.4 Copyright (c) 2000-2021 the FFmpeg developers
  built with gcc 11.1.0 (GCC)
  configuration: --prefix=/usr --enable-lto --disable-rpath --enable-gpl --enable-version3 --enable-nonfree --enable-shared --
disable-static --disable-stripping --enable-gray --enable-avresample --enable-alsa --enable-avisynth --enable-bzlib --enable-c
hromaprint --enable-frei0r --enable-gcrypt --enable-gmp --enable-gnutls --enable-iconv --enable-ladspa --enable-libaom --enabl
e-libaribb24 --enable-libass --enable-libbluray --enable-libbs2b --enable-libcaca --enable-libcelt --enable-libcdio --enable-l
ibcodec2 --enable-libdav1d --enable-libdavs2 --enable-libdc1394 --enable-libfdk-aac --enable-libflite --enable-fontconfig --en
able-libfreetype --enable-libfribidi --enable-libglslang --enable-libgme --enable-libgsm --enable-libiec61883 --enable-libilbc
 --enable-libjack --enable-libklvanc --enable-libkvazaar --enable-liblensfun --enable-libmodplug --enable-libmp3lame --enable-
libopencore-amrnb --enable-libopencore-amrwb --disable-libopencv --enable-libopenh264 --enable-libopenjpeg --enable-libopenmpt
 --disable-libopenvino --enable-libopus --enable-libpulse --enable-librabbitmq --enable-librav1e --enable-librist --enable-lib
rsvg --enable-librubberband --enable-librtmp --enable-libshine --enable-libsmbclient --enable-libsnappy --enable-libsoxr --ena
ble-libspeex --enable-libsrt --enable-libssh --enable-libsvthevc --enable-libsvtav1 --disable-libtensorflow --enable-libtesser
act --enable-libtheora --disable-libtls --enable-libtwolame --enable-libuavs3d --enable-libv4l2 --enable-libvidstab --enable-l
ibvmaf --enable-libvo-amrwbenc --enable-libvorbis --enable-libvpx --enable-libsvtvp9 --enable-libwebp --enable-libx264 --enabl
e-libx265 --enable-libxavs --enable-libxavs2 --enable-libxcb --enable-libxcb-shm --enable-libxcb-xfixes --enable-libxcb-shape
 --enable-libxvid --enable-libxml2 --enable-libzimg --enable-libzmq --enable-libzvbi --enable-lv2 --enable-lzma --enable-deckli
nk --disable-mbedtls --enable-libmysofa --enable-openal --enable-opencl --enable-opengl --disable-openssl --enable-pocketsphin
x --enable-sndio --enable-sdl2 --enable-vapoursynth --enable-vulkan --enable-xlib --enable-zlib --enable-amf --disable-cuda-nv
cc --disable-cuda-llvm --disable-cuvid --disable-ffnvcodec --enable-libdrm --disable-libmfx --disable-libnpp --disable-nvdec -
-disable-nvenc --enable-omx --disable-rkmpp --enable-v4l2-m2m --enable-vaapi --enable-vdpau
  libavutil      56. 70.100 / 56. 70.100
  libavcodec     58.134.100 / 58.134.100
  libavformat    58. 76.100 / 58. 76.100
  libavdevice    58. 13.100 / 58. 13.100
  libavfilter     7.110.100 /  7.110.100
  libavresample   4.  0.  0 /  4.  0.  0
  libswscale      5.  9.100 /  5.  9.100
  libswresample   3.  9.100 /  3.  9.100
  libpostproc    55.  9.100 / 55.  9.100
Input #0, png_pipe, from 'FFmpeg_4.4_screenshot.png':
  Duration: N/A, bitrate: N/A
  Stream #0:0: Video: png, rgb24(pc), 1014×579, 25 fps, 25 tbr, 25 tbn, 25 tbc
Stream mapping:
  Stream #0:0 → #0:0 (png (native) → webp (libwebp_anim))
Press [q] to stop, [?] for help
Output #0, webp, to 'FFmpeg_4.4_screenshot.webp':
  Metadata:
    encoder         : Lavf58.76.100
  Stream #0:0: Video: webp, bgra(pc, progressive), 1014×579, q=2-31, 200 kb/s, 25 fps, 1k tbn
    Metadata:
      encoder         : Lavc58.134.100 libwebp_anim
[libwebp_anim @ 0×55ef76a18c40] Using libwebp for RGB-to-YUV conversion. You may want to consider passing in YUV instead for l
ossy encoding.
frame=    1 fps=0.0 q=-0.0 Lsize=     109kB time=00:00:00.04 bitrate=21719.0kbits/s speed=0.394x
video:109kB audio:0kB subtitle:0kB other streams:0kB global headers:0kB muxing overhead: 0.000000%
```

Deep learning



This course is about …

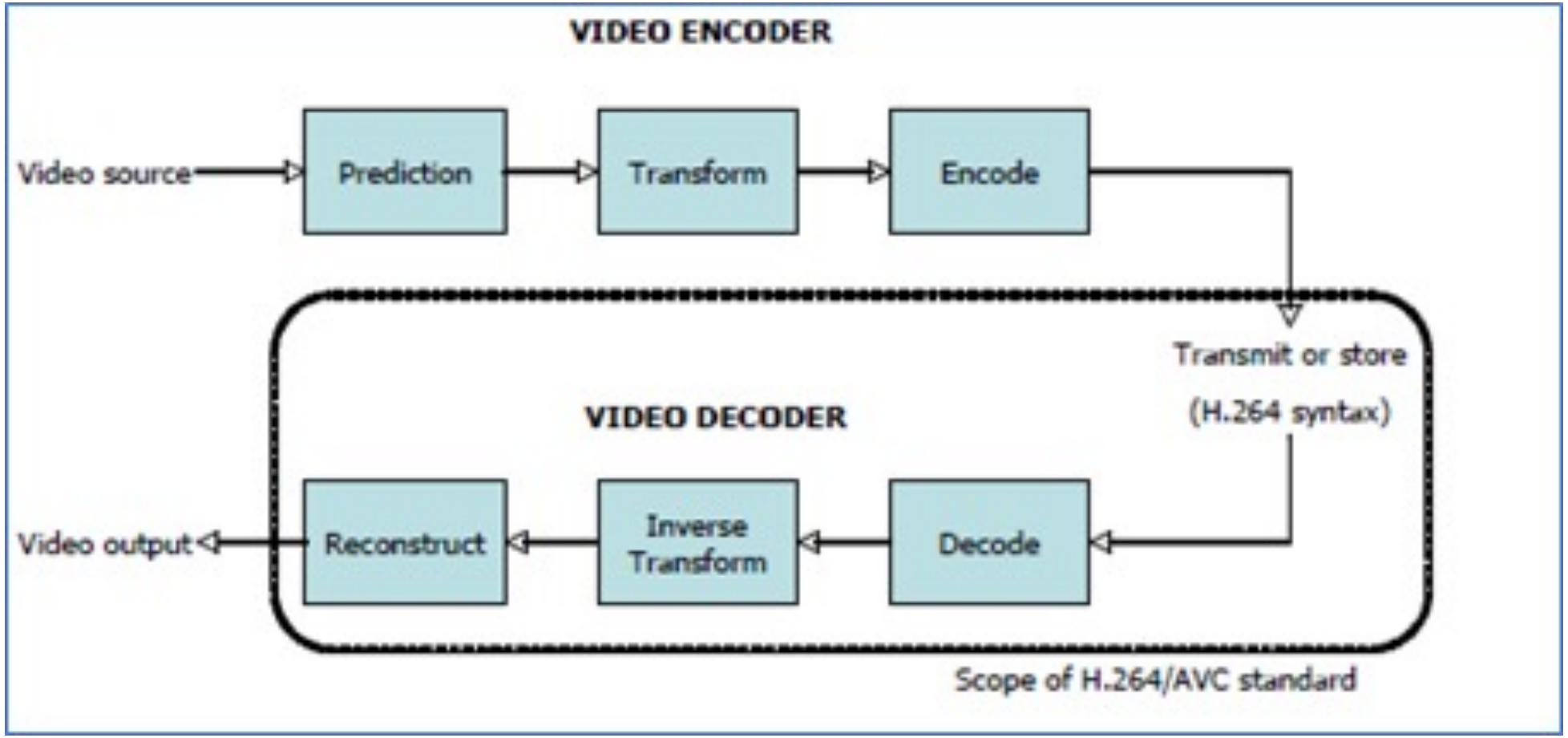
Basic concepts in signal processing



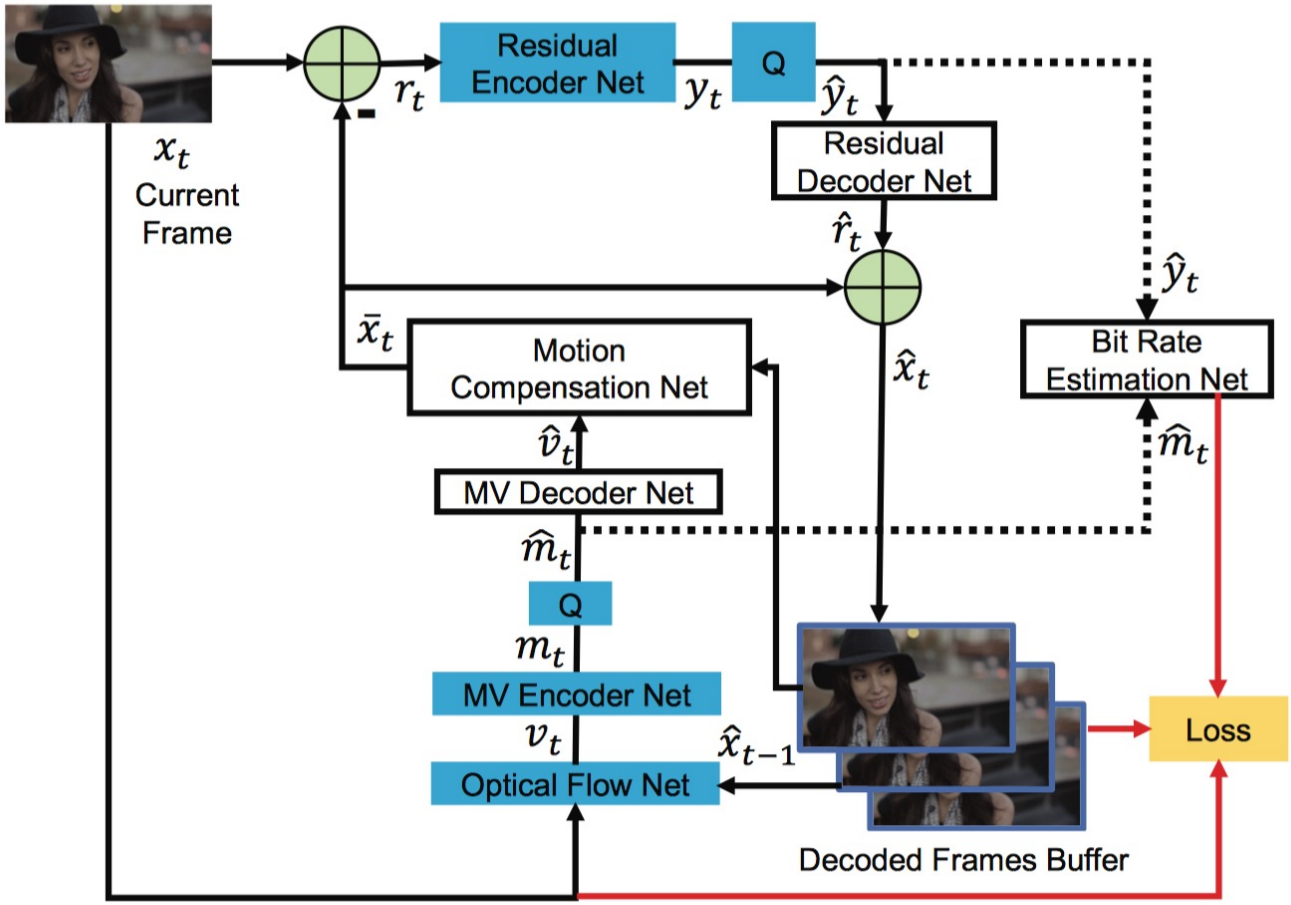
Modeling motions in videos

Compressing data into bitstreams

Basic concepts and components in standard



ML + Compression



Guest lecturers from the industry

Dr. Yu-Wen Huang
MediaTek Inc.

Dr. Li-Heng Chen
Netflix

I do **NOT** do compression research

Yu-Lun Liu | 劉育綸

National Chiao Tung University
B.S. and M.S. both in EE

National Taiwan University
Ph.D. in CS

Academia

2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023

Industry

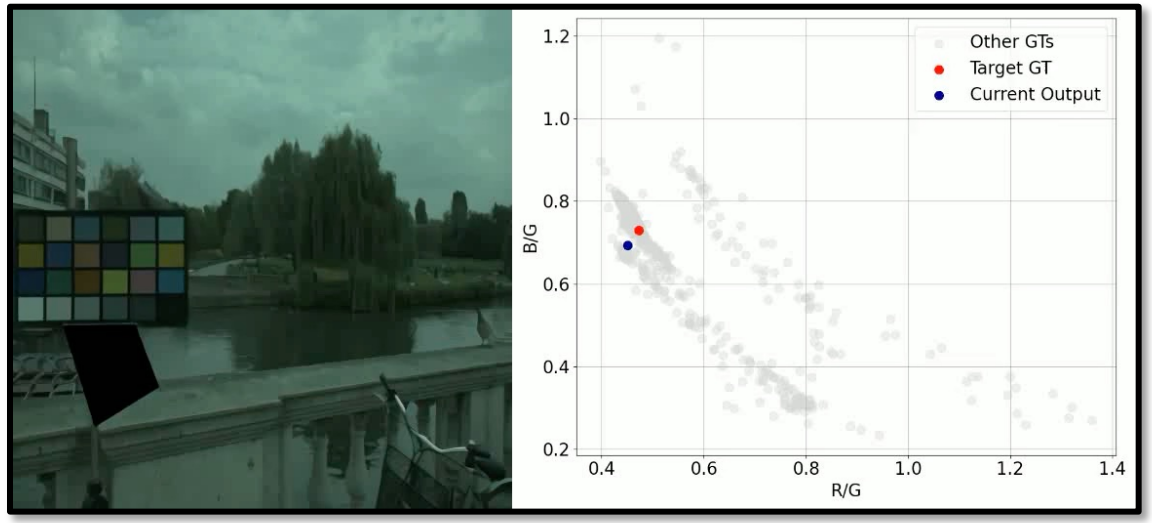
MediaTek Inc.
Algorithm Development Engineer

Meta Reality Labs Research
Research Scientist Intern

My Research Interests: Computer Vision (電腦視覺)

- **Image and Video Synthesis and Generation**
  - GAN/Diffusion models
- **3D from Multi-view and Sensors**
  - NeRFs/3DGS
- **Low-level Vision**
  - Restoration/Enhancement

Image and Video Synthesis and Generation



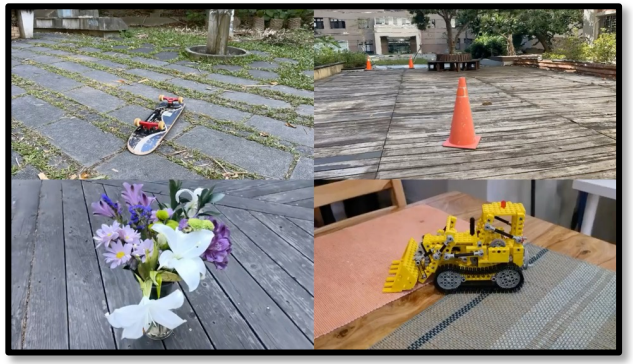
GCC [CVPR'25]

NaRCan [NeurIPS'24]

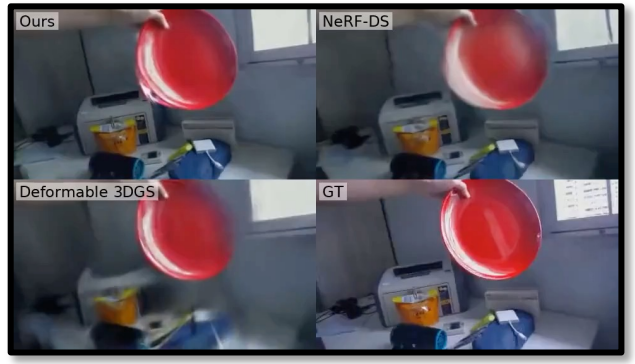
3D from Multi-view and Sensors

StealthAttack
[ICCV'25]

LongSplat
[ICCV'25]



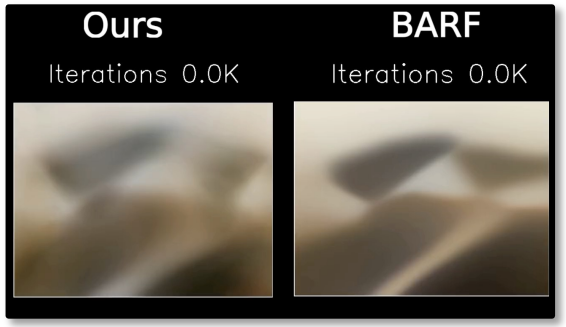
AuraFusion360
[CVPR'25]



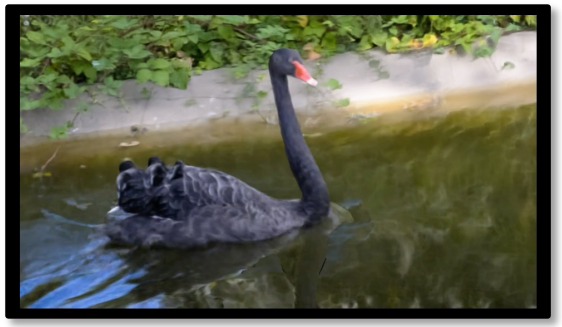
SpectroMotion
[CVPR'25]

FrugalNeRF
[CVPR'25]

BoostMVSNeRFs
[SIGGRAPH'24]

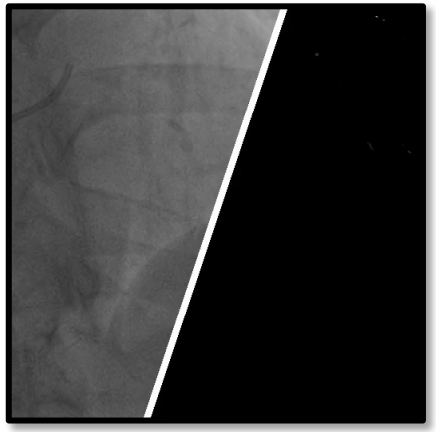


Joint-TensoRF
[AAAI'24]

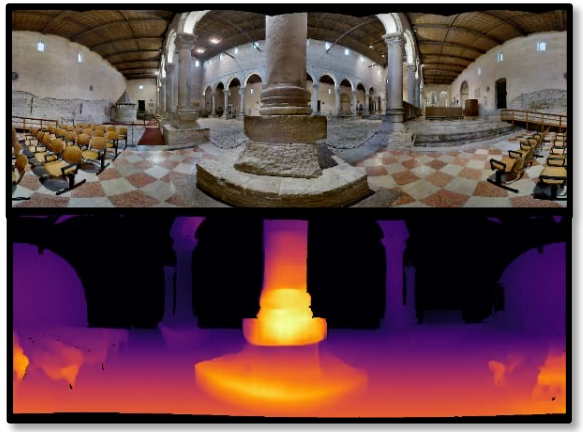


RoDynRF
[CVPR'23]

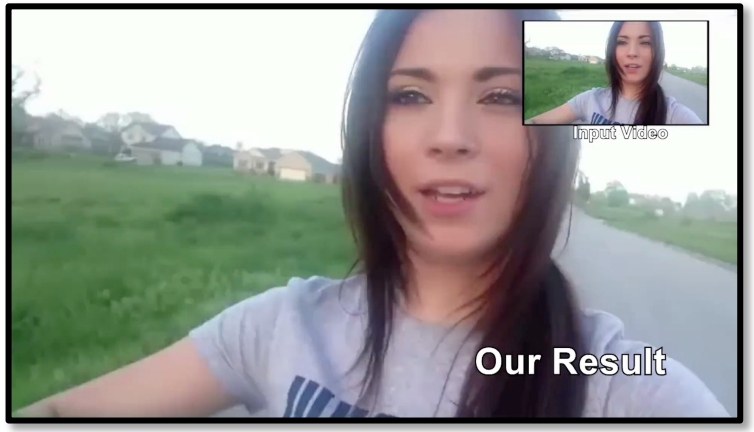
Low-level Vision



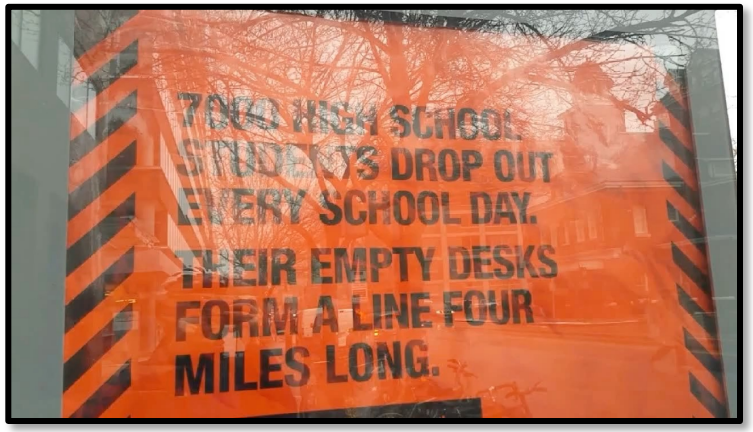
DeVNeR [CVPR'25]



Depth Anywhere [NeurIPS'24]



FuSta [ICCV'21]



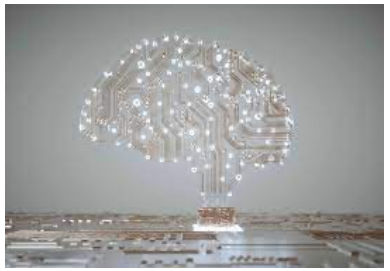
Obstruction Removal [CVPR'20]

SingleHDR [CVPR'20]

CyclicGen [AAAI'19]

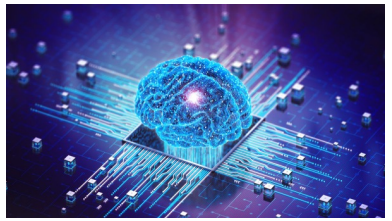
Research Interests

- NeurIPS
- ICLR
- ICML



Machine Learning

Artificial Intelligence



- AAAI
- IJCAI

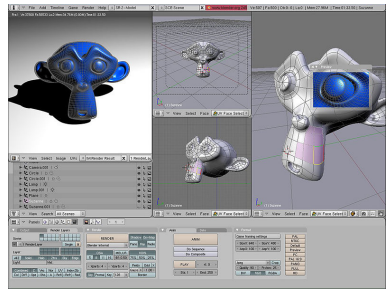
Computer Vision

- CVPR
- ICCV
- ECCV
- TPAMI

Computational Photography

計算攝影

Computer Graphics



- SIGGRAPH
- SIGGRAPH Asia

Collaborators

See you next week!

NYCU
National Yang Ming Chiao Tung University

也歡迎來信共指/合作！