

This course is **NOT** about ...

## Course overview

Digital Visual Effects

*Yung-Yu Chuang*

It isn't about photography



## Logistics



- Meeting time: 2:20pm-5:20pm, Wednesday
- Classroom: CSIE Room 104
- Instructor: Yung-Yu Chuang ([cyu@csie.ntu.edu.tw](mailto:cyu@csie.ntu.edu.tw))
- Teaching assistants:
- Textbook: Readings from books, journals and proceedings. Richard Szeliski's [Computer Vision: Algorithms and Applications](#). Richard Radke's [Computer Vision for Visual Effects](#).
- Webpage: <http://www.csie.ntu.edu.tw/~cyu/vfx>

## It isn't about physical effects

DigiVFX



## It isn't about 3D animations

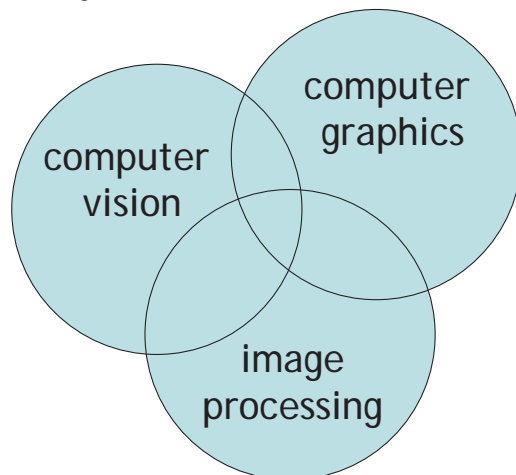
DigiVFX



## It's not about industrial tricks

DigiVFX

You will learn more about Taylor and Poisson than Lucas and Spielberg in this course. If you hear Lucas in the class, it is more likely to refer to Bruce Lucas, not George Lucas.



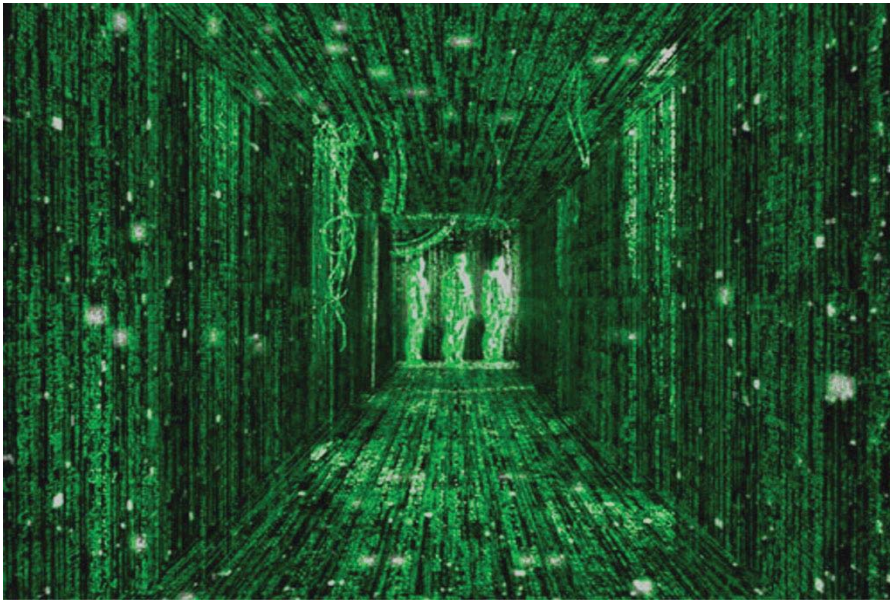
## It isn't about watching movies

DigiVFX





## Be cautious!



## Prerequisites

- It is a *must* that you have programming experiences.
- It is a *must* that you have basic knowledge on linear algebra and probability.
- It is a *plus* if you have background knowledge on computer vision, image processing and computer graphics.
- It is a *plus* if you have access to digital cameras and camcorders.

## Warning from previous students

- 請學期初老師要多提醒這門課的困難度請興趣或實力不足的同学勿修，否則就會像我一樣停修 XD

## The vfx course



what other professors think you do

what other students think you do

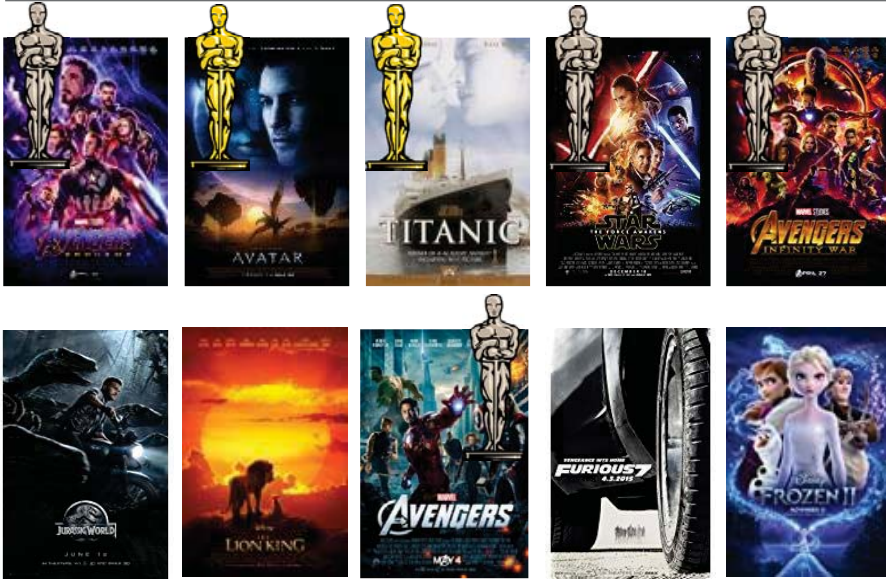
what you thought you will do



what you actually do

## Digital Visual Effects

DigiVFX



This course is about ...

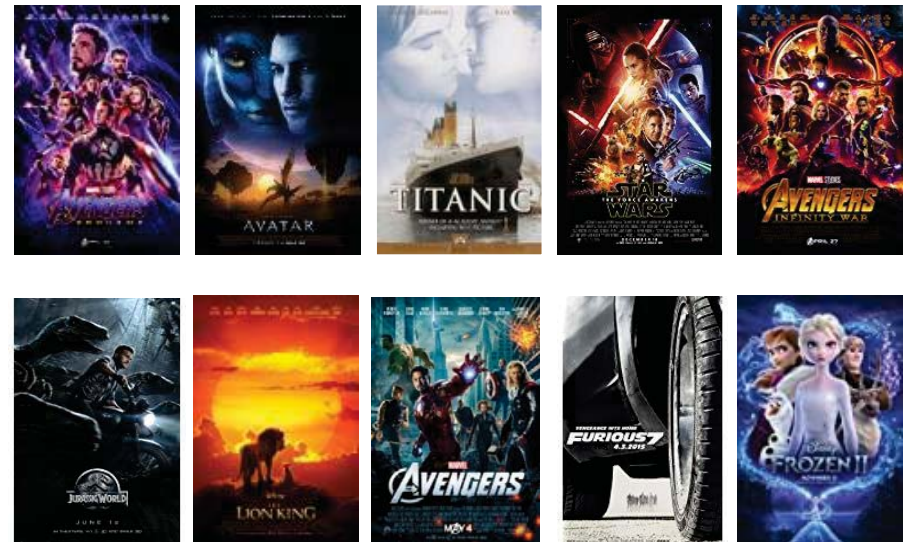
## Deadpool

DigiVFX



## Digital Visual Effects

DigiVFX





## Life of Pi

DigiVFX



## Deadpool

DigiVFX



## 獨自一人拍和十三人的戲

DigiVFX



要把身材高大的甘道夫和小矮人們拍攝在一起，我們是沒法在同一個片場的。和我一起拍攝的只有柱子上貼著的13張他們的照片，後面還有一個小燈，哪個角色說話了燈就亮起來。想像一下你在拍一場和13個人一起演的戲，但你卻只有獨自一人。這真的會把你的演技推到極限。我哭了，真的，我當時真的哭了。然後我還說出了聲：我認真演了一輩子不是為了跟這些照片對戲啊！

## Life of Pi

DigiVFX



## Retouching

DigiVFX



## VFX of the Hobbit

DigiVFX



## Retouching

DigiVFX



## Reality?

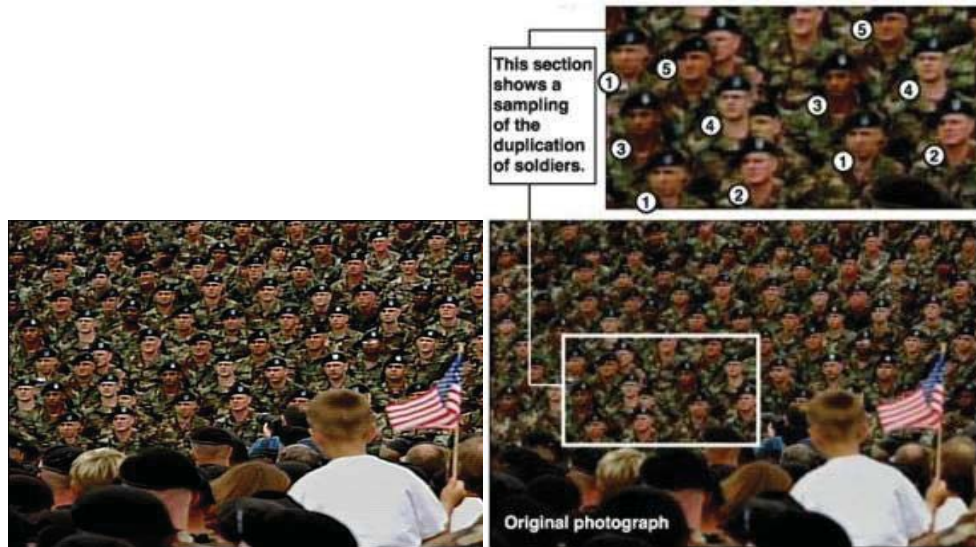
DigiVFX





## Texture synthesis and inpainting

DigiVFX



## Retouching

DigiVFX



## Iraq War, LA Times, April 2003

DigiVFX



## Bush campaign's TV AD, 2004

DigiVFX





## Stop action

DigiVFX



*The execution of Mary, 1895*

## Domestic example

DigiVFX

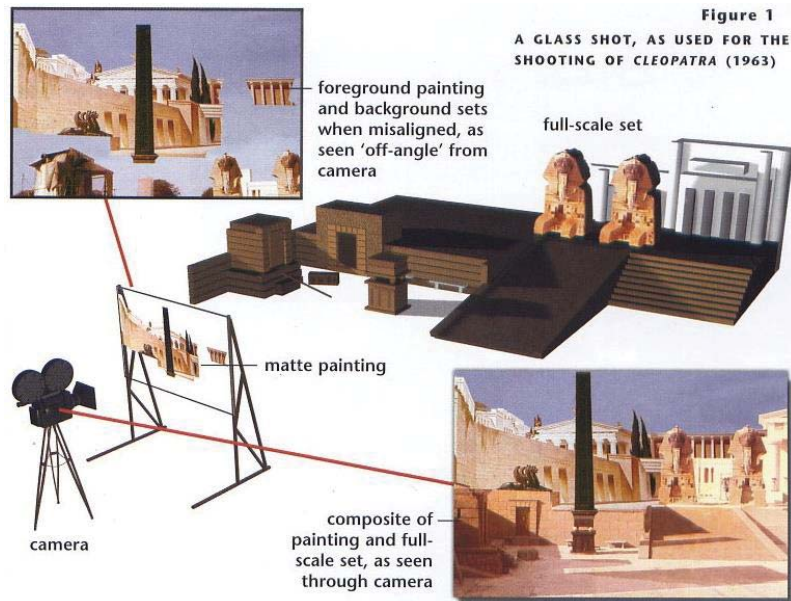


The Liberty Times  
2007.12.17



## Glass shot

DigiVFX

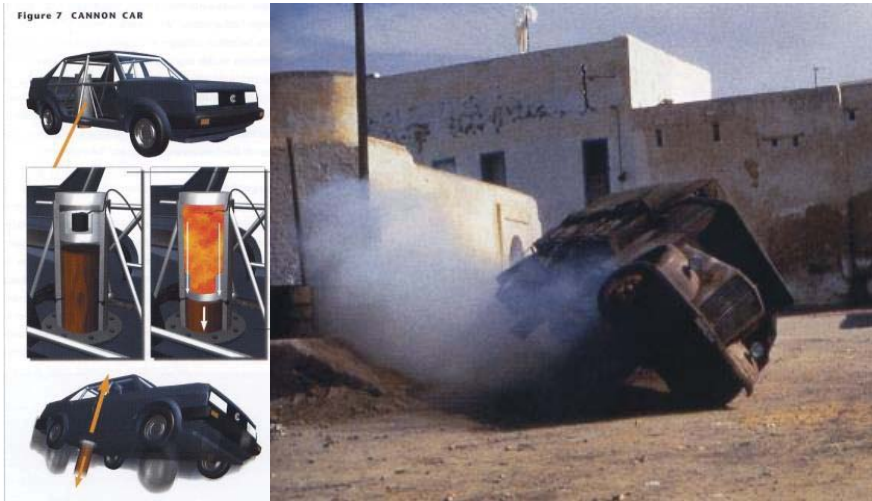


## Special effects



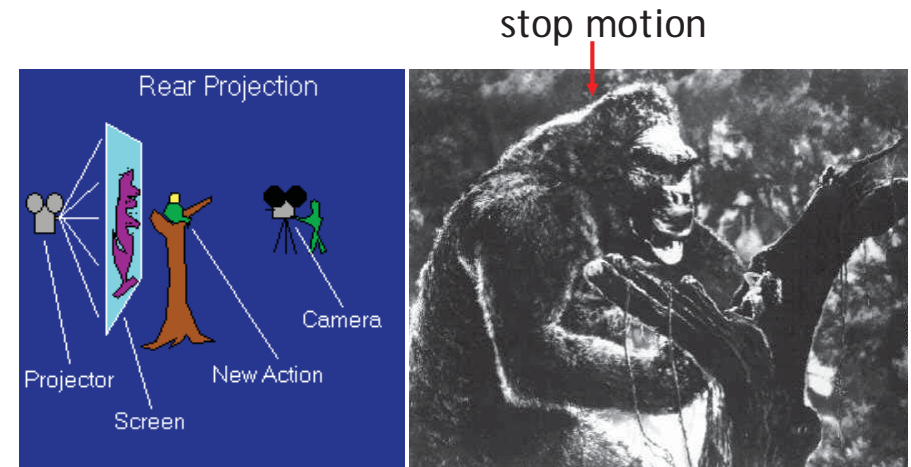
## Special effects (physical effects)

DigiVFX



## Rear projection

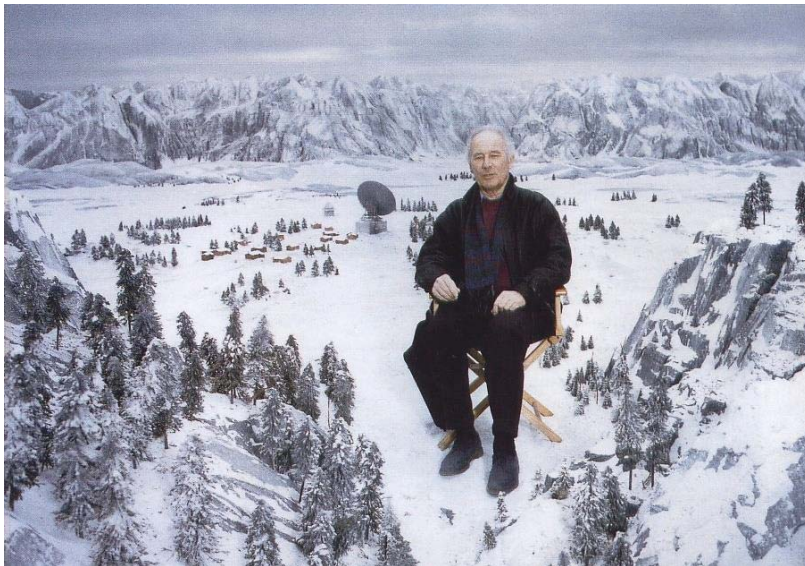
DigiVFX



*King Kong, 1933*

## Special effects (miniature)

DigiVFX



## Special effects (make-up)

DigiVFX





## Illusion - forced perspective

DigiVFX



## Special effects (matte painting)

DigiVFX



## Computer-generated model

DigiVFX



## Lord of the Rings

DigiVFX





## The Avengers (2012)

DigiVFX



## The Avengers

DigiVFX



## Visual effects 100 Years

DigiVFX

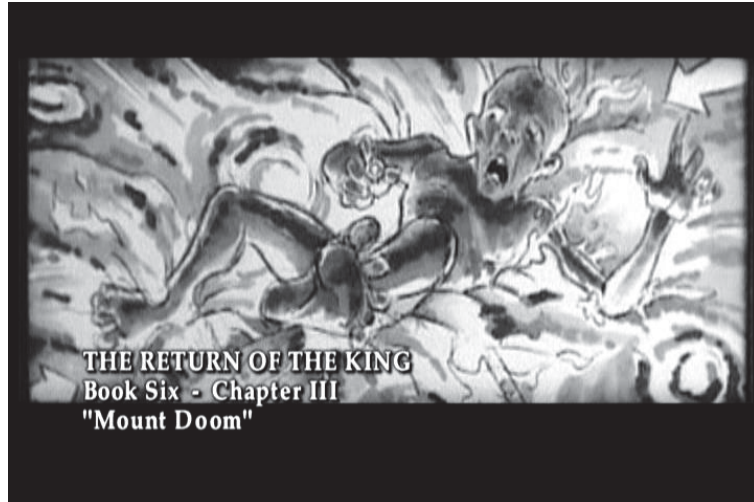


## The Avengers (1978)

DigiVFX



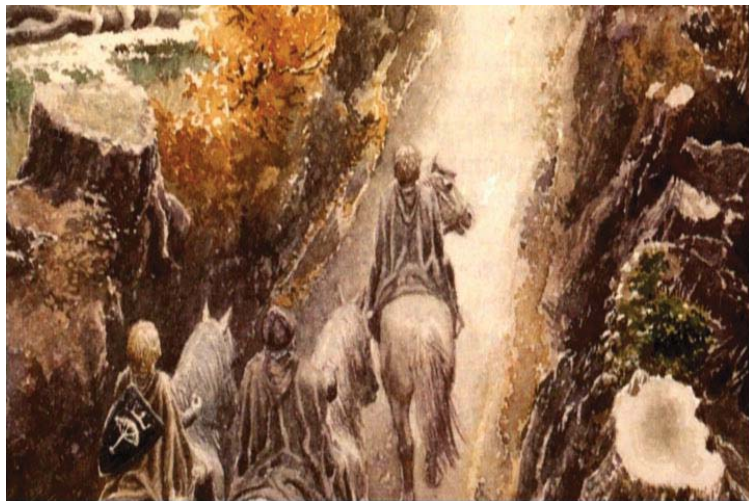
## Preproduction



Storyboard

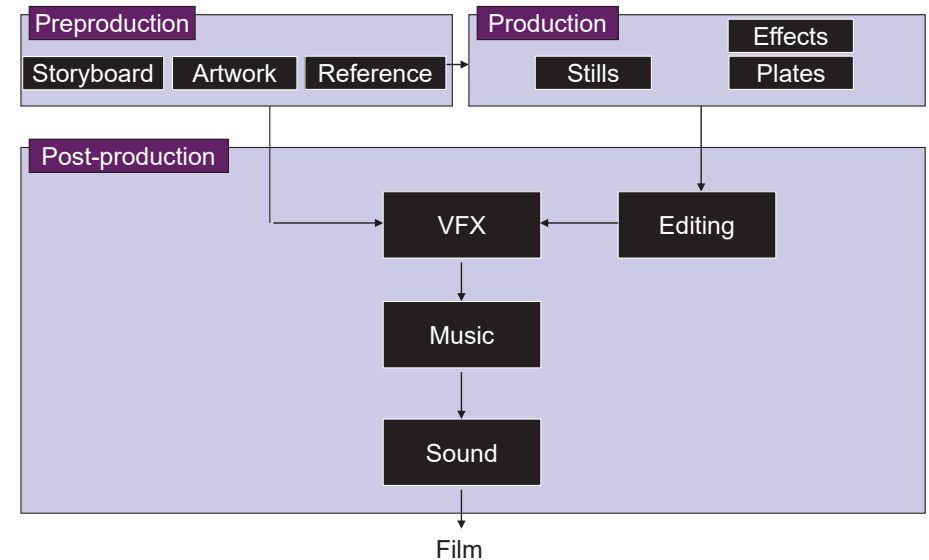
## Production pipeline

## Preproduction



Artwork

## Production pipeline





## Post-production

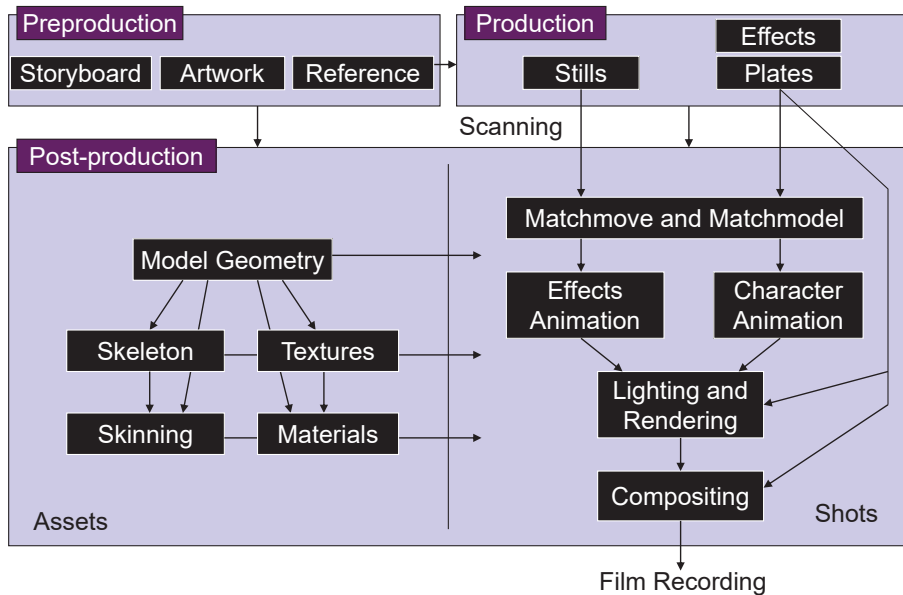


## Preproduction



Reference & Research

## Visual effects production



## Production



Shooting

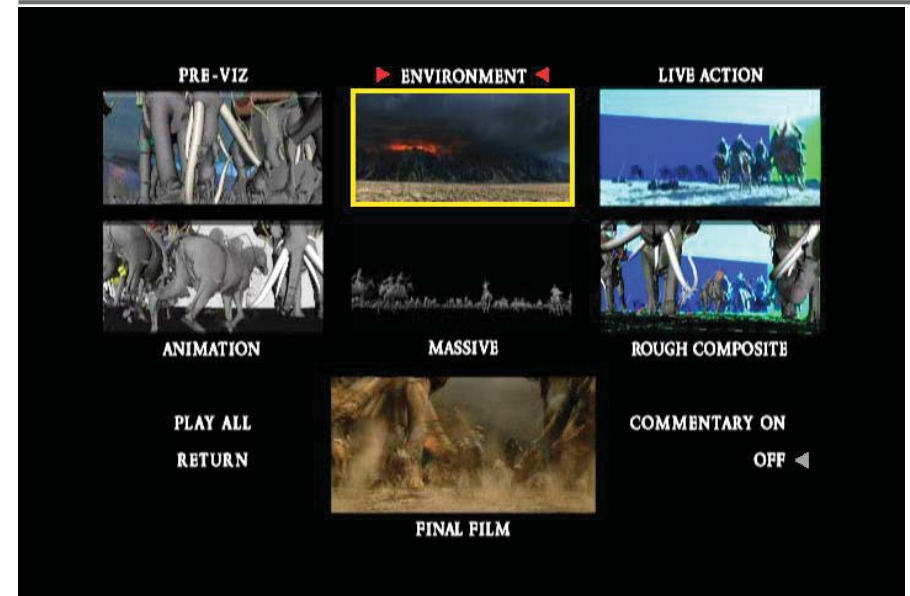
## 405: The Movie



- This movie were created solely by two visual effects artists in the year of 2000. It was a process that took over three months of nights, weekends and any spare moments that they could find.
- [https://en.wikipedia.org/wiki/405\\_\(film\)](https://en.wikipedia.org/wiki/405_(film))
- An early example of digital filmmaking and the use of Internet as media
- Budget: \$300 (\$140 for tickets. The officer is acknowledged)



## Visual effects post-production



## 405: The Movie



A case study



## Making of 405

### Step 2: building CG world

total 62 shots, 42 enhanced with digital VFX.  
19 shots are entirely digital creations.

plane, two cars, freeway background are digital

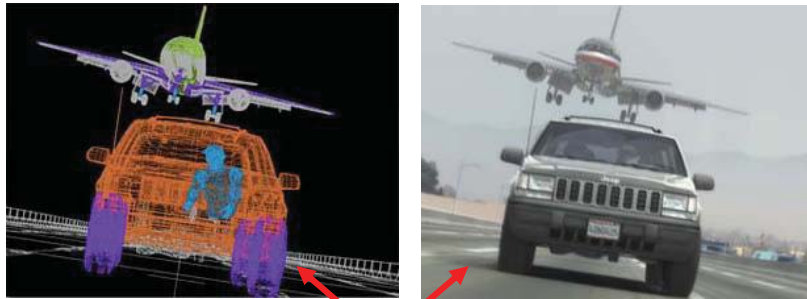


photo-based 3D environment

## Making of 405

### Step 0: script and shooting plan

Shot#	Description	Full CG	CG	Length Frames
01	Title Animation	X	X	401
02	Freeway speeds beneath car			123
03	Speed Limit 65			120
04	LA Freeway from Overpass			238
05	Empty Freeway--Car enters frame	X	X	150
06	Pan From Freeway J looks at lack of traffic			237
07	Plane swings into landing position toward freeway	X	X	139
08	Hand on Gear shift			36
09	Plane lowers into view through rear window		X	84
10	Plane hears Car	X	X	65
11	J looks to side mirror--plane visible behind		X	84
12	Plane in sideview mirror		X	65
13	J looks from side view to rear view mirror -- plane behind		X	27
14	J eyes react in rear view mirror--remove traffic		X	33
15	Plane chases Car toward camera	X	X	77

## Making of 405

Real cars were used for close-up and interior shots



A low-resolution mesh scanned by a cyberscanner.  
Mapped with photographs.



## Making of 405

### Step 1: shooting

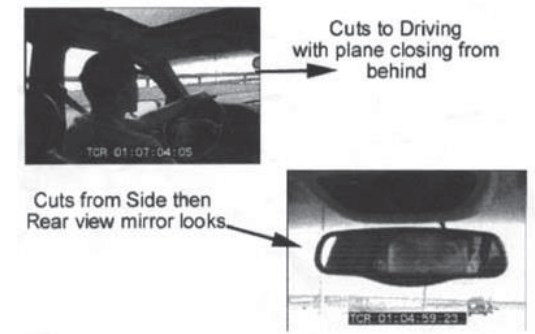
two days with a Canon Optura DV camera with progressive mode.

⇒ a 70-minute raw footage



initial editing

⇒ pickup shots



## Making of 405

DigiVFX

### Step 4: compositing



shot with the vehicle standing still in a backyard

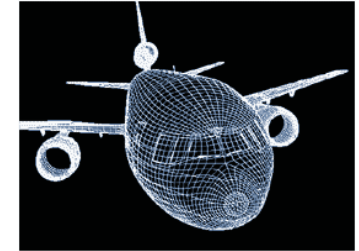


## Making of 405

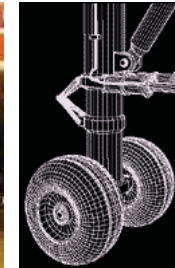
DigiVFX

DC-10 plane took a month to model in details for the needs of close-up shots.

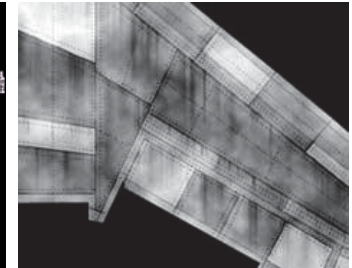
59 objects, 142,439 polygons



reference



modeling



material painting

## Making of 405

DigiVFX



## Making of 405

DigiVFX

### Step 3: traffic clearing

clean plate



close-up shots



inpainting





## Bloody Omaha

DigiVFX



## Making of 405

DigiVFX

Step 5: fine touchup



3D hat



compositing and inpainting

## Breakdown (Wolf of Wall Street)

DigiVFX



## Making of 405

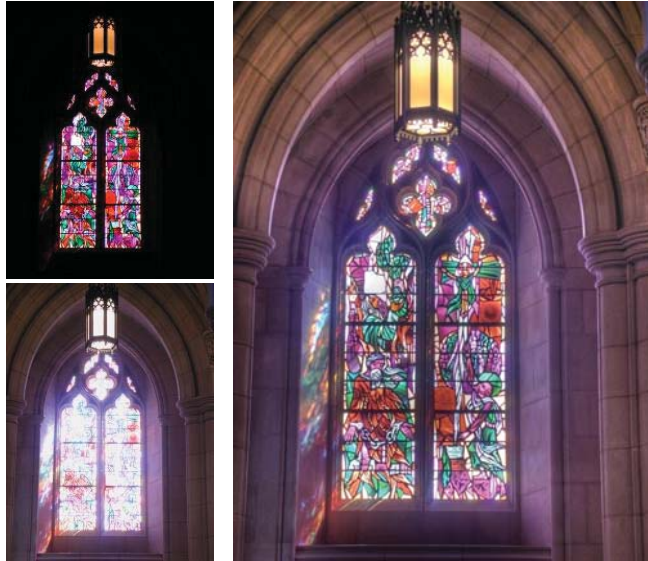
DigiVFX

Step 6: music and delivery



## High dynamic range imaging/display

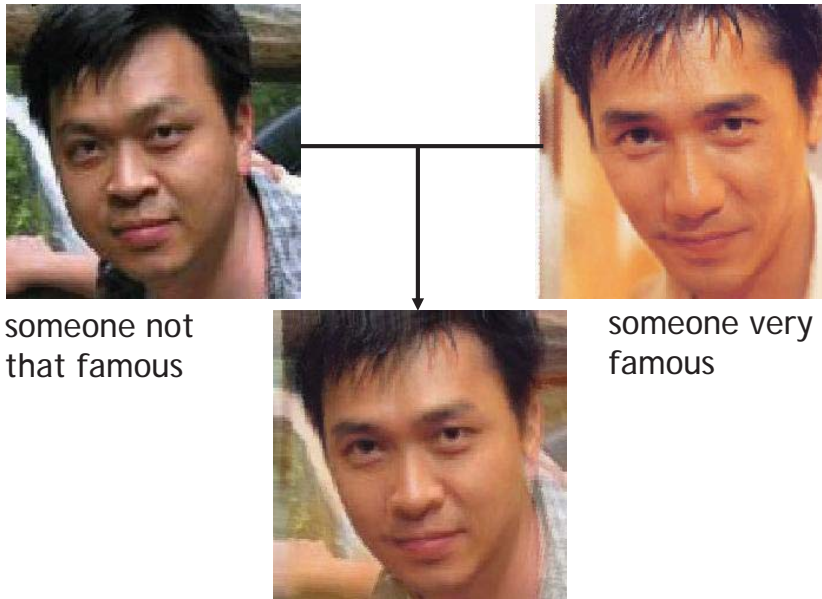
DigiVFX



Topics we plan to cover

## Image warping/morphing

DigiVFX



## Camera

DigiVFX

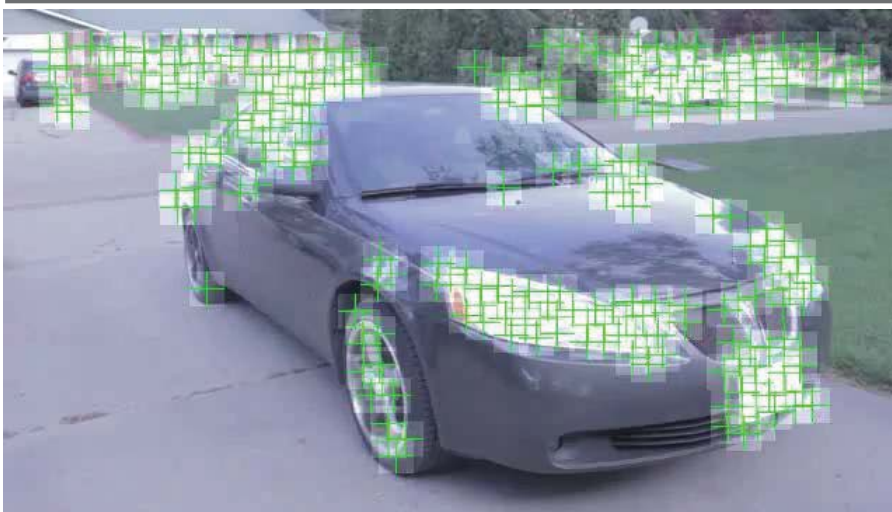


Canon 10D



## Tracking

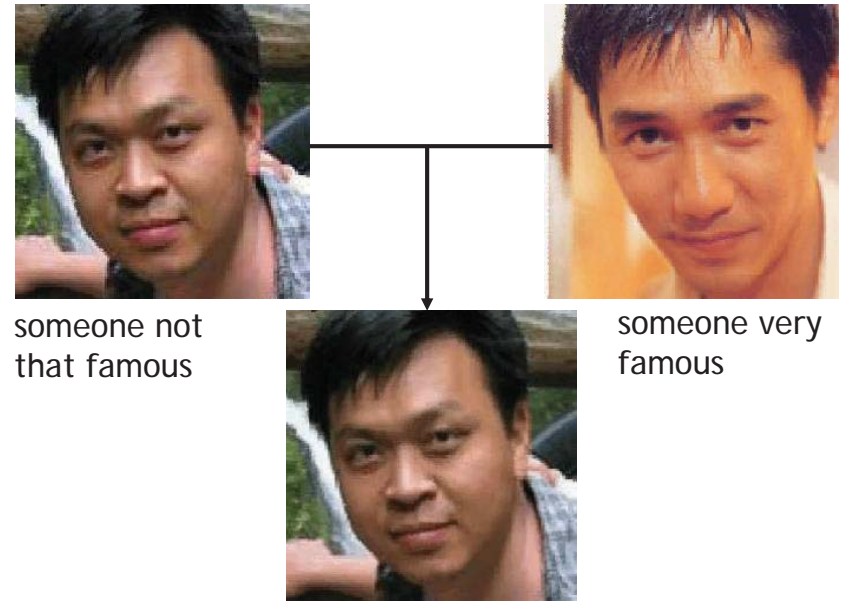
DigiVFX



Feature tracking

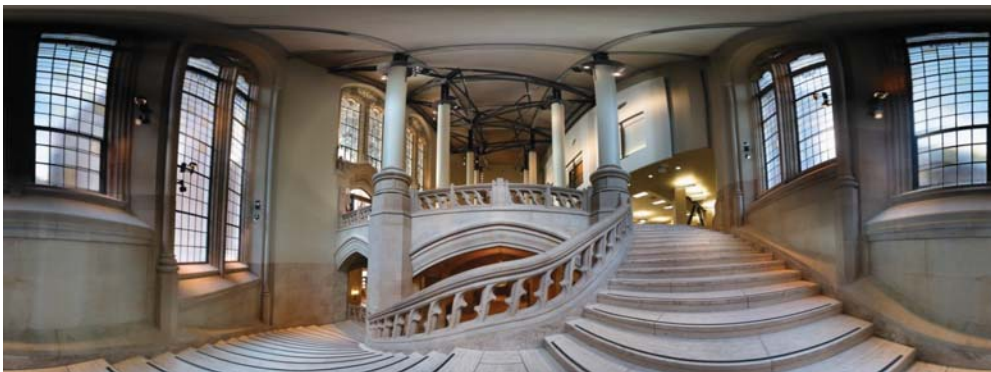
## Image warping/morphing

DigiVFX



## Image stitching

DigiVFX



## Image warping/morphing

DigiVFX



## Matchmove

DigiVFX



*Move matching using scene planes*

## MatchMove

DigiVFX



*Move matching using scene planes*

## Photo tourism

DigiVFX



### Photo Tourism

Exploring photo collections in 3D

Microsoft



(a)



(b)



(c)

## Matchmove

DigiVFX



*Move matching using scene planes*



## Matting and compositing

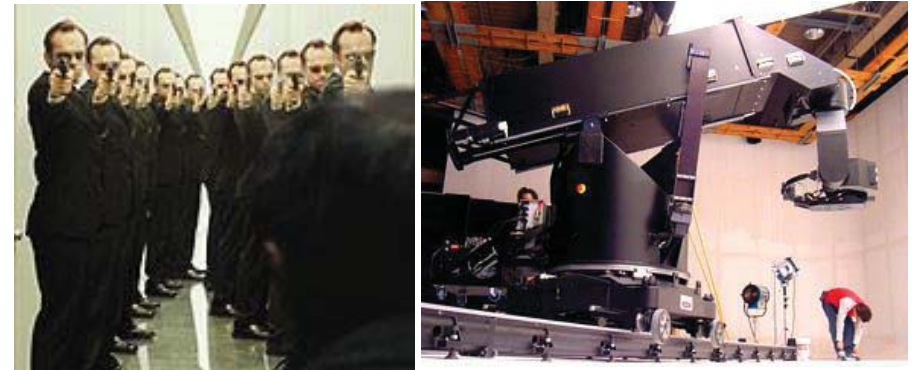
DigiVFX



*Titanic*

## Video matching

DigiVFX



*Matrix*

*MOCO (Motion control camera)*

## Matting

DigiVFX



## Video matching

DigiVFX



*Video matching*

## Image-based modeling

DigiVFX



*photogrammetric modeling and projective texture-mapping*

## Object selection

DigiVFX



*LazySnapping*

## Image-based modeling

DigiVFX



*photogrammetric modeling and projective texture-mapping*

## Image-based modeling

DigiVFX



*photogrammetric modeling and projective texture-mapping*



## 3D photography (active)

DigiVFX



*Cyberware whole body scanner*

## Image-based modeling

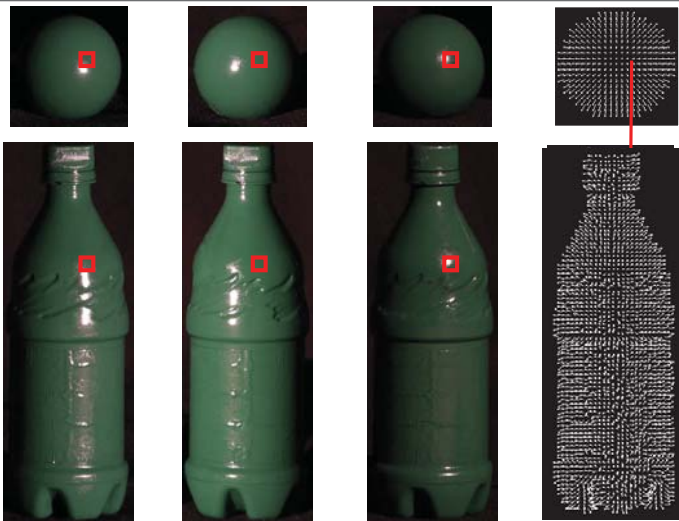
DigiVFX



*Tour into a picture*

## 3D photography (active)

DigiVFX



*Photometric stereo*

## Image-based modeling

DigiVFX



*Tour into a picture*

## View interpolation

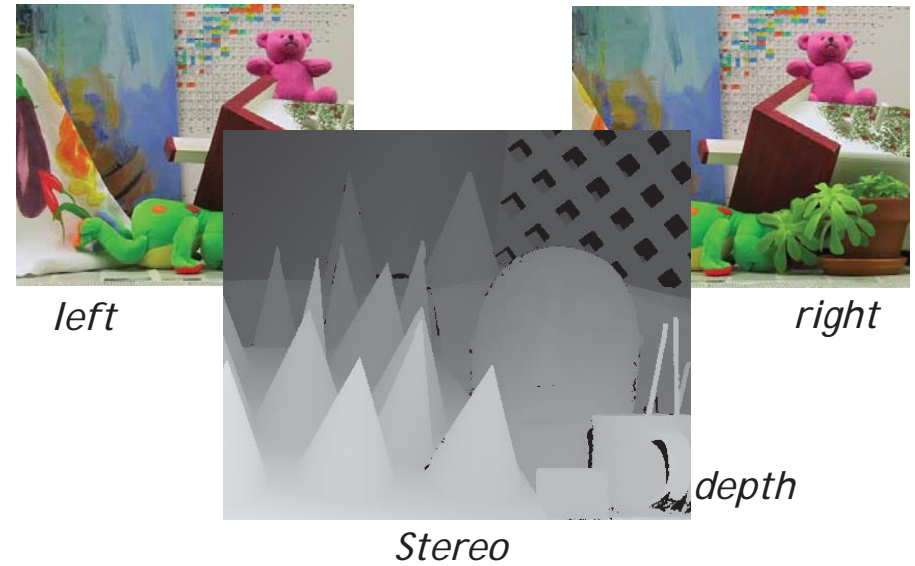
DigiVFX



Bullet time video

## 3D photography (passive)

DigiVFX



## View interpolation

DigiVFX



High-Quality Video View Interpolation

## Image-based rendering

DigiVFX



Surface lightfield



## Stereoscopic films

DigiVFX



## Image manipulation

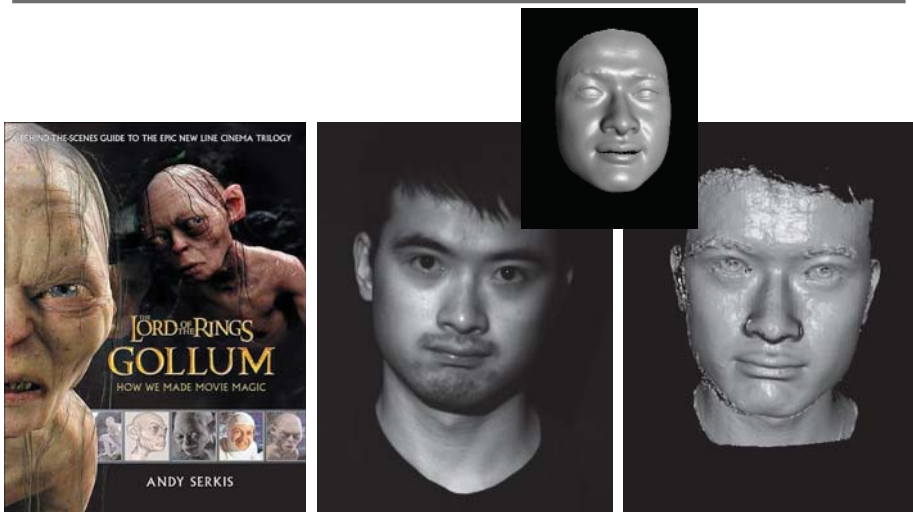
DigiVFX



*GraphCut Texture*

## Making face

DigiVFX



*Gollum*

*Spacetime face*

## Image manipulation

DigiVFX



*Poisson blending*

## Video rewrite

DigiVFX



Trainable videorealistic speech animation

## Virtual human

DigiVFX



## Inpainting (wire removal)

DigiVFX



*Inpainting*

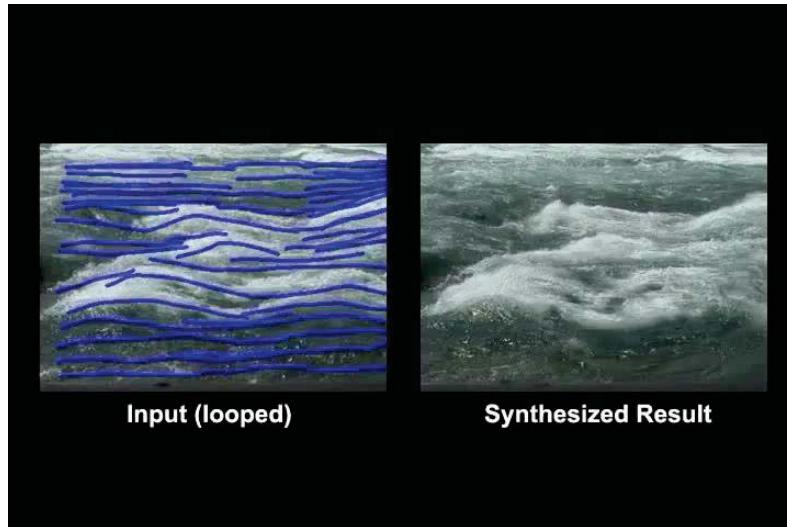
## Virtual human

DigiVFX





## Video editing



*Flow-based video editing*

## Texture synthesis/replacement

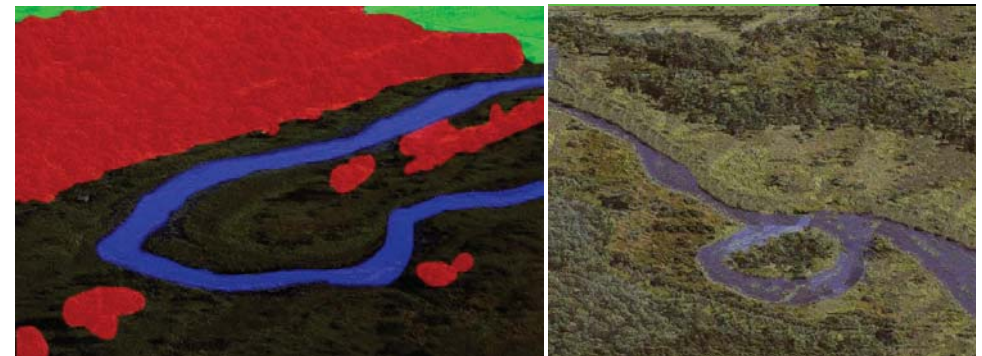


*Texture replacement*

## Grading (subject to change)


- 3 programming assignments (60%)
  - HDR Imaging (18%)
  - AutoStitch (24%)
  - MatchMove (18%)
- Class participation (5%)
- Final project (35%)
  - Research
  - System
  - Film

## Semi-automatic matte painting



*Image analogies*




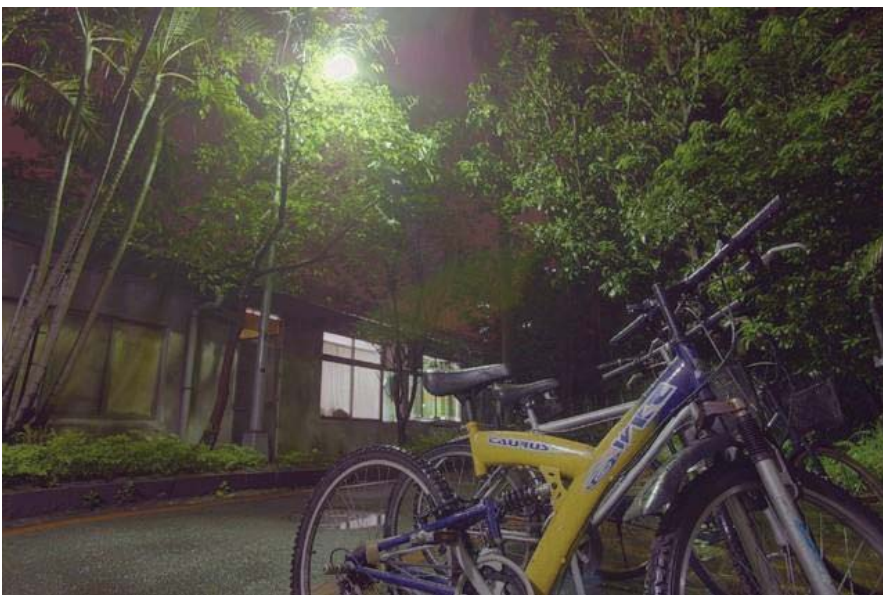
From past semesters (吳侑親, 張書瑋) 



High dynamic range imaging 



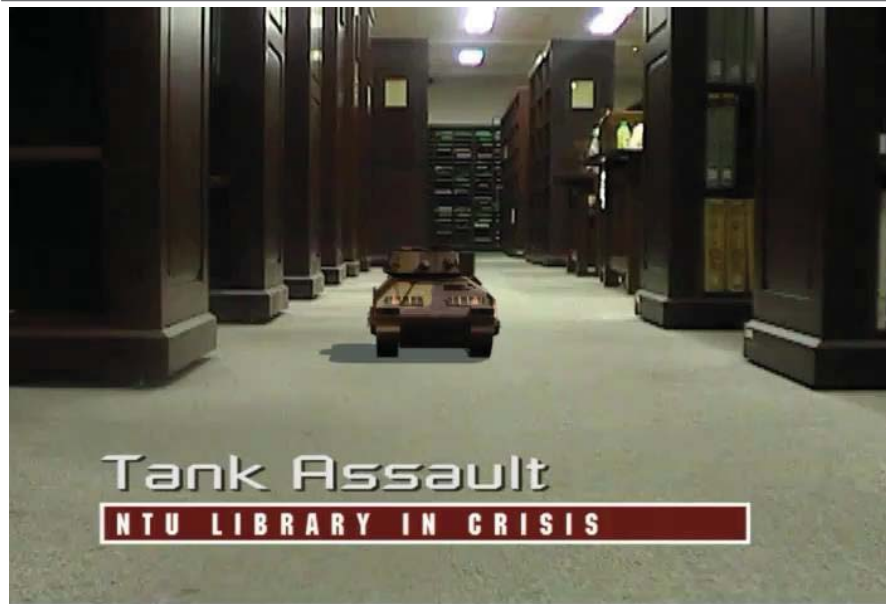
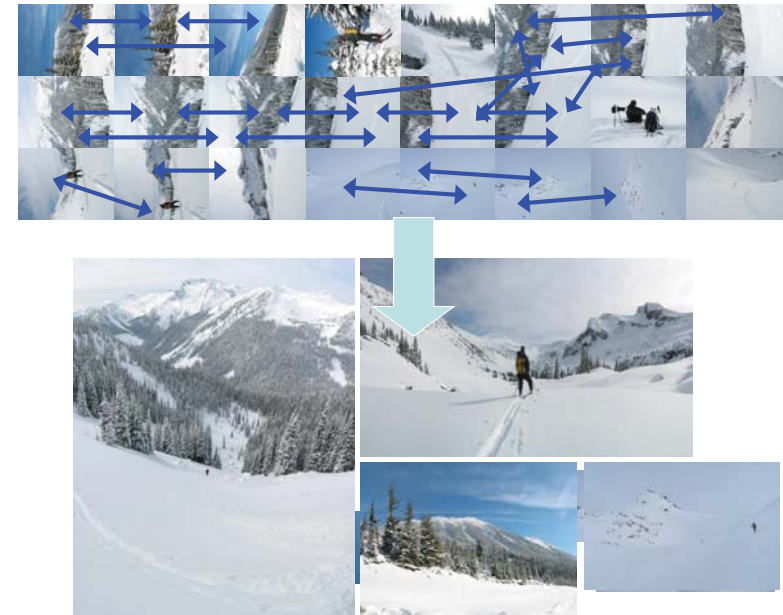
From past semesters (王瑋馥, 余雁雲) 



From past semesters (鄭逸廷 陳柏叡) 





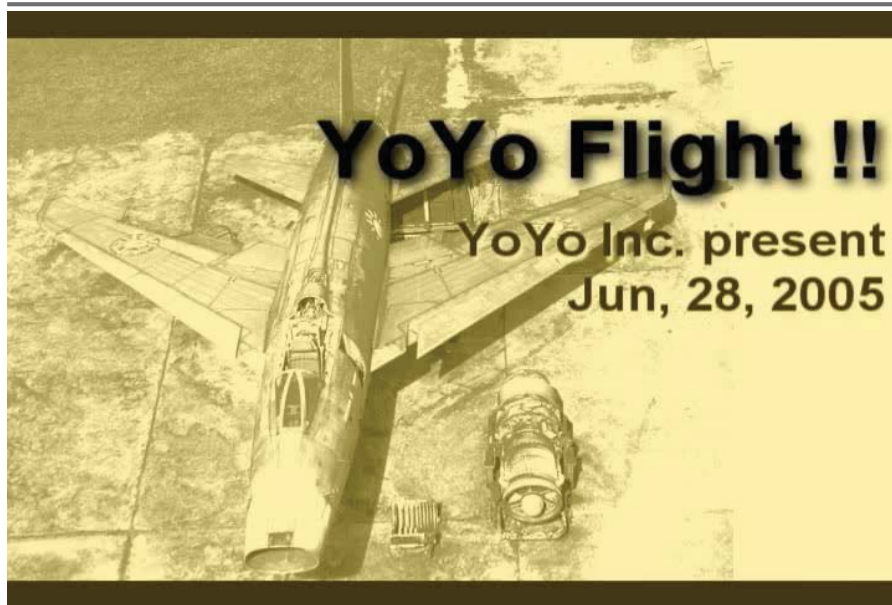


羅聖傑



連奕婷 張宇蓓

## Making of YoYo Flight



Final projects from the past.

## YoYo Flight

