Introduction to Multimedia System (CSC3185)

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Lecturer

❑ Academic Position

Chair Professor (2005-2018) (香港理工大学)
Emeritus Professor (2018 to date) (香港理工大学)
Website: https://www4.comp.polyu.edu.hk/~csdzhang/

X.Q. Deng Presidential Chair Professor in CUHKSZ
Website: https://sds.cuhk.edu.cn/en/teacher/315

❑ Professional Honors

Fellow, Royal Society of Canada (加拿大皇家科学院 院士）

Fellow, Canadian Academy of Engineering (加拿大工程院院士)

Life Fellow, IEEE (国际电机电子工程师终身会士）

Fellows, IAPR & AAIA (国际模式识别联合会&亚太人工智能学会会士)

❑ Research Interests

Biometrics, Artificial Intelligence, Image Processing & Pattern Recognition

Teaching Arrangement

❑ Management (Lecture/Tutorial + Assignment)

Lectures: 15:30-16:50   Tuesday   CD_207
15:30-16:50   Wednesday   CD_207
Office Hour: 16:50-17:50   Wednesday   CD_207/DY513

Tutorials: 18:00-18:50   Wednesday   TA_307

TA: Chaoxun Guo (郭超勋)   (222010062@link.cuhk.edu.cn)
Phone: 18361245369
Office Hour: 14:30-15:30   Tuesday   DY_318

USTF: Nikita Tanjaya   (121040027@link.cuhk.edu.cn)
Phone: 15217763089
Office Hour: 15:00-16:00   Monday   DY_317

❑ How to download the teaching materials?
1) **PolyU link**: https://www4.comp.polyu.edu.hk/~csdzhang/
2) **CUHKSZ link**:
https://bb.cuhk.edu.cn/webapps/blackboard/content/listContentEditable.jsp?content
_id=_455655_1&course_id=_12862_1&mode=reset

Main Content

❑ Aim: Introduce fundamental MM concepts and understand about common form of MM content.

❑ Main topics

  ➢ Introduction to MM (**Lecture 1**)

  ➢ Part I: Audio in MM (**Lecture 2**)

  ➢ Part II: 2D/3D/Multispectral Image and its Basic Technologies (Image Processing and Various Transformations) (**Lectures 3-8**)

  ➢ Part III: MM Data Compression (General Methods, JPEG and MPEG) (**Lectures 9-12**)

  ➢ Part VI: Video in MM (**Lecture 13**)

❑ Assessment

Mid-term exam	30%
Assignment	30%
Final exam	40%

Learning Outcomes

Upon completing this course, students will understand

- ❏ The representation of **common MM data** in the form of image, video and audio;

- ❏ The different image types (2D/3D/Multispectral image) and the basic application technologies about **image processing / transformation**;

- ❏ The principal concepts of **lossless & lossy compression**, as well as JPEG & MPEG compression technologies.

Why Image Technology?

❑ Image is an **important media**, which is the collection of external messages that we communicate about our inner selves. The main image types have **2D/3D/multispectral** image.

❑ Image technology is a way to **convert** an image to a digital aspect and **perform** certain functions on it, in order to get an enhanced image or extract other useful information, like **preprocessing** **& transformations**.

❑ **Applications**: Military reconnaissance/surveillance; Fingerprint retrieval; Automatic target recognition; Industrial inspection; Medical diagnosis; Satellite imagery; Civil surveillance, Law enforcement, …

Why Data Compression?

❑ Why is data compression important? Data compression **can dramatically decrease the amount of storage a file takes up**;

❑ Data compression is the **process of modifying, encoding or converting the bits structure of data in such a way that it consumes less space on disk**;

❑ As a result of compression, administrators spend **less money** and **less time** on storage. Compression **optimizes backup storage performance** and has recently shown up in primary storage data reduction.

Mid-Term Exam and Assignment

- ❏ Mid-term test (Week 8):
  - – Explain the requirement in the lecture time

- ❏ Assignment (Week 3 - Week 14):
  - – A special topic for each group
  - – Project output
    - ➤ Midterm report/Short introduction
    - ➤ Final presentation materials
    - ➤ Group presentation

Active Learning & Group Study: 3D/Multispectral Image Application

1. **3D Object Reconstruction**

   It uses multiple images with different views of the object to reconstruct the 3D object.
   - Examples: Scene Reconstruction (http://vclab.kaist.ac.kr/siggraph2022p2/)
       3D Object Model (https://www.kuleiman.com/3dmx/)

2. **3D Medical Reconstruction**

   It uses CT or X-ray images to build 3D model to help doctors view the patients' condition.
   - Examples: 3D Bone Guidance (Han R, Uneri A, Vijayan R C, et al. Fracture reduction planning and guidance in orthopedic trauma surgery via multi-body image registration[J]. Medical image analysis, 2021, 68: 101917.) 3D Surgery Simulation
   (https://cuhko365-my.sharepoint.com/:v:/g/personal/116010268_link_cuhk_edu_cn/EUqhEB7oJldCms_8mCA5HcYBQDbzOd8lihAo3gM90Z11fQ?e=kGxIq7)

3. **Environmental Monitoring**

   It uses multispectral images to monitor the states of environmental.
   - Examples: Forest Management (https://gisresources.com/lidar-and-hyperspectral-data-fusion/)
       Crop Health Monitoring (https://www.mdpi.com/2072-4292/14/17/4426)

Recommended Texts

- Z. Li, M.S. Drew, J. Liu, *Fundamentals of Multimedia*, 2nd Edition, Springer, 2014, Print ISBN: 978-3-319-05289-2; eBook ISBN: 978-3-319-05290-8. https://link.springer.com/book/10.1007%2F978-3-319-05290-8

- A. Sethi, *Multimedia Education- Theory and Practice*, International Scientific Publishing Academy, 2005.

- N. Chapman and J. Chapman, *Digital Multimedia*,3rd Edition, John Wiley & Sons, 2009.

- D. Zhang, Z. Guo and Y. Gong, 2015, *Multispectral Biometrics- Systems & Applications*, 229pp, ISBN 978-3-319-22484-8, Springer, UK.

- D. Zhang and G. Lu, 2014, *3D Biometrics- Technologies and Systems*, 290pp, ISBN 978-1-4614-7400-5. Springer, USA.