

CSC 678

Course title: Selected Topics in Virtual Reality and Computer Vision

Instructor Prof. Dr. M. Hussain

Email: mhussain@ksu.edu.sa (Ph: 4673427)

Credit hours: 3

Semester: First Semester 2020-21

Goal of the Course:

To enable the students to do research on advanced topics of Computer Vision and related areas

Objectives of the course:

It is an advanced level course, and will focus on selected advanced topics of Computer Vision. Its main objective is to create a sound basis for PhD research. Specific objectives are as follow. A student must

- be familiar with both the theoretical and practical aspects of computing with images
- have theoretical and practical knowledge of the state-of-the-art deep neural networks and its applications to Computer Vision
- have developed the practical skills necessary to apply Computer Vision techniques for solving different real life problems.

Recommended text:

- Richard Szeliski, COMPUTER VISION – Algorithms and Applications, second edition, 2010
- R. C. Gonzalez and R. E. Woods. Digital Image Processing, Prentice Hall 2008
- Research Papers
- Handouts

Topics (tentative): not covered necessarily in the order shown

Lectures	Topic
1	Introduction of Computer Vision Review of Neural Network
Classification	
5	Background of CNN and stat-of-the-art CNN models Paper: VGGNet - Very deep convolutional networks for large-scale image recognition (2015)

	<p>Paper: ResNet - Deep Residual Learning for Image Recognition (2016)</p> <p>Paper: DenseNet - Densely Connected Convolutional Networks (2018)</p> <p>Paper: Dense2Net - Efficient Densely Connected Convolutional Neural Networks</p> <p>Paper: Fine-tuning Convolutional Neural Networks for Biomedical Image Analysis: Actively and Incrementally (2017)</p> <p>Paper: DRN - Dilated Residual Networks (2017)</p> <p>Paper: SKNet: Selective Kernel Networks</p>
2	<p>Interpret Deep Neural Networks</p> <p>Paper: Visualizing and Understanding Convolutional Networks (2014)</p> <p>Paper: Striving for simplicity: the all convolutional net (2015)</p> <p>Paper: Grad-CAM: Visual Explanations from Deep Networks via Gradient-based Localization (2017)</p> <p>Paper: Methods for interpreting and understanding deep neural networks (2018)</p>
1	<p>Feature Transforms: PCA, LDA</p> <p>Paper: Multi-class Fukunaga Koontz discriminant analysis for enhanced face recognition (2016)</p> <p>Paper: Two-dimensional Whitening Reconstruction for Enhancing Robustness of Principal Component Analysis (2016)</p>
2	<p>Sparse and Collaborative Representation: SCR, CRC, Ridge Regression</p> <p>Paper: SCR - Robust Face Recognition via Sparse Representation (2009)</p> <p>Paper: CRC - Sparse Representation or Collaborative Representation: Which Helps Face Recognition? (2011)</p> <p>Paper: Efficient Classification with Sparsity Augmented Collaborative Representation (2017)</p> <p>Paper: Robust joint representation with triple local feature for face recognition with single sample per person (2019)</p> <p>Paper: Ridge Regression - Comparing Data-Dependent and Data-Independent Embeddings for Classification and Ranking of Internet Images (2011)</p>
Object Detection	
4	<p>Object Detection</p> <p>Paper: R-CNN: Region-based Convolutional Networks for Accurate Object Detection and Segmentation (2016)</p> <p>Paper: Fast R-CNN (2015)</p> <p>Paper: Faster R-CNN: Towards Real-Time Object Detection with Region Proposal Networks (2017)</p> <p>Paper: YOLO: You Only Look Once: Unified, Real-Time Object Detection (2016)</p>

Evaluation:

1. Presentations: Every student will prepare some topics and present (10%)
2. Assignments (30%)
3. Final Exam (40%)
4. Term Paper. Each student will work on an advanced topic and will write a research paper. (20%)

Term Paper

What will be in the research paper?

Each student will select a research topic, will review at least 5 recent papers on the topic, will develop some idea, design the methodology and implement the method. The research paper must include the following sections:

1. Abstract

It must include the brief description of

- a. the problem, a brief description of the problem
- b. the idea proposed to solve the problem, the approach or methodology you adopted to solve the problem
- c. Findings, what are your results and findings.

2. Introduction

It will include the detail of the following

- a. Briefly motivate the problem i.e. give some background.
- b. Give clear statement of the problem, which is addressed in this paper
- c. State why this problem is important
- d. State your approach briefly used to solve the problem. To what extent your approach is adequate?
- e. State how others have solved this problem in the past, and what the gaps are. How your approach is different and fill this gap.
- f. State your contributions
- g. Explain why your results are important.
- h. An overview of the whole paper.

3. Selection of Topic and Related work (Due on 6th Week)

You will select a topic and problem.

The section will give an overview of some recent research papers which have addressed the selected problem. The detail of the techniques is needed.

4. Methodology (Due on 8th Week)

In this section, you will describe in detail of your proposed idea and its design.

During literature review, you will develop some idea, and prepare a design.

The design will involve a statement of the method, descriptive diagrams, possibly pseudocode, the justification for the proposed method.

5. Implementation (Due on 12th Week)

Implement the proposed method

6. Results and Discussion (Due on 15th Week)

In this section, you will provide

- a. The implementation detail, i.e. how the proposed have been implemented.
- b. Evaluation Protocol
 - i. Which database has been used
 - ii. How the experiments have been performed
 - iii. Which performance measures have been used for evaluation
- c. Present results
- d. Discuss the results
- e. Give comparison with the published papers, and discuss

7. **Conclusion**

Give conclusion of the research

- Describe the major contributions of the paper.
- State some interesting related problems for future work.

8. **References**

Final paper with Abstract and Introduction completed: (Due on 16th Week)

Where to Find the Research Papers

- **IEEE Transactions**
- **Elsevier Journals**
- **IEEE Conferences**
 - **ICIP**
 - **ICASSP**
 - **CVPR**
 - **ICCV**
 - **ECCV**
 - **ACCV**
 - **ICPR**