Suggested projects for ECE-GY 6123 Image and Video Processing (Spring 2020)

Updated 3/1/2020

Please email the contact person to set up an appointment to learn more about the project. If you want to choose a project outside this list, you should discuss your idea with the instructor before deciding.

- **360 Degree Video Saliency Estimation and/or View Prediction** (contact: Zhipeng, zf606@nyu.edu)
  
  Background needed: deep learning

  References:
  

- **Brain lesion segmentation from MRI images** (Contact: Zhipeng Fan, zf606@nyu.edu)
  
  Background needed: deep learning

  References:
  
  Brain and lesion segmentation in multiple sclerosis using fully convolutional neural networks: A large-scale study

  Learning joint lesion and tissue segmentation from task-specific hetero-modal datasets
  [https://openreview.net/forum?id=HJeZW_QxxN](https://openreview.net/forum?id=HJeZW_QxxN)

  Evaluation of a deep learning approach for the segmentation of brain tissues and white matter hyperintensities of presumed vascular origin in MRI
Segmentation using a Data Management and Processing Infrastructure

- Denoising using deep networks with unknown and possibly spatially varying noise levels. (Contact: Amirhossein Khalilian akg404@nyu.edu).

Background needed: deep learning

- Video compression using deep learning based frame prediction and/or interpolation (Contact: Haojie Liu, hl3933@nyu.edu)

Background needed: deep learning and image compression

Refs:

Background: image compression and deep learning

- Layered image coding using multiresolution neural networks (Contact: Yao Wang, yaowang@nyu.edu Haojie Liu, hl3933@nyu.edu)

Background: image compression and deep learning.

Refs:

- Learning multi-resolution representations (contact: Yao Wang yaowang@nyu.edu)

- Video interpolation: predicting intermediate frames from surrounding frames using deep learning. (contact: Ran Wang, rw1691@nyu.edu)


- Video prediction: predicting future frames from prior frames using deep learning method (contact: Ran Wang, rw1691@nyu.edu)


Older papers:


● Segmentation of ultrasound images of mouse embryos. (contact: Ziming Qiu zq415@nyu.edu)
  Background: deep learning

● Tracking the movements of plants, as part of our PlantTracer Project (http://planttracer.com/) (Contact: Yixiang Mao, yixiang.mao@nyu.edu)
  ○ Tracking plant apex using classical tracking approaches (e.g. KLT tracker, multi-view block matching)
  ○ Using deep learning approach (you will help to annotate ground truth data as well as training and testing the network)

● Moving Foreground detection in video using Robust Principal Component Analysis or other sparse-representation-based optimization methods. (Contact: Amirhossein Khalilian akg404@nyu.edu).
  Background needed: Linear Algebra. Convex optimization background is desired but not necessary.
  Ref:
  See the competition http://www.changedetection.net/ for data samples.
- Image/video deblurring or super-resolution with or without knowing the blurring kernels
  (Contact: Amirhossein Khalilian akg404@nyu.edu)
  Background needed: Linear Algebra and DSP background is required. Convex optimization
  background is desired but not necessary.
  Ref:
  Lagrangian method for total variation video restoration. IEEE Transactions on Image Processing, 20(11),
  3097-3111.

- Image/video cutout: the goal of interactive image / video segmentation is to develop a user
  guided segmentation tool. The User provides hints to the region of interest and the
  segmentation tool will provide the result. The results can be further improved when the user
  changes hint points. An effective implementation is possible using graph-cut algorithm.
  (Contact: Amirhossein Khalilian akg404@nyu.edu)
  Background needed: Good understanding of the image segmentation lecture in class. Graph
  signal processing is desired but not necessary.
  Ref:
  (ToG), 23(3), 303-308.
  Transactions on Graphics (ToG), 24(3), 585-594. (Also see
  https://www.juew.org/projects/VideoCutout/VideoCutout.htm for more sample results.)
  connectivity priors. In 2008 IEEE conference on computer vision and pattern recognition (pp. 1-8). IEEE.
  journal of computer vision, 70(2), 109-131.

- Denoising using deep networks with unknown and possibly spatially varying noise levels
  (Contact: Amirhossein Khalilian akg404@nyu.edu)
  Background needed: Understanding of classical denoising techniques and implementing deep
  neural networks is desired.
  Ref:
  Conference on Computer Vision and Pattern Recognition.
- 360 degree or panoramic video or image stitching (contact: Yixiang Mao ym1496@nyu.edu)
  Background needed: Image registration and warping

Ref:

- Medical Image registration (cross-modality, or within the same modality) (Contact: Amirhossein Khalilian akg404@nyu.edu)

- Few shot image segmentation using deep learning. (Contact: Ziming Qiu, zq415@nyu.edu)


- 3D Human Face Reconstruction w/o 3DMM face model from RGB image [Zhipeng Fan zf606@nyu.edu]

  In this project, you are required to implement a deep neural net based model to reconstruct the human faces from single RGB images. A statistical model (3DMM Face Model: [https://ibug.doc.ic.ac.uk/media/uploads/documents/0002.pdf](https://ibug.doc.ic.ac.uk/media/uploads/documents/0002.pdf)) will be employed to regularize the reconstructed face. A base approach will be to use the deep net to learn the parameters of the face model while an advanced version will be to employ an additional model to reconstruct details on the human face that is beyond the representation space of the 3DMM. Either the base model or the advanced model will be sufficient for the course project.

  *** This project will use a little computer graphic skills, but necessary functions will be provided.

  Base approach will be like the coarse part of:

Advanced approach will be like:


- Improve neural network generalization for image classification with adversarial information bottleneck. [Ran Wang, rw1691@nyu.edu]

The target of this project is to investigate improving the generalization power of deep neural networks. Previous works explain the network generalization from an information theory point of view [1]. During training, the network forgets redundant information of input whilst remembers information related to the task. Such information refinement is named as information bottleneck. In [3], such information bottleneck is explicitly used as a loss to improve network generalization ability. However the method only achieves an approximation of the actual information bottleneck.

In this project, we are going to borrow idea of the information bottleneck and develop a new approach for generalize the network for image classification task.

Requirement: Deep learning.


Other possible projects in medical image analysis: you can pick one of the challenges in the link below and work on it. Please discuss with the instructor once you have several choices after you have read the background material. I will gauge whether you have sufficient background and time to do it or suggest a subset to work on.
https://grand-challenge.org/challenges/

Other possible projects in computer vision: you can pick one of the challenges in the links below and work on it. Please discuss with the instructor once you have several choices after you have read the background material. I will gauge whether you have sufficient background and time to do it or suggest a subset to work on.
http://www.robustvision.net/
http://www.icme2019.org/conf_challenges

Optical flow estimation using deep learning:


https://lmb.informatik.uni-freiburg.de/Publications/2017/IMKDB17/


Older papers:

• Depth estimation from single image:


• Image inpainting: filling holes in an image