EE 5806: Topics in Image Processing
Test 2 Review

<u>General Information:</u>
- This is an online open-book examination taken in Canvas.
- Scope: Chapters 5 to 7
- 1 hour in-class exam: Nov. 11, 2020. 8:40pm – 9:55pm.
- Duration of the examination is 60 minutes (1 hour). An additional 15 minutes will be given afterwards for you to upload your answers. As such, the total time for the examination is 60+15=75 minutes.
- Students must have confirmed that they can upload materials to Canvas through the mock test.
- No material will be accepted beyond the end of the 75 minutes.
- No material will be accepted through email without **a very strong justification**.

Topics

1. <u>Image Restoration and Reconstruction</u>
   (a) Know noise removal filters: Arithmetic mean filter, geometric mean filter, median filter, alpha-trimmed mean filter, adaptive median filter
   (b) Know three ways for estimating impulse response: by observation, experimentation and modelling.
   (c) Know inverse filtering
      - What issue does it have?
      - How to mitigate this issue?
   (d) Know Wiener filtering
      - What does it optimize?
      - What issue does it have?
      - How to mitigate this issue?
   (e) Image Reconstruction from Projections
      - Know Radon Transform
      - Define "sinogram". Why is this representation called sinogram?
      - Describe backprojection. Describe mathematically why backprojection results in a blurred image.
      - Know the Fourier-slice theorem
      - Define "filtered backprojection". Describe the filter that should be used mathematically. List the steps involved in filtered backprojection.

2. <u>Geometric operations</u>
   (a) Linear transformation: expected to know formulae to relate coordinates in the input image with those in the output image
      - Translation
      - Scaling about origin or an arbitrary point
      - Rotation about origin or an arbitrary point
      - Composite transformation. Order of operation does matter.

   (b) For all transformation described in (a), know how to define the affine matrix to implement the transformation using Python built-in tool [i.e., need to be able to determine T passed to `cv2.warpAffine(im, T, (width, height))` for the transformation described in (a).]

(c) Define forward mapping and backward mappings. Why are the advantages of using backward mapping? Need to be able to perform the backward mapping given the forward mapping [i.e., need to be able to express (i,j) in terms of (i',j').]

(d) Grey level interpolation
- Nearest neighbour
- Bilinear

(e) Landmark registration: expected to know how the four transformation parameters, a, b, t_i and t_j, are derived.

3. Morphological Image Processing
   (a) Binary morphological operations
   - Know how to perform erosion and dilation.
   - Know the applications of erosion and dilation.
   - Know how to perform opening and closing.
   - Know the geometric interpretations of opening and closing.

   (b) Connected components and labelling
   - Identify connected components based on the 4-connectedness and 8-connectedness definitions.
   - Understand the two-pass labelling algorithm.

   (c) Morphological algorithms
   - Hit-Or-Miss transform
   - Boundary extraction
   - Region filling
   - Skeletonization (no need to know detailed algorithm)

   (d) Grayscale Morphology
   - Know how to perform erosion and dilation.
   - Know how to perform opening and closing.
   - Know the geometric interpretations of opening and closing.
   - Know the following grayscale morphology algorithms: morphological smoothing, morphological gradient, top-hat and bottom-hat transformations