Special Topics Course on Image Processing Techniques

Course Number: CMSE890-001 Spring 2018
Title: Image Processing Techniques
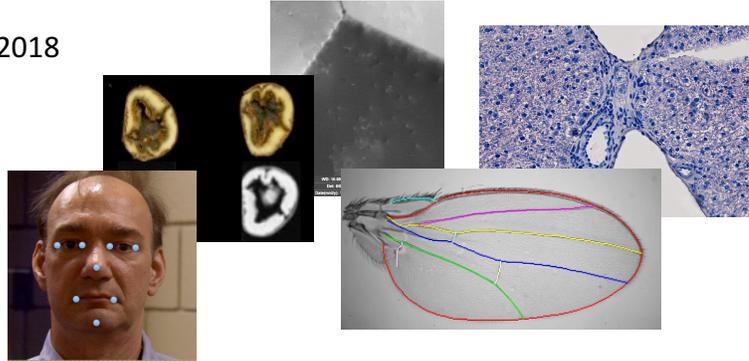**Time:** MWF - 9:10 AM - 10:00 AM
Location: 1300 Engineering Building

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Motivation: Analyzing vast amounts of image data for science continues to be a time-consuming process. Commodity cameras (e.g., cell phone cameras) and Imaging sensors (MRI, CAT Scans, Lidar, etc.) are becoming more affordable and thus reducing the cost for researchers to gather image-based data. However, the relatively low acquisition cost has created a "big data" problem in science. Analysis of all of these images to extract the needed scientific measurements in order to answer research questions is still a time-consuming process, which is only accentuated by this avalanche of additional data. Central to the problem is that every new scientific question and image dataset requires its own image analysis workflow. Most domain scientists do not know what types of solutions are available, and even if an algorithm/solution is available it is expensive to develop custom software analysis tools for a specific research problem or domain. For this reason, many researchers have found it faster and cheaper to manually annotate and process images by hand using low-level tools such as Photoshop.

Description: In this course, we intend to develop and explore tools that assist researchers in analyzing their scientific image datasets. To do this we are focusing on the computational representation of images and the types and classes of algorithms that have been developed for science analysis. Topics covered in this course include, but are not limited to, the following:

- Data representations
- Methodologies for acquisition
- Preprocessing
- Binary morphology
- Segmentation
- Feature selection
- Machine learning
- Visualization
- Computational techniques for dealing with big data (clusters, accelerators, etc.)

Prerequisites: Programming experience is expected (CMSE 801 or equivalent). Most of the course will be taught in Python using Jupyter notebooks. Prior knowledge of Python is not required, however, previous experience in a programming language is expected. Students will also be introduced to other imaging tools such as: ImageJ (Fiji), Matlab, OpenCV, ImageMagick, and FFMpeg.