BIOEN5902
Introduction to Bioimaging

Instructors
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Required Material
Course Textbooks:
Douglas B. Murphy, Michael W. Davidson, Fundamentals of Light Microscopy and Electronic Imaging
Simon R. Cherry, Ramsey D. Badawi, Jinyi Qi, Essentials of In Vivo Biomedical Imaging

Software: Matlab
Further software (freeware) will be used throughout the course.

Description
This course provides students with a broad background in imaging approaches and their application in biomedical research and development. Topics include imaging system theory, imaging physics, microscopy, ultrasound imaging (US), magnetic resonance imaging (MRI) and computed tomography (CT). Associated laboratory modules teach students to design, conduct, and analyze imaging experiments, and to use the techniques, skills and tools necessary for biomedical research and development.

Topics Covered
Imaging System Theory - Linear Systems, Fourier Transformation, Digitization and Sampling, Convolution and Correlation, Projections
MRI, X-Ray, CT, US Imaging

The course aims at Bioengineering undergraduate students. Also graduate students with an interest in microscopy are welcome. Prerequisites are BIOEN 3101: BioSignals Analysis and BIOEN 3301: Computational Methods. Participation of students from other departments and graduate students requires permission by the instructors.

Outcomes
By the end of this course, students will have
• a fundamental knowledge of imaging theory
• an understanding of imaging technology from an engineering perspective
• a solid foundation for application of imaging approaches in biomedical studies

Teaching and Learning Methods
The class format will include didactic lectures, quantitative problem-solving exercises, writing assignments, and laboratory exercises.

Labs
1. Processing and visualization of microscopic images (ImageJ, Rendering software)
2. Computational lab “3D convolution and deconvolution”. Students will use MatLab.
3. Hands-On lab “Fluorescence and confocal microscopy”. Lab will be at Imaging core or CVRTI.
4. US lab “Introduction to hardware, acquisition and analysis”
5. MRI lab “Introduction to hardware, safety, acquisition and reconstruction”. Students will use software for quantitation of MR data, eg T2 fitting. Lab will be at Small Animal Imaging Facility.
6. CT lab “Introduction to hardware, acquisition, reconstruction, and Hounsfield calibration” Students will use software for quantitation of CT data. Lab will be at Small Animal Imaging Facility.

Schedule
Class times: Tuesday and Thursday, 12:25-13:45
Classroom: TBD
For detailed lecture, lab, homework and exam schedule see Canvas.

Grading
Six lab reports. Each lab report contributes 10% to the overall score.
Midterm exam. The exam contributes 20% to overall score.
Class project. The project contributes 20% to overall score.

Class Policies
Attendance and Punctuality. Regular attendance is required at all class meetings and laboratories. Moreover, this course is discussion-oriented and requires your presence in the classroom. You are expected to attend class and laboratories on time.

Etiquette. Please maintain an environment conducive to learning by observing the following: arrive on time to class; make sure that your phone is either off or on silent before class begins; and use laptops/tablets/other electronic devices for class activities only. If you need to take a phone call, please leave the classroom when doing so. Texting during class is not permitted.

University Policies
Academic Honesty. The University of Utah maintains a strict policy regarding academic misconduct. “Academic misconduct” includes, but is not limited to, cheating, misrepresenting one's work, inappropriately collaborating, plagiarism, and fabrication or falsification of information, as defined further below. It also includes facilitating academic misconduct by intentionally helping or attempting to help another to commit an act of academic misconduct. A student who engages in academic misconduct may be subject to academic sanctions including but not limited to a grade reduction, failing grade, probation, suspension or dismissal from the program or the University, or revocation of the student's degree or certificate. Please see http://regulations.utah.edu/academics/6-400.php for more information.

The Americans with Disabilities Act. The University of Utah seeks to provide equal access to its programs, services, and activities for people with disabilities. If you will need accommodations in this class, reasonable prior notice needs to be given to the Center for Disability Services, 162 Olpin Union Building, (801) 581-5020. CDS will work with you and the instructor to make arrangements for accommodations. All written information in this course can be made available in an alternative format with prior notification to the Center for Disability Services.

Addressing Sexual Misconduct. Title IX makes it clear that violence and harassment based on sex and gender (which includes sexual orientation and gender identity/expression) is a civil rights offense subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, color, religion, age, status as a person with a disability, veteran’s status or genetic information. If you or someone you know has been harassed or assaulted, you are encouraged to report it to the Title IX Coordinator in the Office of Equal Opportunity and Affirmative Action, 135 Park Building, 801-581-8365, or the Office of the Dean of Students, 270 Union Building, 801-581-7066. For support and confidential consultation, contact the Center for Student Wellness, 426 SSB, 801-581-7776. To report to the police, contact the Department of Public Safety, 801-585-2677(COPS).

Note: This syllabus has been created as a guide to the class and is as accurate as possible. However, all information is subject to change as class needs change. Any changes will be discussed in advance during class sessions.