Computer Integrated Surgery II
601.456/496/656

Spring 2025
Russell H. Taylor
Tu, Th 1:30-2:45
Hackerman B17

Course concept

- Combination:
  - <u>Projects</u>
  - Seminar on current research
  - Lectures on computer-integrated surgery and related subjects by instructor, guests (time permitting)
- Projects should have some medical application tie, but this can be fairly broadly construed. E.g.,
  - Medical image analysis
  - Diagnosis
  - Interventional systems & applications
  - Rehabilitation
  - Health informatics
  - Mobile health
  - Infrastructure development for CIS research
- Prerequisite: 601.455/655 or my consent

Course Numbers and Credits

- 601.456 (3 credits)
  - Full course (lecture/seminar + project)
  - Advanced undergrads
- 601.496 (3 credits)
  - Intended for CS students who want to use CIS II to satisfy the CS "team" requirement
  - Same as 601.456 except that students enrolled must be in 3 person teams (who can include students enrolled in other 456 and 656, as well).
- 601.656 (3 credits)
  - Same as 601.456 but intended for grad students
  - Projects tend to be more advanced
  - Project teams can consist of grad students and undergrads

3

Meeting logistics

- **Meeting Time and Place**
  - Tuesday and Thursday 1:30-2:45
  - Hackerman B17
- **Web Sites**
  - We will use the course Wiki page and Piazza for course administration and communication
  - Wiki page: https://ciis.lcsr.jhu.edu/dokuwiki/doku.php?id=courses:456
  - Piazza: https://piazza.com/jhu/spring2025/cs601456496656
  - Canvas: https://jhu.instructure.com/courses/91983
    - Really only landing page pointing to the class Wiki pages
    - Also has Panopto and Zoom links
- **Zoom and video**
  - Zoom link available via Canvas for people who are ill or otherwise unable to attend and for mentors or guest speakers.
  - Panopto recordings will available via the Canvas page.
  - The course zoom link and Panopto recordings are intended for members of the class and their mentors only. They are **not** to be shared with any third parties
  - Similarly, the video recordings may be watched by class members but are **not** to be downloaded or redistributed.

4

Contact Information

- Head TA = Jasmine Cho
  - Email: scho72@jhu.edu
  - Office Address: Hackerman 137
  - TA office Hours = By appointment
- My office hours
  - By appointment (see Michele in Hackerman 200)
- My lab meeting is Mon. 16:00-17:00 on Zoom
  - Link is https://wse.zoom.us/j/870643547
  - May change, but all are welcome
- ERC/LCSR Seminars Wed. 12-1:00 on Zoom
  - Link is https://wse.zoom.us/s/94623801186
- Medical Image Analysis Seminar (601.856)
  - Jointly led by Prof. Taylor and Prof. Prince Tues. 3-4:30 on Zoom
  - Paper reading and discussion on medical image analysis

5

Grades

- 601.456/496/656
  - 23 % seminar presentation/writeup
  - 15 % project plan
  - 10 % project checkpoint presentation
  - 7.5 % project final presentation (poster presentation)
  - 37.5 % project implementation & final report
  - 5% project Wiki pages
  - 2% in-class status reports ("elevator pitches")
  - Attendance can affect your seminar / presentation grades, so see me and the TA if you have special situation or needs
  - **Note:** We may modify this a bit (e.g., to include quizzes based on materials presented in class or to modify the relative weights)
  - **Note:** We may modify a bit as semester proceeds
- 601/356
  - Grade based on seminar presentation & critical summary of pertinent research papers

6

Date conflicts

- I may be out of town occasionally
  - Will arrange for guest speakers if cannot connect via zoom
- Also, the number of projects may create schedule crunch
- We may need to find make-up dates
  - Pick an evening (e.g., 5-7pm) or dawn (7-8am)
  - Evenings preferred
  - The TA will make a poll when things settle down

7

Rough Calendar

- 1/21,1/23,1/28, 1/30: Discuss possible projects in class
- Will probably begin project plan presentations 1/30
- Pick project & seminar topics by 2/13 (preferably sooner)
- Approved project plans by 2/24
- Project plan presentations 2/4 or sooner thru early March
- Paper seminars March through April
- Project checkpoints mid-March through mid-April
- Project poster session on final exam day (may be sooner)
- Project final reports on final exam day (may be sooner)
- Will modify a bit as semester unfolds

8

Projects

- Typically, will involve some substantial implementation/experimentation component
- Require a "mentor"
  - Me, colleague, or an end user
  - **Mentor must interview you and agree that you are appropriate for the project**
- Required funding/equipment support
  - Can come from me, project mentor, or end user
  - Note that my personal discretionary funds are limited and are unlikely to be provided for projects other than my own
- Require a defined plan and budget
- Team projects strongly encouraged

9

Project Web Sites

- **The course web site is a Wiki**
  - http://ciis.lcsr.jhu.edu/dokuwiki/doku.php?id=courses:446
  - Access to students-only pages is controlled
  - Log in with JHED ID
    - I preloaded from class enrollment on SIS, but a few late arrivals may not be there
    - Try login; if problem send your JHED id as soon as possible to me and the TA.
- **Piazza web site for communication**
  - https://piazza.com/jhu/spring2025/cs601456496656
  - You will need to log in and "join"
  - This web site is to be used **only** for business associated with this course
- **Each group should maintain a project web site as a wiki page under the course web site**
  - Will contain project descriptions and also PDF copies of all reports and presentations.
  - May contain media and other material as well.
  - Format and template guidelines on the web site
  - Each group will have permissions to write own site, read others in course
  - Each group should indicate if their web site may be viewed outside of course
  - Please respect the rules for where things can be put
  - Please keep them up-to-date. The TA and I will be spot-checking them.

10

Confidentiality and Projects

- **Some of the projects may involve potentially patentable or otherwise confidential material**
  - Premature disclosure can compromise patentability
  - Student inventors can get patents and licensing income
  - Some projects (e.g., those using ISI API data) may require students to sign a separate non-disclosure agreement with a company.
  - You need to close the loop with me on projects involving 3rd party confidential data, to be sure that something is publishable. Usually, this has not been a problem, but should be addressed early
- **Web sites for these projects will be only accessible by me, the TA, the students involved, and the mentors**
- **To permit free discussion in class, we will have this plan**
  - The whole class will sign a **non-disclosure agreement** to cover in-class presentations and discussion (JHTV has provided a template)
  - Agreement PDF is on course web site
  - You will sign an online form version (see CIS II Wiki for the link)
  - If any student is uncomfortable with this, please speak up. In that case, we will need to consider our options.

11

Project Proposals

- "Closed" plan by 2/24 or before
- Approximately 5-8 page summary containing
  - Stated topic and goal
  - Team members, mentor
  - **Short** statement of relevance/importance
  - **Short** technical summary of approach
  - List of "deliverables" (min, expected, max)
  - Key dates & assigned responsibilities
  - List of dependencies & plan for resolving
  - Management Plan
  - Reading list
- Project plan presentations in late Feb, early March
  - Cover similar material to written proposals
  - Bring a hard copy of plan and all presentation materials to class for me to use and post electronic form to your wiki page

12

Key Project Documentation

Note: May vary a bit depending on the project. These documents are often outlined in your project plan, which should (at least) include dates for initial drafts, checkpoint, and final versions. They should not be left for the end of the project.

- **Functional specifications:** Describe the operational characteristics of the system, together with key performance parameters.
  - You should have at least an initial version reviewed with your mentor at the time your project plan is submitted.
- **Design specifications:** Describe the system architecture, key interfaces, major components, necessary technical implementation details, and similar information.
  - A high-level overview identifying key components and interfaces should be reviewed with your mentor at project plan submission, but more detailed versions should be developed as the project proceeds.
- **Test plan:** Describe component tests and system verification tests.
  - Dates for test plan development should be in the project plan document, and the test plan should be developed concurrently with the design and implementation
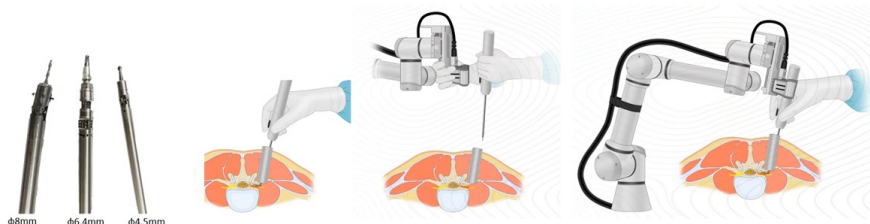- **User documentation:** Self-explanatory

13

Case Study Example from CUHK/MRC

14

The Development Gap from Prototype to Clinical Application

1. Inadequate user and design requirements
   - Uncertainty regarding articulation joint range of motion for mandibular drilling and screw placement
   - Uncertainty about tip geometry suitability for mandibular screw placement
   - Uncertainty about the drill rotation speed requirement for bone drilling and torque requirement for screw placement etc.
2. Insufficient design control and documentation
   - Failure to adhere to formal design control processes.
   - Lack of comprehensive documentation of design progress and history publications
   - Poor documentation traceability
3. Inadequate verification and validation testing
   - Insufficient or ineffective testing protocols for system specification verification
   - Incomplete validation protocols overlooking crucial contextual factors and user

Slide credit: Jayson Ding

15

Seminar Presentations

- Select a single important paper or series of papers (2-5) relevant to your project or other interest
- Give short (typically, 15-20 minutes) talk
  - Critical summary of what paper says & its significance
- Post a PDF copy of your materials (paper, presentation, etc.)
- Also, write a short (3-5 page) critical review
  - Due on specified date
  - Post on your project WIKI page
- Copy of paper (or link to public repository) will go onto your wiki page & hard copy to me
- Will be critiqued in class (in a friendly way)

17

Typical Outline (modify as appropriate)

- 1 slide statement of your project
- Paper selection and why
- Summary of problem & key result
- Significance of key result
- Necessary background
- Description of what the author(s) actually did
  - Theory, experiment, etc.
- Your assessment
  - Importance, relevance to you, good & bad points, etc.
  - Possible next steps for this work
- Conclusions

610.456/496/656 Spring 2025
Copyright R. H. Taylor

Engineering Research Center for Computer Integrated Surgical Systems and Technology

---

Project Checkpoint Presentation

- Approximately 12-15 minutes talk + 5-8 minutes discussion
  - Time guidelines based on number of projects and will be announced after project groups are identified
- Given in late March, early April
- Summarize/update plan material
- Present work to date
- Present problems, exposures, dependencies
- Bring hard copy of presentation materials to class for me to use and also post to your wiki page
- Will be critiqued in class (in a friendly way)

610.456/496/656 Spring 2025
Copyright R. H. Taylor

Engineering Research Center for Computer Integrated Surgical Systems and Technology

Project Final Presentation (Poster)

- Currently planned for date of final exam
- Standard format
- Project should be done or nearly so
- Present/demo results
- Discuss work remaining to be done
- Discuss significance of work

- Discuss lessons learned
- Prizes awarded in various categories

Project Final Report

- Technical summary
  - Similar to a short conference paper
  - Explain background, problem, approach, results, significance, etc.
  - Refer to the other required documents on your project wiki page
- Management summary (1 page)
  - Who did what
  - Discuss what was accomplished *vs* planned
  - Discuss what might be next
  - What you learned
- Technical appendices
  - Code, user's manual, etc. (may be on the Wiki)

Have fun!

- In conclusion, let me just welcome everyone to the course. Generally, students need to put a lot of work into these projects, but they also get a lot out of them.

- Again, your immediate job is defining projects, establishing your project teams, and making a project plan in cooperation with your mentors.

- You can either pursue one of the suggested projects or propose one of your own. In either case, you should pay attention to the requisite background and skills mix needed to do the proposed project. If you are missing a skill, you may be able to recruit someone who has it.

- Feel free to discuss things with me or the TA if you have any questions or ideas.

Engineering Research Center for Computer Integrated Surgical Systems and Technology

22