

COMPUTER INTEGRATED SURGERY, MINOR

The Whiting School of Engineering offers a minor in Computer Integrated Surgery (CIS) for full-time, undergraduate students at Johns Hopkins. The minor is particularly well suited for students interested in computer integrated surgery issues who are majoring in a variety of disciplines including biomedical engineering, computer science, computer engineering, electrical engineering, and mechanical engineering. The minor provides formal recognition of the depth and strength of a student's knowledge of the concepts fundamental to CIS beyond the minimal requirements of his/her major.

In order to minor in CIS, a student will require a minor adviser from the Engineering Research Center in Computer Integrated Surgical Systems and Technology (CISST ERC) in the Laboratory for Computational Sensing and Robotics. Current faculty members available as advisers include Professors Russell Taylor (CS), Greg Hager (CS), Jerry Prince (ECE), Ralph Etienne-Cummings (ECE), Louis Whitcomb (ME), Noah Cowan (ME), Marin Kobilarov (ME), Peter Kazanzides (CS), Iulian Iordachita (ME), and Emad Boctor (Radiology).

Program Requirements

To satisfy the requirements for the minor in CIS, a student must have a fundamental background in computer programming and computer science, sufficient mathematical background, and also take a minimum of six courses (with a total of at least 18 credits, earning at least a C- in each course) directly related to the concepts relevant to CIS. These six CIS courses must include two fundamental CIS core courses, which provide the student with the fundamental basis for CIS, and four approved upper-level courses (300-level or above) to allow the student to pursue an advanced CIS topic in depth. The additional four upper-level courses must include at least one course designated as an 'imaging' course or one course designated as a 'robotics' course, as discussed below.

Graduate levels of the same course may be substituted for the undergraduate levels listed below without additional permissions.

| Code | Title | Credits |
|--|---|---------|
| Fundamental Computer Science Courses | | |
| EN.601.226 | Data Structures ¹ | 4 |
| EN.500.112 | Gateway Computing: JAVA ¹ | 3 |
| Fundamental Mathematics Courses ² | | |
| AS.110.108 | Calculus I (Physical Sciences & Engineering) | 4 |
| | or AS.110.106 Calculus I (Biology and Social Sciences) | |
| AS.110.109 | Calculus II (For Physical Sciences and Engineering) | 4 |
| | or AS.110.107 Calculus II (For Biological and Social Science) | |
| AS.110.202 | Calculus III | 4 |
| | or AS.110.211 Honors Multivariable Calculus | |
| Select one of the following: | | 4 |
| EN.553.291 | Linear Algebra and Differential Equations | |
| AS.110.201 | Linear Algebra | |
| AS.110.212 | Honors Linear Algebra | |
| Fundamental Computer Integrated Surgery Courses | | |
| EN.601.455 | Computer Integrated Surgery I | 4 |
| A design course in CIS ³ | | 4 |

Other Courses Related to CIS

Select at least four other courses related to CIS. Of these, at least one must be in either the Imaging Subgroup or the Robotics Subgroup:

| | |
|---------------------------|--|
| <i>Imaging</i> | |
| EN.520.414 | Image Processing & Analysis |
| EN.520.432/ EN.580.472 | Medical Imaging Systems |
| EN.520.433 | Medical Image Analysis |
| EN.601.461 | Computer Vision |
| <i>Robotics</i> | |
| EN.530.420 | Robot Sensors/Actuators |
| EN.530.421 | Mechatronics |
| EN.530.603 | Applied Optimal Control |
| EN.530.646 | Robot Devices, Kinematics, Dynamics, and Control |
| EN.601.463 | Algorithms for Sensor-Based Robotics |
| <i>Other</i> | |
| EN.520.448 | Electronics Design Lab |
| EN.530.445 | Introduction to Biomechanics |
| EN.580.471 | Principles of Design of BME Instrumentation |
| EN.601.454 | Augmented Reality |
| EN.601.476 | Machine Learning: Data to Models |
| EN.601.482 | Machine Learning: Deep Learning |

Total Credits 43-46

- ¹ Or equivalent experience determined by your CIS minor adviser.
- ² Each math requirement may be satisfied by one of the specific courses listed, or by an equivalent course as determined by CIS advisor.
- ³ A design course in CIS. Either EN.601.456 Computer Integrated Surgery II or a design course in biomedical engineering, electrical and computer engineering, or mechanical engineering with substantial CIS content approved by the student's faculty adviser in the CIS minor.

Please visit <http://lcsr.jhu.edu/computer-integrated-surgery-minor/> for current course listings.