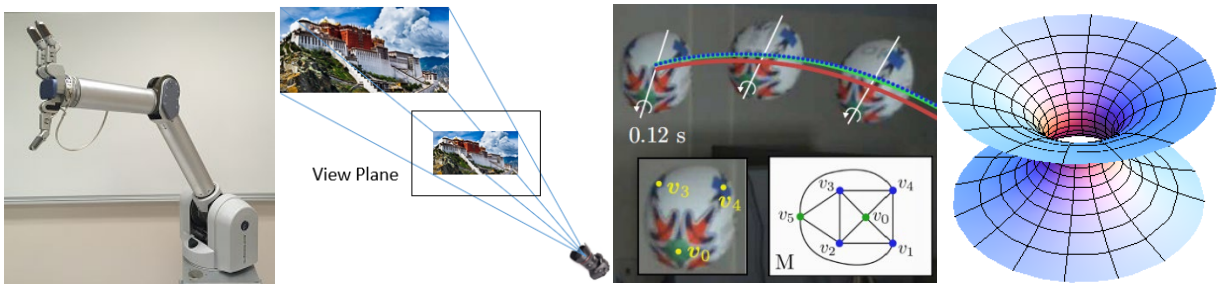
Com S 477/577
Foundations of Robotics and Computer Vision

Fall 2022
TR 2:10-3:25pm



Robots and vision systems are playing an increasingly important role in the world today by automating many tasks and assisting people in others. Robotics and computer vision are two fields that not only share close roots in engineering and computer science and draw upon overlapping mathematical backgrounds, but also have exerted a significant influence on each other's development.

How to compute the projection of a 3D object onto an image plane? How to reconstruct a surface over 3D range image data? What path will a bug be crawling along on a curved surface without making any turn? How to optimize a functional – a function of functions? Apart from answering these and other questions, this course aims at equipping you with a collection of powerful mathematical and computational tools that are being applied in robotics and computer vision, as well as in related areas such as graphics, geometric modeling, artificial intelligence, machine learning, and data science. Knowledge of contemporary and powerful problem-solving skills will not only provide you a competitive edge over others on the job market, but also likely impact your career path in a lifetime.

We will study ***algorithmic***, ***geometric***, ***numerical***, and ***optimization*** methods that have profound applications ***in the real world***. Below is a tentative list of topics:

1. Projective geometry (homogenous coordinates and transformations)
2. Rotations in space (orthogonal matrices, Euler angles, and quaternions)
3. Solution of systems of equations (linear, nonlinear, and polynomial)
4. Differential geometry (curves, surfaces, fundamental forms, and geodesics)
5. Approximation and data fitting (FFT, least squares, and surface fitting)
6. Optimization (unconstrained, constrained, and variational)
7. State estimation (Kalman filters)

There will be plenty of coding exercises (accounting for 30% to 40% of the assignments), as the course strives to keep a good balance between programming and analytical problem solving. Plus, you will be given the freedom to use your ***favorite*** programming language.

Finally, you will be able to save some textbook money as the course completely relies on ***self-contained lecture notes*** written by the instructor and made available online.

Prerequisites: (i) Com S 228, (ii) Com S 230 or Cpr E 310, (iii) Math 166 and (207 or 317); or consent from the instructor.

For more information, please contact the instructor:

Yan-Bin Jia
Professor of Computer Science
131 Atanasoff Hall
Tel: 515-294-2577
E-mail: jia@iastate.edu
Web: https://faculty.sites.iastate.edu/jia/
Lab: https://robolab-iastate.github.io/