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| Image result for Wichita State logo | **Introduction to Intelligent Robotics, 2022 / CS898 CA**  Dr. Hongsheng He, School of Computing |

Grasp Objects in Pybullet Environment

# Project Objective

* Get familiar with 3D robot simulation
* Understand intelligent robot programming
* Apply inverse kinematics algorithm in simulated environment

# Project Steps

1. Install pybullet with Anaconda (recommended)
   * Install Anaconda: https://www.anaconda.com/products/individual
   * Install Pybullet: https://anaconda.org/conda-forge/pybullet
2. (If you have done the first step, please ignore)

Install python3 (optional)

Setup the python3 environment on your system.

* + Windows 10:
    - https://phoenixnap.com/kb/how-to-install-python-3-windows
  + Mac:
    - https://docs.python-guide.org/starting/install3/osx/
  + Ubuntu 16.04:
    - https://www.digitalocean.com/community/tutorials/how-to-install-python-3-and-set-up-a-local-programming-environment-on-ubuntu-16-04

1. (If you have done the first step, please ignore)

Setup Pybullet Environment:

* + Run following commands in the terminal:
    - pip3 install pybullet --upgrade --user
    - python3 -m pybullet\_envs.examples.enjoy\_TF\_AntBulletEnv\_v0\_2017may
    - python3 -m pybullet\_envs.examples.enjoy\_TF\_HumanoidFlagrunHarderBulletEnv\_v1\_2017jul
    - python3 -m pybullet\_envs.deep\_mimic.testrl --arg\_file run\_humanoid3d\_backflip\_args.txt
  + Pybullet Reference: https://github.com/bulletphysics/bullet3

1. Load assigned object in the environment
   * In sawyerEnv.py, change the variable *object\_path*  to your assigned object.
   * In main.py, update *object\_path*  to your assigned object.
2. Record the tray location in the environment
   * run tune\_grasping.py
   * Click the GUI and Press Q on your keyboard
   * Record the tray\_x and tray\_y
   * update tray\_x and tray\_y in both sawyerEnv.py and main.py
   * Please make sure the tray and the object is not conflict.
3. Run tune\_grasping.py
   * Adjust your hand position and grasp type by using the slider
   * After you have adjusted your hand position. Press Q on your keyboard
   * you can get 3 outputs
     + handIReading: the pose of the hand
     + palmPosition: arm postion
     + Orientation: arm orientation
4. Find grasping trajectory
   * Run tune\_grasping.py and record parameters for each step in lines 340 – 376 in main.py
     + handIReading
       - handInitial
       - handClose
       - handOpen
     + palmPosition and orientation
       - grasp\_palmPosition, grasp\_orientation
       - pu\_palmPosition, pu\_orientation
       - final\_palmPosition, final\_orientation
5. Update the outputs in step 7 to main.py
6. write code for the grasping task
   * Use **Inverse Kinematics Function** in main.py to control the position and orientation of the arm
   * Use **Hand Direct Control Function** in main.py to control the hand

1. Record a video for successfully trail

# What you need to submit

* Functional codes (30%)
* Demo illustration (30%)
  + A video that contains one trial of successfully grasping the target objects. Please share the video at OneDrive at WSU and share the link (Don’t upload to Blackboard).
* Project Report (40%)
  + A project report that in academic paper format should be written for this project (IEEE conference templates) (1%).
  + The report should include:
    - Introduction (5%)
      * Background about robotic Object Recognition and Grasping (2%)
      * Procedure of the project (2%)
      * Brief Summary of the project (1%)
    - Project Descriptions (10%)
      * Describe the procedure (2%)
      * Describe the applied algorithm/methods of the project (4%)
      * Save the grasping parameters of the hand and fingers into a “.csv” file. For example, if your object is “203”, save your parameters into a “203.csv” including all parameters in step 7 (3%)
      * Include a picture of the hand gesture (1%)
    - Results (10%)
      * Trajectory of the object in grasping (5%)
      * Snapshots of successful and failed grasps (if there are any) (5%)
    - Discussion of results (10%)
      * Discuss the advantages and disadvantages of the designed hand gesture in grasping the object. Why is it successful? (5%)
      * Discuss the designed trajectory of hand movement. What are the key parameters and how are the parameters are selected? (5%)
    - Conclusion (3%)
      * Conclude the report, what you have done (1%), what results you have got (1%), what worked and what did not (1%).
    - Reference (1%)