

CSE 170 – Introduction to Computer Graphics

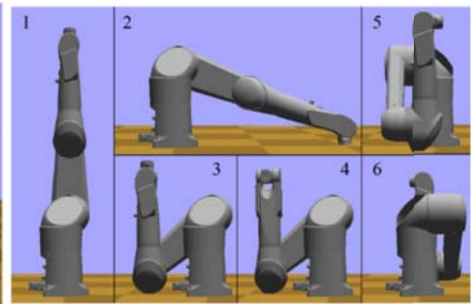
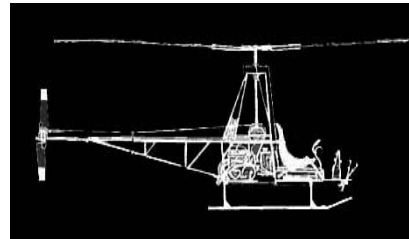
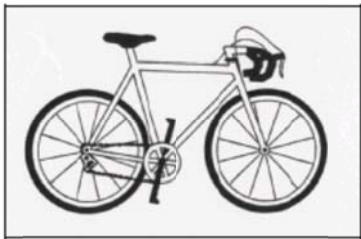
Project 1 – Animating a Hierarchical Object

Deadline:

Wed/Fri Labs (Mar 22/24) - presentation and submission until end of lab
(The deadline is your last lab before Spring Break)

Late Projects:

We will accept presentations and submissions until April 5/7, but under a 20% penalty



Description

You will model a simple hierarchical object with primitives (capsules, cylinders, spheres, superquadrics) in OpenGL and animate it using transformations. Use of external tools is acceptable but the requirements have to be implemented with your own code, including the OpenGL code/commands respective to the requirements.

You can choose which object to build and animate. The pictures above give some examples but you can certainly find many other interesting options. It can be any object as long as you follow the requirements.

Requirements

1. (28%) Parts: you will have to model a hierarchical object of at least 5 parts interconnected by joints which will be animated. The joints have to create at least 5 degrees of freedom in total, and produce movements in 3 dimensions. You also have to place your object in a scene with a floor and a few other simple objects around in order to give some context to the scene. The objects may be all based on your tube or capsule primitives. Below are some examples for different objects taking into account their typical parts:

Bicycle	Crane	Helicopter	Character
- Wheels	- Wheels	- Body	- Body
- Frame	- Cabin	- Main rotor axis	- Right Arm
- Pedals	- Main arm	- Main rotor blades	- Left Arm
- Fork	- Secondary arm	- Tail rotor axis	- Right Leg
- Handlebar	- Hook	- Tail rotor blades	- Left Leg
- Floor with objects	- Floor with objects	- Floor with objects	- Floor with objects

2. (28%) Animation: Your object will have two types of animation: global motion (to move it around your scene), and joint motion (to move the joints of the object). If you are implementing a vehicle what you want to achieve is a controllable vehicle where all of the parts correctly move in a synchronized way.

Up/Down and Left/Right keys: these keys are reserved for animating the global motion of your object. You may use additional keys if you need (for ex. like PageUp/PageDown for elevation), but at least the arrow keys have to meaningfully control the global motion of your object. For a bicycle or a vehicle what makes sense is to change the linear velocity of your vehicle with the Up/Down keys and change the direction of the wheels with the Left/Right keys. For other objects you just have to find a meaningful way to control the global motion of your object with the arrow keys. If for your object there is no meaningful way to control its global motion you may just use the arrow keys to move it around the scene.

Keys Q/A, W/S, E/D, etc.: These keys are reserved to control the joints of your object. Use as many keys as you need (at least 5 pairs) to achieve a meaningful control of the individual parts of your object. Each pair of keys (Q/A, W/S, E/D, etc.) will control one degree of freedom of your object on its normal and opposite direction. For example you can use Q/A to test a steering wheel rotation towards the left and right directions, by increments for each key press. The keys may be used only to test the joint movements of your object, while other keys and controls (like the arrow keys) are reserved for proper global object movement.

→ *Note that the animations must be implemented by using transformation matrices that are sent to your shaders, and not by re-computing new objects in new positions at every frame. This means that you should only build your objects once. After the objects are built, they will only move based on transformation matrices that will be sent to the shaders (via uniforms) at the time of drawing them. It is a requirement to implement your animations like this, otherwise you will get 0% on the animation requirement.*

3. (24%) Visualization. In order to test and improve your project you also have to develop the following visualization tools/effects:

- a) Include at least two different camera modes to be switched with the **space bar**: the first mode can be a fixed one, but the second mode is from a moving camera, like from inside the vehicle or from an animated bird's eye view camera floating around/on top of your scene. You may experiment with additional modes if you wish but at least one moving camera should be there.
- b) Include at least one object with texture.
- c) You also have to display on the floor a correct shadow of your hierarchical object. You may just use geometric projection as seen in a previous programming assignment.

4. (15%) Overall Project Quality. It is also a requirement that your project looks good. Note that you do not need to make a complex project or go beyond the minimum requirements to get all points; it is fine to stay with simple primitives as long as everything works and looks carefully prepared. Be creative and be sure to describe all your features in the project presentation day.

This project will certainly require several days of implementation, so come to all the labs to have continuous support during your development!!

5. (5%) Presentation and Project Submission

As usual, you will present your project to the TA by the deadline and then submit your code. You are encouraged to show your results to your colleagues in the lab, and everyone is welcome to come to other labs to see the projects. Unfortunately it will not be feasible to have everyone show their projects to everyone else, but we are going to post your results in a web page.

=> As part of your submission, in addition to uploading your code as usual, you will also be required to supply one .png or .jpg snapshot of your project. This image should be the best representative image to highlight your project. We will later organize a web page with all pictures. Please name your picture in the following format:

`proj1_[your last name]_[your first name].jpg/png`

(Note: if for any reason you do not want your image posted in a web page, just let me know.)

Summary of Requirements

1. (28%) Parts: at least 5 connected parts with 5 degrees of freedom (moving in 3D), and a scene with extra objects.

2. (28%) Animation: global motion controlled with arrow keys and individual animation of main degrees of freedom (at least 5) with Q/A, W/S, E/D, etc, keys.

3. (24%) Visualization: include a) static and moving camera (8%), b) textured objects (8%), and c) a shadow of the hierarchical object (8%).

4. (15%) Overall Quality: your project has to look good! (You may get full points here even if you do not complete all items in requirement 3.)

5. (5%) Presentation and Submission: Do not forget to submit your representative image!