Perception and Multimedia Computing

3D Graphics

Friday 1st Dec 2017

1. **Vector Maths: dot product rotation in 2D**

   a. Download the code (q1.js) from learn.gold, you can see a little black triangle travelling upwards, The tip of the triangle aligns with the direction of its velocity

   b. Change the velocity to (0.3,0.4). You will see that now the triangle is no longer aligned its travelling direction. Rotate the triangle to make it align with its velocity using angleBetween().

   c. Does your code handle the situation where velocity is (-0.3, -0.4)? Why? How do you fix it? (hint: use cross product)

   d. Can you replace the angleBetween function with dot product?

   - hint: to calculate theta, use the equation:

$$\mathbf{a} \cdot \mathbf{b} = \|\mathbf{a}\| \, \|\mathbf{b}\| \cos\phi$$

   - Useful functions: acos(), mag().

2. **3D shapes and Camera:**

   a. So far you have probably tried various ways of drawing 2D shapes in p5 using primitive (line(), rect(), ellipse(), triangle(), etc). p5 also have primitive 3D shapes: box( ) and sphere( ). Try to draw a box and a sphere.

   b. Can you put the sphere and the box together to create something meaningful? Try to make a 3D stick figure with box and sphere (**Figure A**).

   - hint: you will need translate( ). Try to also use push( ) and pop( )

   c. Play with the camera: do you understand how the camera parameter works? In your draw function, add the code to control the camera:

   camera(mouseX*2, mouseY*2, (height/2) / tan(PI/6), width/2, height/2, 0, 0, 1, 0);

   d. Can you try to draw something more interesting than a stick figure?

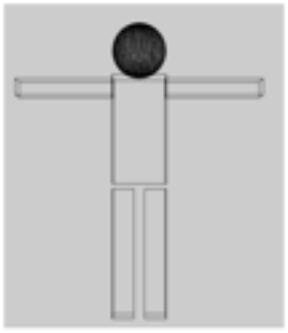

Figure A

3. **Vector maths: draw cross product in 3D**

   a. Can you visualise the cross product of two vectors as shown in **Figure B**? The red line is the cross product of the blue and green vector.

   hint: define two 3D vectors (*a*, *b*), calculate the cross product (*c*), visualise all 3 vectors. code for drawing vector *a*: line(a.x, a.y, a.z, 0, 0, 0);

   hint: you will also need the camera code to view it properly.

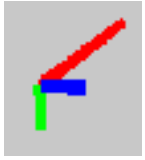

Figure B

b. What's the difference between b.cross(a) and a.cross(b)?

4. Explore lighting and materials

a. Download the lighting.js code from learn.gold. Run the sketch and try putting some comments in the code (you might need to read https://github.com/processing/p5.js/wiki/Getting-started-with-WebGL-in-p5).

b. Try to switch off one or two of the lights and observe the three lights separately. What do you see?