LEI / LCC
Departamento de Informática
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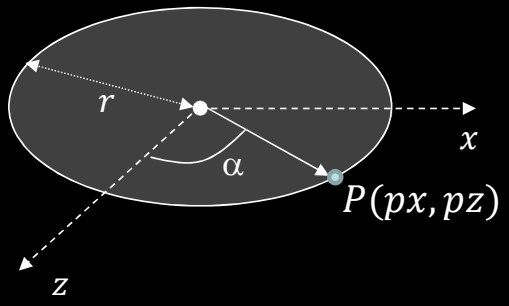
Camera Motion
Drawing a Cylinder

Polar Coordinates

- Polar coordinates specify points based on an angle and a radius.



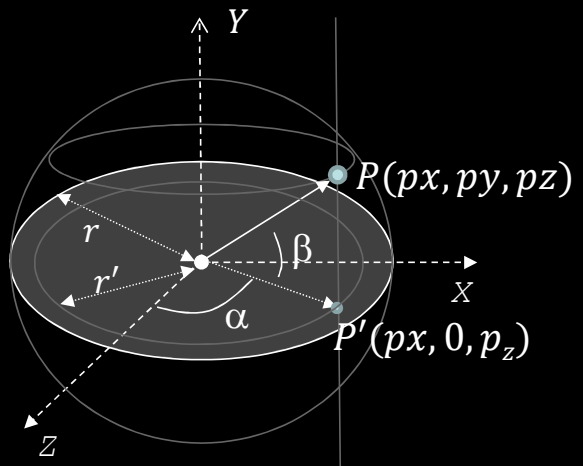
Polar Coordinates
(α, r)

Cartesian Coordinates
$px = r * \sin(\alpha);$
$pz = r * \cos(\alpha);$

Spherical Coordinates

- Specify a point on the surface of a sphere

$r' = r \times \cos(\beta)$



Spherical Coordinates

(α, β, r)

por limite a 1.5 ↔ $(-\frac{\pi}{2})$ $-90 < \beta < 90$ $(\frac{\pi}{2})$ → por limite a 1.5

Cartesian Coordinates

$z = r \times \cos(\beta) \times \cos(\alpha);$

$x = r \times \cos(\beta) \times \sin(\alpha);$

$y = r \times \sin(\beta);$

Explorer Mode Camera

- The camera moves in the surface of a sphere, always looking at the centre of the sphere.
- Don't allow the camera to be upside down.

```
gluLookAt( px, py, pz,     // camera position
           lx, ly, lz,     // look at point
           ux, uy, uz)     // "up vector" (0.0f, 1.0f, 0.0f)
```

- The look at point is constant (0.0f, 0.0f, 0.0f)
- The camera position is defined based on spherical coordinates (*alpha*, *beta*, *radius*) that must be converted to Cartesian coordinates (p_x, p_y, p_z)
  - (*alpha*, *beta*) determine the position of the camera in a sphere of radius r. Limit |*beta*| < 1.5 (radians)
  - *radius* determines the distance of the camera to the look at point

FPS Camera

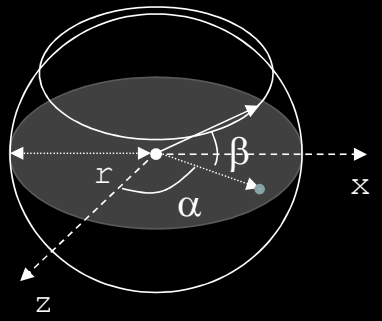
- Camera Orientation

- The view direction is obtained using spherical coordinates. The look at point is defined based on the view direction and the actual camera position.

- The view direction is a vector D computed based on the two angles (*alpha* and *beta*) that define the horizontal and vertical orientation respectively.

- Considering `P = (px,py,pz)`, the camera position, and `D = (dx, dy, dz)`, the view direction is:

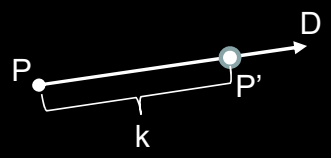
```
gluLookAt(px,py,pz,
          px+dx, py+dy, pz+dz,
          ux, uy, uz);
```



FPS Camera

- Camera Motion
- Forward and backward movement is achieved using vector `D`
- `D` should be normalized
- To move the camera `k` units forward, and considering `D` to be a unit vector, implies recomputing the camera position as follows:

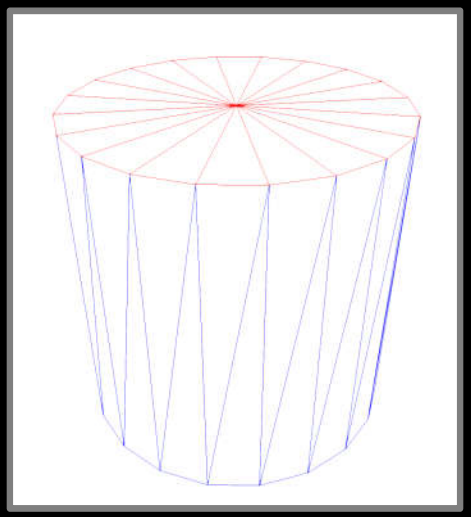
```
P' = P + k x D
```



- Note: the look at point must also be displaced.

Practical Assignment

- Build a cylinder using triangles defining the vertices based on polar coordinates
  - function drawCylinder(float radius, float height, int slices)
- Complete the code skeleton to build an interactive application using the keyboard to move the camera up/down and left/right (explorer mode) using spherical coordinates.
  - function processKeys and processSpecialKeys



π and math.h

- A value for PI is defined in constant `M_PI` in math.h
- To have this constant available we should write:

```
#define _USE_MATH_DEFINES // always before the include
#include <math.h>
```

- Usage example:

```
float x = M_PI / n;
```

Useful functions

- Set a color:

```
glColor3f(r,g,b)
```

  - note: call the function before sending the vertices to the GPU

- Change drawing mode:

```
glPolygonMode(faces, mode);
```

  - faces: `GL_FRONT, GL_BACK, GL_FRONT_AND_BACK`
  - mode: `GL_FILL, GL_LINE, GL_POINT`