SPHERICAL COORDINATE SYSTEM

In spherical coordinate system, a point P in space is represented by triplet (r, θ, ϕ) where,

- r is distance between point and origin
- θ is clockwise angle from the X axis in XZ plane
- ϕ is angle between the Y axis and the point.

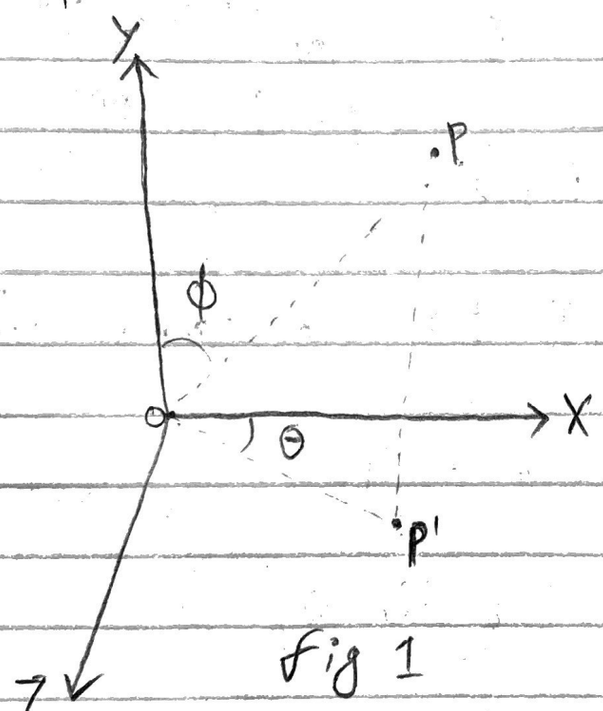

Fig 1

Note that in literature elsewhere, it is also common to see Z axis aligned in up direction in which case our figure would be like fig 2 below. Fig 1 above is most apt for 3D graphics.

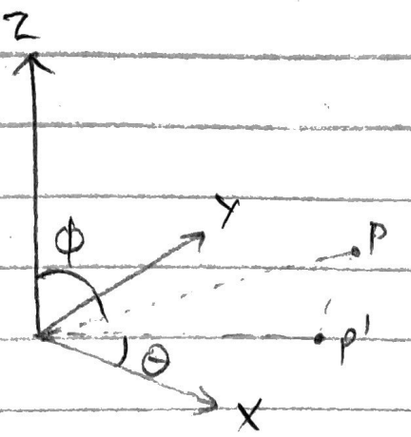

fig 2
(not referenced here)

Our motivation for spherical coord. system is mostly for expressing camera position in world space.

To express $P\langle x, y, z\rangle$ in terms of $P\langle r, \theta, \phi\rangle$, from fig 1:

$$r^2 = x^2 + y^2 + z^2 \;;\; r = \sqrt{x^2 + y^2 + z^2}$$
$$\tan\theta = z/x \;;\; \theta = \tan^{-1}(z/x)$$
$$\cos\phi = \frac{y}{\sqrt{x^2 + y^2 + z^2}} \;;\; \phi = \cos^{-1}\left(\frac{y}{\sqrt{x^2 + y^2 + z^2}}\right)$$

To express $P\langle r, \theta, \phi\rangle$ in terms of $P\langle x, y, z\rangle$, from fig 1:

$$y = r\cos\phi$$

$$OP' = r\sin\phi$$

$$x = OP'\cos\theta = r\sin\phi\cos\theta$$
$$y = OP'\sin\theta = r\sin\phi\sin\theta$$