

Re: converting star coordinates to x,y,z

Source: <http://sci.tech-archive.net/Archive/sci.astro.amateur/2004-12/1624.html>

From: Brian Tung (brian_at_isi.edu)

Date: 12/09/04

Date: Thu, 9 Dec 2004 17:25:56 +0000 (UTC)

Rick wrote:

> *I'm working on a project of modeling the stars of the constellations in
> 3-D; not for their positions relative to Earth, but relative to any
> given person being at 0,0,0.*

You need RA, Dec, and parallax for each star. You can then convert to rectangular coordinates as follows:

1. First, convert RA and Dec to decimal degrees.

$$\begin{aligned} \text{RA_deg} &= 15 * \text{RA_h} + \text{RA_m}/4 + \text{RA_s}/240 \\ \text{Dec_deg} &= \text{Dec_d} + \text{Dec_m}/60 + \text{Dec_s}/3600 \end{aligned}$$

2. Next, convert parallax to distance (in parsecs).

$$\begin{aligned} \text{Dist} &= 1/\text{Par_arcsec}, \text{ *or*} \\ \text{Dist} &= 1000/\text{Par_mas} \end{aligned}$$

Here, mas = milliarcseconds, a common unit for parallax.

3. Then convert to rectangular coordinates. There is no fixed way to do this; however, one way is

$$\begin{aligned} x &= \text{Dist} * \cos(\text{Dec_deg}) * \cos(\text{RA_deg}) \\ y &= \text{Dist} * \cos(\text{Dec_deg}) * \sin(\text{RA_deg}) \\ z &= \text{Dist} * \sin(\text{Dec_deg}) \end{aligned}$$

Many programming languages perform trigonometric operations in radians rather than degrees. In that case, first convert the coordinates to radians:

$$\begin{aligned} \text{RA_rad} &= \text{RA_deg} * (\text{PI}/180) \\ \text{Dec_rad} &= \text{Dec_deg} * (\text{PI}/180) \end{aligned}$$

where PI = 3.14159..., and then

$$\begin{aligned} x &= \text{Dist} * \cos(\text{Dec_rad}) * \cos(\text{RA_rad}) \\ y &= \text{Dist} * \cos(\text{Dec_rad}) * \sin(\text{RA_rad}) \end{aligned}$$

sci.astro.amateur: Re: converting star coordinates to x,y,z

$$z = \text{Dist} * \sin(\text{Dec_rad})$$

I guess I should have made you look it up, but I'm feeling generous today.

Brian Tung <brian@isi.edu>

The Astronomy Corner at <http://astro.isi.edu/>

Unofficial C5+ Home Page at <http://astro.isi.edu/c5plus/>

The PleiadAtlas Home Page at <http://astro.isi.edu/pleiadatlas/>

My Own Personal FAQ (SAA) at <http://astro.isi.edu/reference/faq.txt>