The ITRF coordinates of the spherical center of FAST

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ABSTRACT

The ITRF coordinates of the spherical center of the Five-hundred-meter Aperture Spherical radio Telescope (FAST) are $(X, Y, Z) = (-1668557.2070983793, 5506838.5266271923, 2744934.9655897617)$.

Subject headings: telescopes

Five-hundred-meter Aperture Spherical radio Telescope (FAST, Nan et al. 2011) is the largest single-dish radio telescope in the world, starting to achieve in the studies of pulsars and fast radio bursts (Qian et al. 2020).

The ITRF coordinates of a fixed point of an observatory is required for pulsar search and pulsar timing software. For the Five-hundred-meter Aperture Spherical radio Telescope (FAST), the fixed point can be taken as the spherical center of the the reflector. In using various software, we find all kinds of inconsistent coordinates of FAST. Here we try to nail it down.

In the WGS-84 coordinate, the longitude, latitude, and altitude of the spherical center of FAST are $\lambda = 106°51'24.000740"$, $\phi = 25°39'10.626537"$, and $h = 1110.028801$ m, respectively (from FAST technical report). The ellipsoids of ITRF and WGS-84 are almost the same, with a difference less than 1 meter. Here we use the WGS-84 ellipsoid. The transform from (λ, ϕ, h) to $(X, Y, Z)$is

$$\begin{aligned} X &= (N+h)\cos\phi\cos\lambda \\ Y &= (N+h)\cos\phi\sin\lambda \\ Z &= [N(1-e^2)+h]\sin\phi \end{aligned}$$

where $N = a/\sqrt{1-e^2\sin^2\phi}$, the semi-major $a = 6378137$ m, semi-minor

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$b = 6356752.3142451795$ m, $e^2 = \frac{a^2-b^2}{a^2}$

It is straight forward to get $(X, Y, Z) = (-1668557.2070983793,$

$5506838.5266271923, 2744934.9655897617)$. This value is consistent with that used by PINT, $(X, Y, Z) = (-1668557.0, 5506838.0, 2744934.0)$, which is provided by Youling Yue, one of the authors. We think the FAST coordinate used by PINT is OK. More accurate coordinates will be obtained with pulsar timing and VLBI observations.

REFERENCES

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