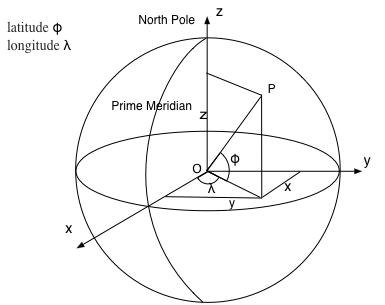
The algorithm for calculating the center point of a series of coordinates through combining geographical coordinate system with a cartesian coordinate systems that regards the Earth as a sphere (Fig.1). This combination is also known as ECEF ("earth-centered, earth-fixed") [1]. In Cartesian coordinates, Earth is a sphere centered at the origin [2]. The z axis points to the north pole. The x, y axis are on the equatorial plane that the x-axis passes through the equator and the prime meridian and the y-axis points to the equator at 90 degrees east [3].



**Figure. 1 geographical coordinate system with a cartesian coordinate systems**

As Fig.1 shows, point P in Fig. 1 represents a geographical coordinate with latitude and longitude . A series of coordinates can be represented as latitude , longitude  (i = 1n). Thus, in cartesian coordinate systems, the coordinates of the three directions can be expressed as:

= ,

= ,

= ,

The centroid of these points is the average of the sum of :

() = ,

The coordinate of the centroid can be expressed as:

= ,

=

1. Zhu, J. (1994). Conversion of Earth-centered Earth-fixed coordinates to geodetic coordinates. *IEEE Transactions on Aerospace and Electronic Systems*, *30*(3), 957-961.
2. Clynch, J. R. (2006). Earth coordinates. *Electronic Documentation, February*.
3. Montenbruck, O., Gill, E., & Terzibaschian, T. (2000). Note on the BIRD ACS Reference Frames.