https://doi.org/10.1051/matecconf/201819806005

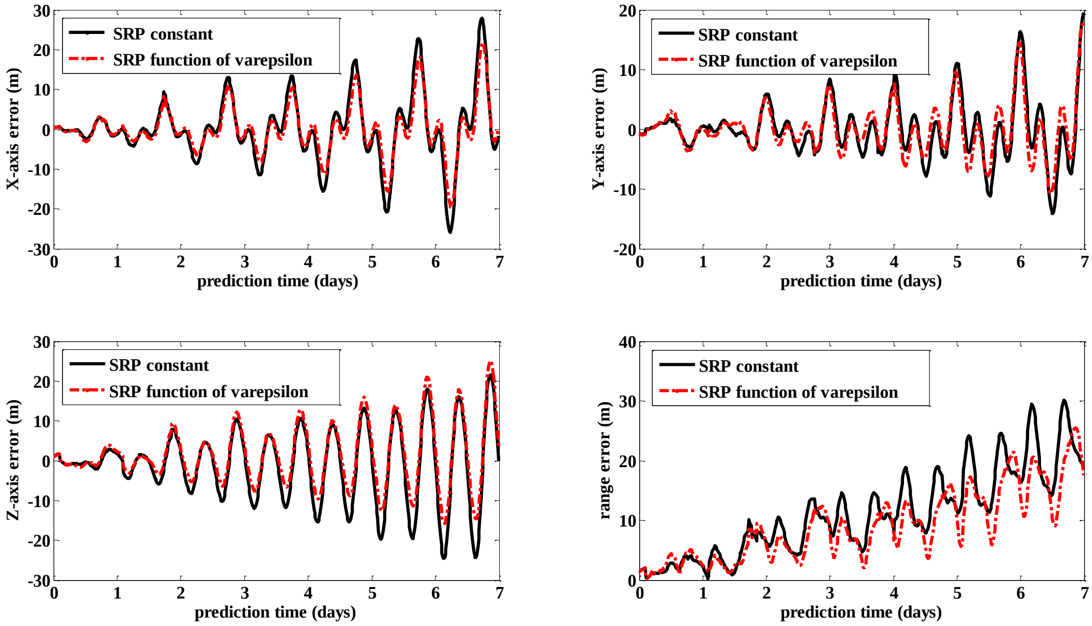

Figure 3. 7-days orbit prediction for GPS PRN1.

result of same orbit prediction, but using the constant parameter SRP model introduced in [5]. The initial points of prediction are calculated by each broadcast from 08:00:00 to 12:00:00 (GPS time) on 13 Jan 2017. The orbit information of initial points are improved by an least squares algorithm, then predict for 7 days with our propagator, and finally compare the predicted orbit with the precise orbit product to obtain the orbit prediction error.

Fig. 3 shows that with the SRP parameters varying as ε angle change, orbit prediction result became better than using constant SRP parameters, and the peak values of error are smaller.

The orbit prediction results show in Fig. 3 are summarized in Table 1.

Table 1. 7-days orbit prediction error for GPS PRN1.

SRP Model	Average error(m)	Variance of error(m^2)	Maximum error(m)
SRP constant	11.74	64.44	37.00
SRP function of ε	9.52	40.44	26.40

5 Conclusion

The TTFF of receivers can be significantly reduced if the satellite's position and velocity information can be obtained by some alternative ways instead of reading the navigation message send by the satellite. This paper presents an orbit prediction algorithm which can run on receivers whose network connections are nonexistent.

Satellite orbit can be predicted by numerically integrating the satellite's equation of motion. In this work, only the four forces (including the Earth's gravitation, solar gravitation, lunar gravitation, and solar radiation pressure) that primarily affect the GPS satellite are taken into account. Satellite's initial position and velocity value, as well as the Earth's polar motion parameters, used in prediction correspond to the locally collected previous broadcast ephemeris. In this paper, an empirical SRP model with two parameters that change with the movement of satellite and Earth is presented to improve the accuracy of the orbit prediction. The procedure of estimating the SRP parameters, and its curve fitting were described in detail.

The orbit prediction algorithm is verified by GPS satellites using the initial position and velocity as well as polar motion parameters divided from three groups of the broadcast ephemeris data. As an example, the results of orbit prediction for GPS PRN1 with the SRP model described in this paper were show. From it we can see that the satellite's position error limited to 30 meters within 7 days prediction. What's more, with the SRP parameters varying with ε angle, orbit prediction result became better than using constant SRP parameters, and the peak values of error are smaller.

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