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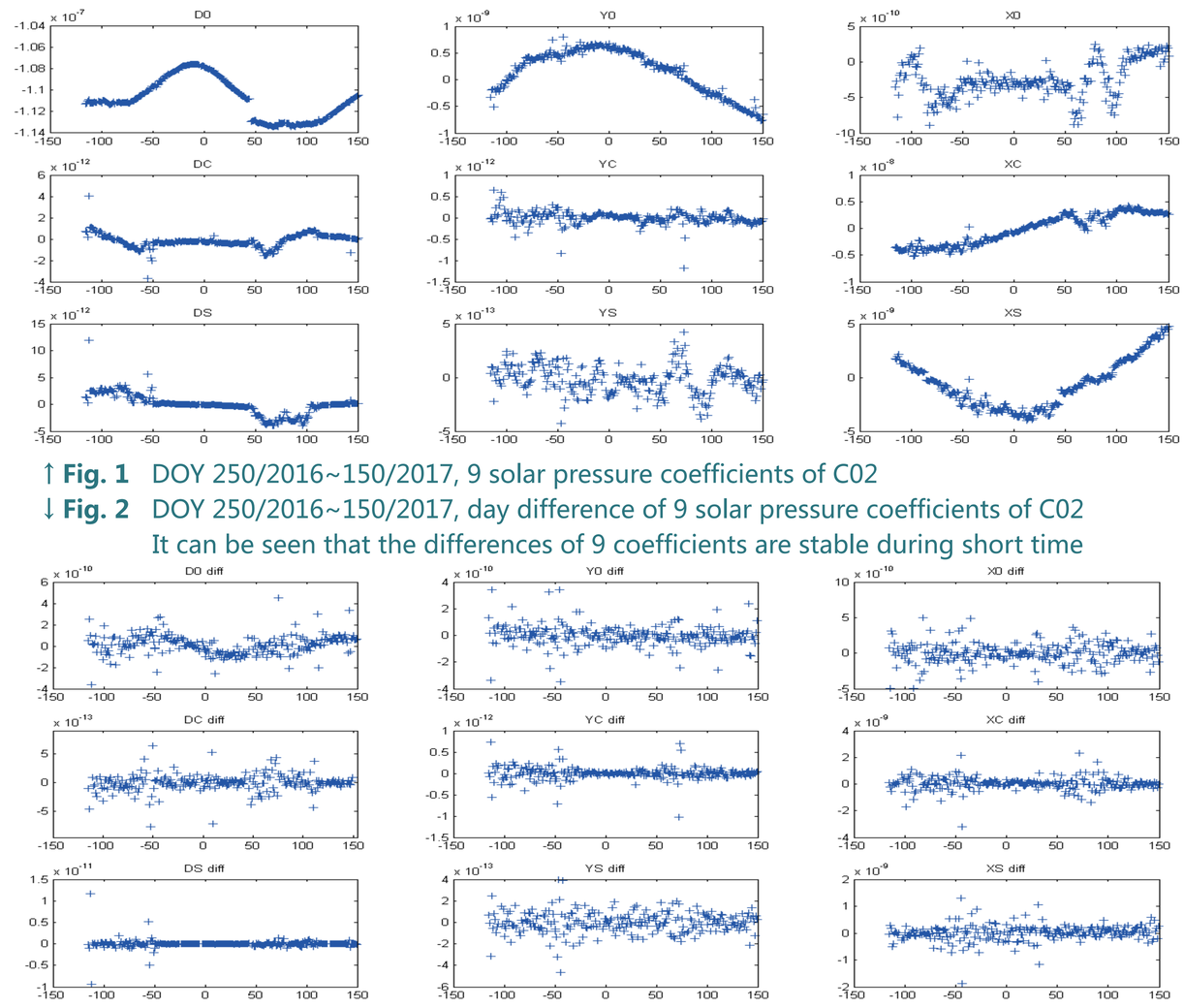
Continuous Information Aided Rapid Orbit Recovery for Maneuvered BeiDou GEO Satellites

Introduction

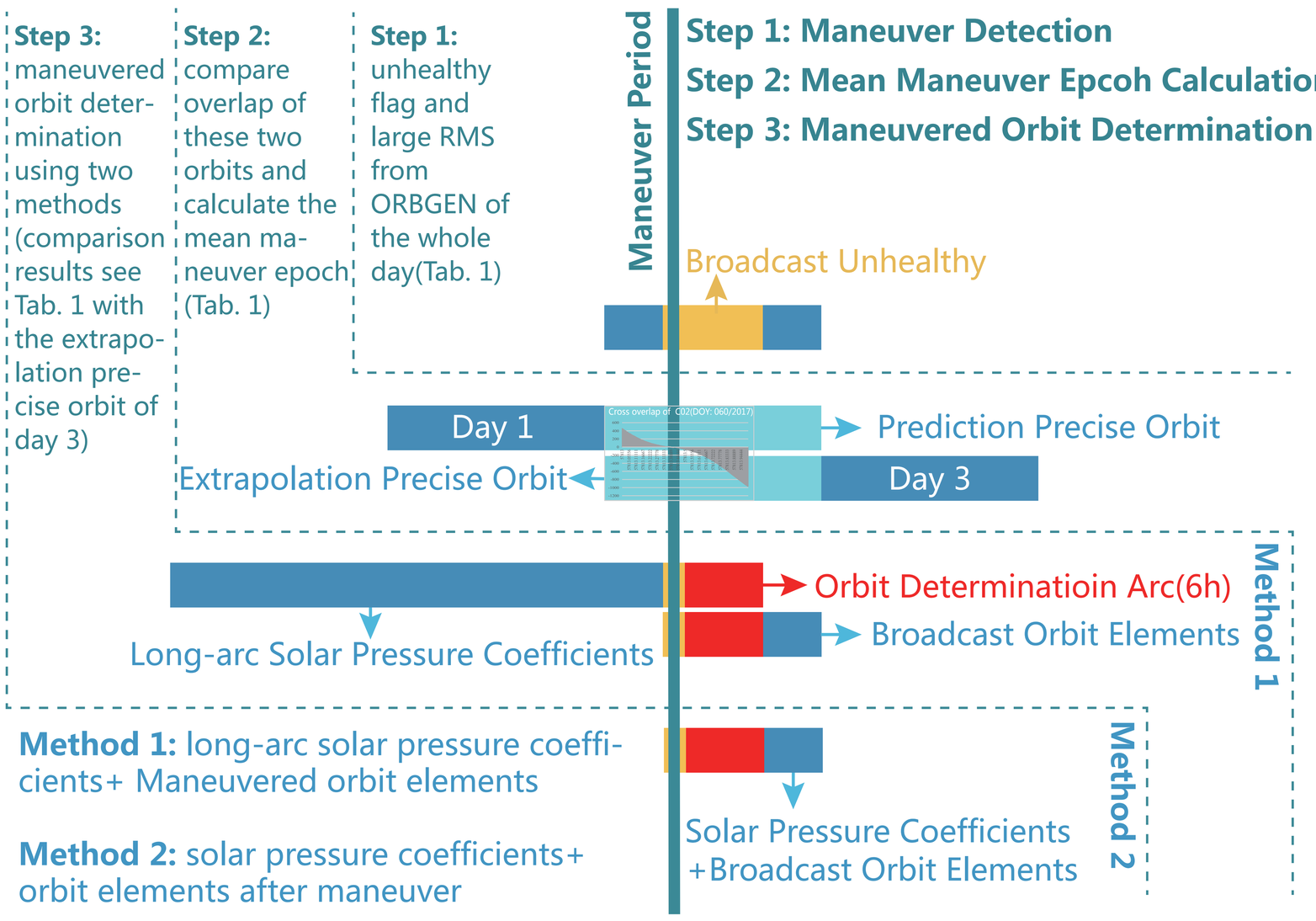
GEO satellites play an important role in the regional BeiDou system due to their continuous coverage on the particular area of the earth surface. However, the availability of these GEO navigation satellites is decreased dramatically because of frequent maneuvers for orbit keeping.

Although the maneuver causes a steep change in the force model, the surface optical properties of satellite body and solar panel are usually not affected. Therefore the solar pressure coefficients are continuous before and after the satellite maneuver and could be considered as the same values. (Fig.1 & Fig. 2)

In this contribution, the feasibility of utilizing continuous solar pressure coefficients in GEO satellites rapid orbit recovery after maneuver was investigated.



↑ **Fig. 1** DOY 250/2016~150/2017, 9 solar pressure coefficients of C02
↓ **Fig. 2** DOY 250/2016~150/2017, day difference of 9 solar pressure coefficients of C02
It can be seen that the differences of 9 coefficients are stable during short time



↑ **Fig. 3** Details of step1~3. Diagram of method 1 & 2.

Data and Method

The satellite BeiDou C02, which is located at 80.3°E, was selected in rapid orbit recovery experiments. Observation data of about 90 stations, during 2016.09.06-2017.05.30 , from iGMAS/IGS network was used. Totally seven orbit recovery experiments were carried out (Tab. 1).

Firstly, we use step 1~2(Fig. 3) to determine the mean maneuver epoch (Tab. 1). Secondly, we use two methods (Fig. 3) to determine 6 hours orbits after maneuvered.

- **Method 1:** we use the broadcast navigation file with healthy-flag to extrapolate the initial orbit elements, and use the long-arc solar pressure coefficients as a priori value with tight constraint.

- **Method 2:** as a reference method, we use the healthy broadcast file to extrapolate the initial orbit elements and solar pressure coefficients.

Results and Discussion

From Tab. 1 it can be seen that constrain the long-arc solar pressure coefficients with tight constraint as the continuous information is effective to determine the 6 hours maneuvered orbit. 5/7 results of method 1 are better than method 2 compared to the extrapolation orbit the day after maneuver. As for the 2 exceptional events(No. 3 & No. 4). We can see the absolute value of D0 are smaller than others in Fig. 1 when the earth' s position is near apogee, maybe that is the reason why method 1 is not good as method 2 on No.3 & No. 4. So it could say that this method is useful to achieve the rapid orbit recovery of the maneuvered BeiDou GEO satellite under certain situation.

No.	DOY	RMS	Mean Maneuver Epoch(UTC)	Method 1	Method 2
1	262 /2016	35 m	9:30	0.11 m	0.71 m
2	306 /2016	70 m	9:28	0.11 m	0.13 m
3	351 /2016	79 m	9:25	0.72 m	0.29 m
4	025 /2017	37 m	9:26	0.46 m	0.12 m
5	060 /2017	38 m	9:24	0.16 m	0.25 m
6	100 /2017	58 m	9:28	3.23 m	8.15 m
7	136 /2017	50 m	9:46	0.62 m	0.66 m

↑ **Tab. 1** Details of 7 maneuver events, and the 6 hours(10:00~15:59,UTC) comparison resultes after helmert transform of the two methods to the extrapolation precise orbit of the day after maneuver(Day 3 in Fig. 3).

Outlook

Use the geometric method to get the initial orbit elements of maneuvered satellite is the future work we plan to do.