IGSO Operation and De-orbit Area

vs.

GSO Protected Region

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ICG
(International Committee on GNSS)
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1. Purpose

This material

• proposes the current possible issues of IGSO orbit and

• initiates a discussion to seek the most appropriate solutions for IGSO.
2. IGSO operation orbit vs. GSO

- IGSO interference time increases as the inclination and the eccentricity become lower.
- The longitude deviations are longer than GSO.

**Table 1-1**

<table>
<thead>
<tr>
<th>Fig.</th>
<th>IGSO</th>
<th>Inclination [deg]</th>
<th>Eccentricity</th>
<th>Interference time [hr]</th>
<th>Longitude deviation [deg]</th>
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<td>8.6</td>
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</table>
2. IGSO operation orbit vs. GSO

Fig.1-1  Cross section of GEO and LEO protected regions
2. IGSO operation orbit vs. GSO

Fig.1-2 Representative Orbit  Semi-major [km] vs Latitude [deg]
2. IGSO operation orbit vs. GSO

Blue: interference time is 0.9 [hr]
Orange: not interference time is 23.1 [hr]

Fig. 1-3 Longitude [deg] vs Latitude [deg]  QZS (Inc : 36 [deg] )
2. IGSO operation orbit vs. GSO

Fig.1-4 Longitude [deg] vs Latitude [deg]  QZS (Inc : 47 [deg] )

Blue: interference time is 0.9 [hr]

Orange: not interference time is 23.1 [hr]
2. IGSO operation orbit vs. GSO

Blue:
interference time is 4.9 [hr]

Orange:
not interference time is 19.1 [hr]

Fig. 1-5 Longitude [deg] vs Latitude [deg]  BeiDou (Inc : 55 [deg] )
2. IGSO operation orbit vs. GSO

Blue: interference time is 8.6 [hr]

Orange: not interference time is 15.4 [hr]

Fig.1-6 Longitude [deg] vs Latitude [deg]  NAVIC (Inc : 29 [deg] )
QZSS’s de-orbit parameters are actual numbers as these satellites are currently in orbit.

As for BeiDou and NAVIC, assumed de-orbit parameters are used. These assumptions are referring open papers.
# 3. IGSO De-orbit vs. GSO and Other IGSO

<table>
<thead>
<tr>
<th>Figure</th>
<th>IGSO</th>
<th>De-orbit height [km]</th>
<th>RAAN [deg]</th>
<th>Inclination [deg]</th>
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</thead>
<tbody>
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<td>0-360</td>
<td>36-47</td>
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Key parameters of IGSO de-orbit are the height, RAAN and inclination.

• De-orbit perturbed area increases as the inclination decreases.

• The possibility of interfering into GEO region decreases as the height of de-orbit increases.

• The area of de-orbit perturbation depends on initial RAAN.
Table 1-3 Interference Summary

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<tr>
<th>Figure</th>
<th>IGSO</th>
<th>De-orbit Height [km]</th>
<th>RAAN [deg]</th>
<th>Inclination [deg]</th>
<th>Interference in protected region</th>
<th>Operation region</th>
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3. IGSO De-orbit vs. GSO and Other IGSO

Fig. 1-7 QZS4 Disposal Orbit Height 3600km and Perturbed Range during 100 years
3. IGSO De-orbit vs. GSO and Other IGSO

Fig. 1-8 GEO Disposal Orbit Height 1920km and Perturbed Range during 100 years
3. IGSO De-orbit vs. GSO and Other IGSO

Fig.1-9  BeiDou Disposal Orbit Height 350km and Perturbed Range during 100 years
3. IGSO De-orbit vs. GSO and Other IGSO

Fig.1-10 BeiDou Disposal Orbit Height 350km and Perturbed Range during 100 years
3. IGSO De-orbit vs. GSO and Other IGSO

Fig.1-11 BeiDou Disposal Orbit Height 350km and Perturbed Range during 100 years
3. IGSO De-orbit vs. GSO and Other IGSO

Fig. 1-12  BeiDou Disposal Orbit Height 1000km and Perturbed Range during 100 years
3. IGSO De-orbit vs. GSO and Other IGSO

Fig. 1-13 NAVIC Disposal Orbit Height 350km and Perturbed Range during 100 years
3. IGSO De-orbit vs. GSO and Other IGSO

Fig. 1-14 NAVIC Disposal Orbit Height 350km and Perturbed Range during 100 years
3. IGSO De-orbit vs. GSO and Other IGSO

Fig.1-15  NAVIC Disposal Orbit Height 350km and Perturbed Range during 100 years
3. IGSO De-orbit vs. GSO and Other IGSO

Fig.1-16 NAVIC Disposal Orbit Height 2000km and Perturbed Range during 100 years
4. Conclusion

On operation orbit

• it is recommended to open the orbit information

• check minimum distance frequently

• and decrease the collision possibility
Regarding the disposal orbit

• Achieve the de-orbit not to encroach onto GSO region

• If it cannot achieve the de-orbit, open the disposal orbit to notify the possibility of interference to other satellites
4. Conclusion

For sustainable operation in GEO vicinity, **create a data base of IGSO operation and disposal orbits**

Most importantly, **establish a forum to discuss issues and methods to coordination**
Thank you so much for your attention.