Issue	Date	Page	Comments	Author
1draft1	Choose date		New Document	PHA
	Choose date			

1. INTRODUCTION

This document briefly discusses the current implementation for calculating the look point for the scientific instrument onboard MATS.

2. LIMB POINTING REQUIREMENTS

The limb pointing requirements on the platform are defined in the IRD [S-OSE-IRD-0001]:

IRD-88 (IRD-PO-001) / T, A / MRD-3.1

During nominal science operations, the Platform shall control the attitude of the Spacecraft so that:

- *The +ZLI axis of the Limb Imager is continuously pointing towards a Look Point (LP) located in the satellite orbital plane and 92 km above the horizon as defined by the WGS84 ellipsoid.*
- *The +YLI axis of the Limb Imager is aligned with the WGS84 horizon at the Look-Point.*
- *The +YSC axis is approximately pointing towards the Sun.*

Note: Depending on the orbit (06:00 LTAN or LTDN), the Limb Imager will either be looking forward or backward wih respect of the direction of motion.

OHB-Sweden AB
P.O. Box 1269
SE-164 29 KISTA
Sweden
Tel: +46 8 121 40 100
Fax: +46 8 751 64 20
www.ohb-sweden.se

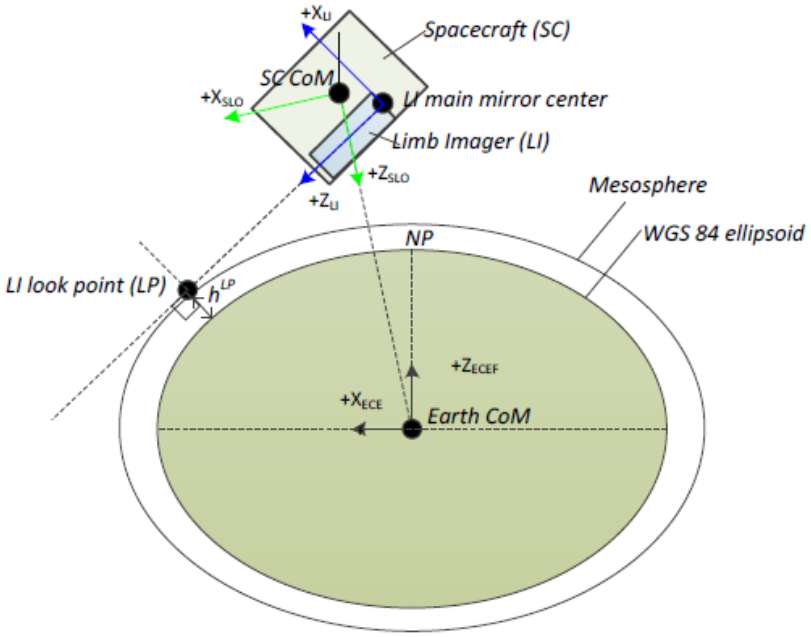

Figure 2-1: Look point illustration from IRD.

3. CURRENT IMPLEMENTATION

The LI look point LP, used for the guidance function in the ACS, is currently calculated as the tangential point on an ellipsoid in the orbital plane. The ellipsoid is created by extending the WGS84 ellipsoid by the desired limb altitude, h. Both the pole and the equator are extended and the new ellipsoid can thus be written as

$$x^2 + y^2 + \frac{z^2}{(1-f_e)^2} = r_{e,ext}^2$$
$$r_{e,ext} = r_e + h = 6378137 + h$$
$$f_e = \frac{r_{e,ext} - r_{p,ext}}{r_{e,ext}} = \frac{r_e + h - r_p - h}{r_e + h}$$
$$f = 1/298.257223563.$$

The LP is then calculated as the tangential point to the above extended ellipsoidal in the orbital plane. A tangential point is any point on the ellipsoid such that the S/C lies in the tangential plane of the point.

This implementation is not exactly what is shown in Figure 2-1. In general the look vector (the vector from the S/C to the LP) will not be perpendicular to the vector with length h from the tangential point on the WGS84 ellipsoid to the LP as shown in Figure 2-1. This is illustrated (albeit exaggerated) is Figure 3-1. In fact, as only the look vector is interesting, any point along the look vector could be viewed as the LP. To be able to do comparisons in the following we will define the “actual” LP as the point such that the look vector is perpendicular to the vector from TP to this point. The distance between the TP and the actual LP is denoted as h_{actual}. We know that the extended ellipsoid is h above the WGS84 ellipsoid at the poles and at the equator but what is the distance in between? Furthermore it is interesting to see how the altitude of the actual LP compares to the desired altitude h over one orbit.

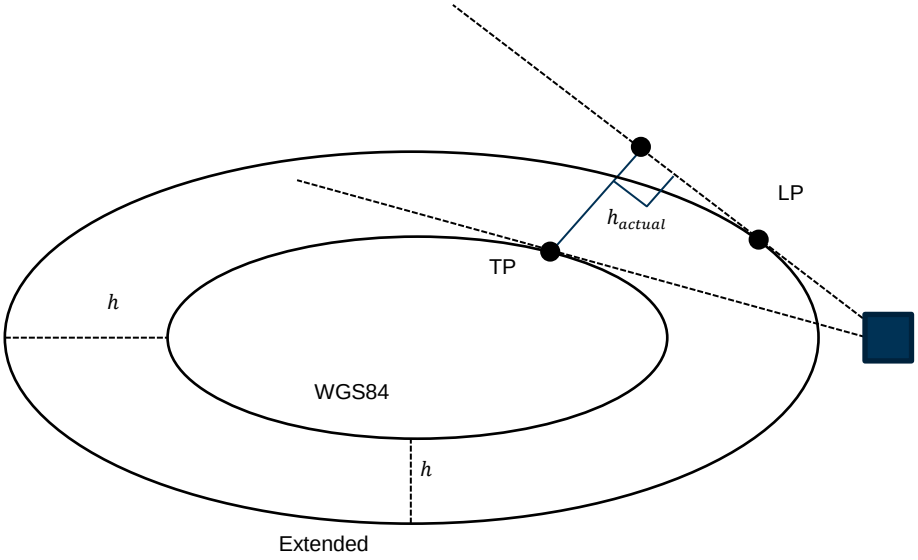

Figure 3-1: Illustration of difference between the implemented LP and the LP defined in Figure 2-1.

3.1 ALTITUDE OF THE ACTUAL LP

The LP is calculated during one orbit for 5 different settings of the desired altitude: $h = 82km, 87km, 92km, 97km, 102km$. From the look vector the actual altitude, h_{actual}, above the tangential point is calculated. The results are presented in Figure 3-2. The mean values are $84.56km, 89.89km, 95.24km, 100.62km$ and $106.02\ km$. It is seen that the actual altitude is higher than the desired altitude as expected from Figure 3-1. The difference is around 2.4 km for 82 km altitude growing to $4\ km$ at 102 km. The variation over one orbit is a couple of hundred meters and can be neglected.

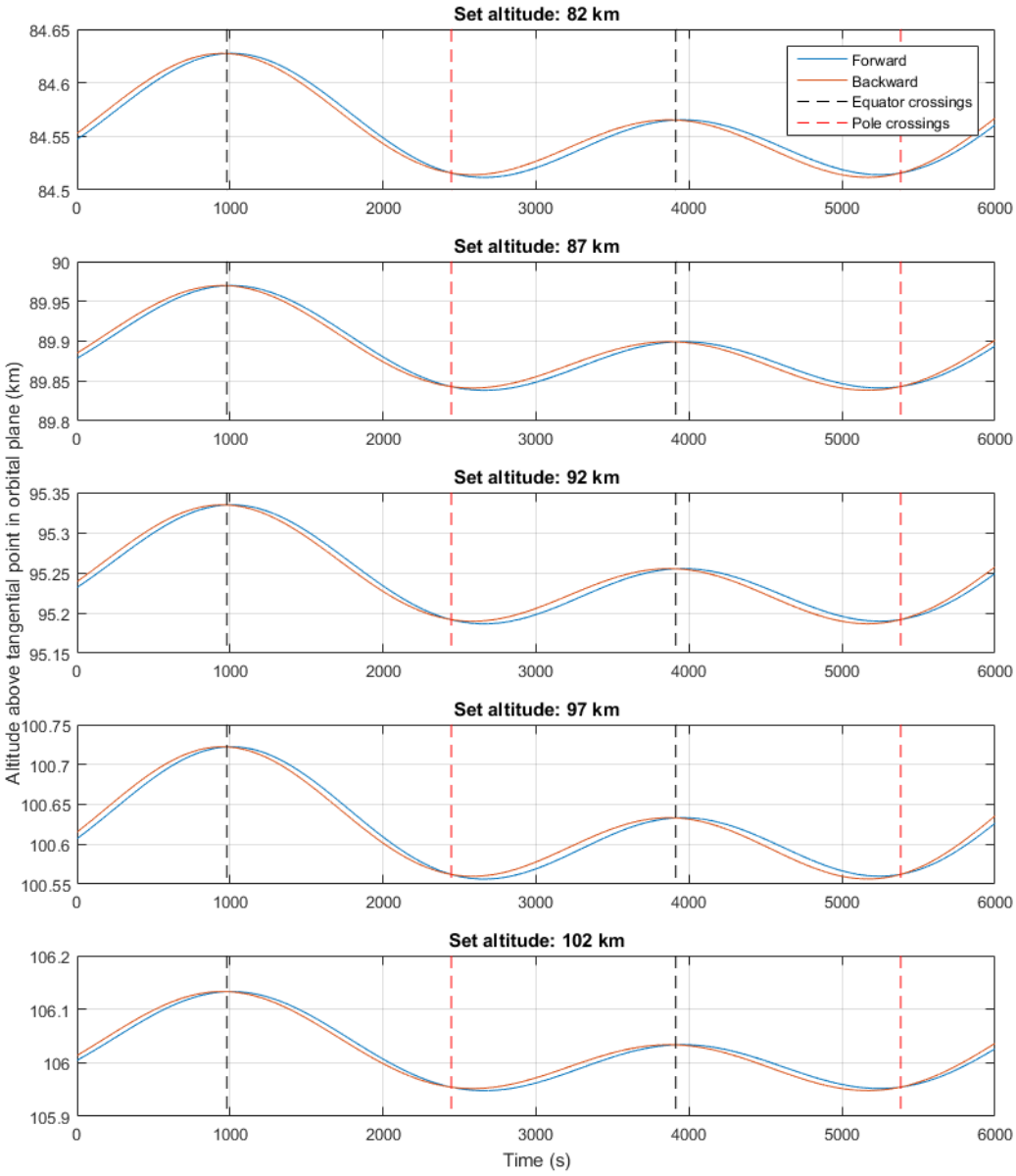

Figure 3-2: The actual altitude above the tangential point for five different desired altitudes.

4. DISTANCE TO THE CLOSEST POINT ON THE WGS84 ELLIPSOID

The implemented limb pointing algorithm looks at the tangential point of the extended ellipsoid. It is interesting to see what the closest point along the look vector and the WGS84 ellipsoid is. The results are presented in Figure 4-1. The closest point is actually very close to the reference altitude, the difference is only a couple of dm. Hence the implemented limb pointing looks in the orbital plane such that the closest point along the look vector to the WGS84 ellipsoid is at the desired altitude.

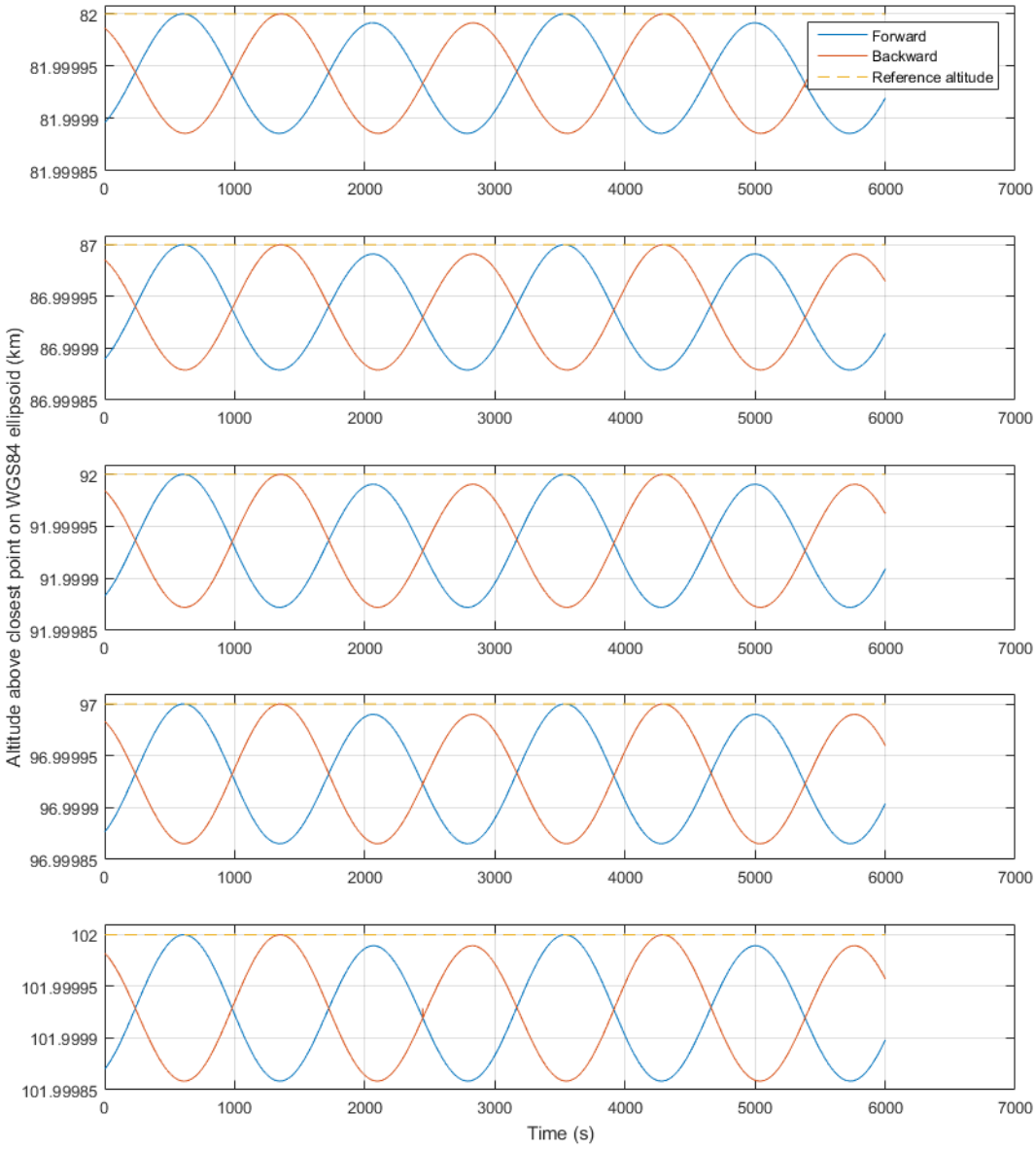

Figure 4-1: Closest distance from implemented LP and closest point on WGS84 ellipsoid for the 5 different test altitudes.

5. CONCLUSIONS

The current implementation, where the WGS84 ellipsoid is extended by the desired altitude, has only negligible variations over the orbit. The implementation differ a couple of kilometres in altitude if the “actual” LP is considered. If one instead considers the closest point along the look vector to the WGS84 ellipsoid the current implementation is preferable. However the current implementation does not satisfy the requirement that the LP should be h above the tangential point.