Analysis on the Minimization of Contact Overlap Time between KOMPSAT-3 and KOMPSAT-3A

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Abstract

The KOMPSAT-3A was launched on March 25, 2015 at 22:08 universal time coordinate (UTC). Its mission is to acquire satellite images for earth observation. KOMPSAT-3A is a part of the KOrean Multi-Purpose SATellite (KOMPSAT) Program developed and operated by KARI, equipped with optical, infrared and radar payloads to deliver data needed for a variety of purposes. KOMPSAT-1, the first KOMPSAT, was launched in 1999. It carried an optical imager with a ground resolution of 6.6 meters. KOMPSAT-2 was launched in July 2006 and delivered imagery at a 1 meter ground resolution. KOMPSAT-3 was launched in May 2012 using a similar bus architecture as KOMPSAT-2 but an improved optical payload that reached a resolution of 0.7 meter for panchromatic imagery. In August 2013, a Dnepr rocket launched KOMPSAT-5, becoming the first radar satellite, outfitted with a Synthetic Aperture Radar (SAR) capable of covering a wide ground swath or operating in a high resolution mode delivering imagery at a 1 meter resolution. KOMPSAT-3A is the sister of KOMPSAT-3. It's using an identical satellite bus and payload with the only difference being an added infrared capability. The mission orbit of KOMPSAT-3A is a sun-synchronous orbit at 528 Kilometers in altitude, inclined 98.513 degrees. Orbit period is about 95.3 minutes and mean local time of ascending node (LTAN) is 13:30 P.M. Table 1 show the mission orbit of KOMPSAT-3A and KOMPSAT-3.

Table 1. Mission Orbit of KOMPSAT-3A and KOMPSAT-3

	KOMPSAT-3A	KOMPSAT-3
Launch date	March 25, 2015	May 18,2012
Altitude	528 kilometers	685 kilometers
Inclination	97.513 degrees	98.13 degrees
Orbit Period	93.5 minutes	98.5 minutes
Mean LTAN	13:30 P.M.	13:30 P.M.

Due to the same LTAN and different altitude, the close approach of two satellites are foreseen. For example, the difference of orbital periods makes two satellites approach each other every 2 days. In this paper, the optimization approach is proposed to operate a KOMPSAT-3 and -3A in more efficient way. For this purpose, we examine the communication windows, geometrical characteristic between KARI Ground Station (KGS) and two satellites, etc.. Also, this paper presents a mitigation plan for the KOMPSAT-3A to minimize the contact overlap time with KOMPSAT-3. The phasing of two satellites are proposed so as to decrease the possibility of

KOMPSAT-3 and 3A flying over a KGS at the same time. As a result, contact overlap time between two satellites and KGS are remarkable minimized, and frequency interference, issues are resolved. Finally, the period orbit maneuvers to keep the phasing needed are analyzed through numerical simulations. To analyze of the close approach effect, we confirmed contact sequence of the KGS with KOMPSAT-3 and KOMPSAT-3A from April 16, 2015 to May 1, 2015 using the real orbit data. During 15 days, KGS contact with satellites about 15 times at the same time. From among these cases, only 3 cases have interference possibility due to the angle between KGS and two satellites is under 2 degrees as Figure 1. In this cases, the operational impact will be analyzed by real test data on the contact overlap time between KGS and two satellites. Figure 2 show an illustrative design example of orbit maneuvers result. Here, Only KOMPSAT-3A's orbit is re-designed. During 3 months period, the interference possibility is removed that angle between KGS and two satellites are not under 1 degrees. Mean relative distance of two satellites is about 1160km. Assuming the ground speeds of satellites are about 7 kilometer per second, differences of acquisition of ssignal (AOS) between satellites and KGS are about 166sec. This paper will present more representative analysis result of real satellite operation and could be a reference to setup an operational strategy for the multiple satellite operations on terms of orbit and their communication windows.

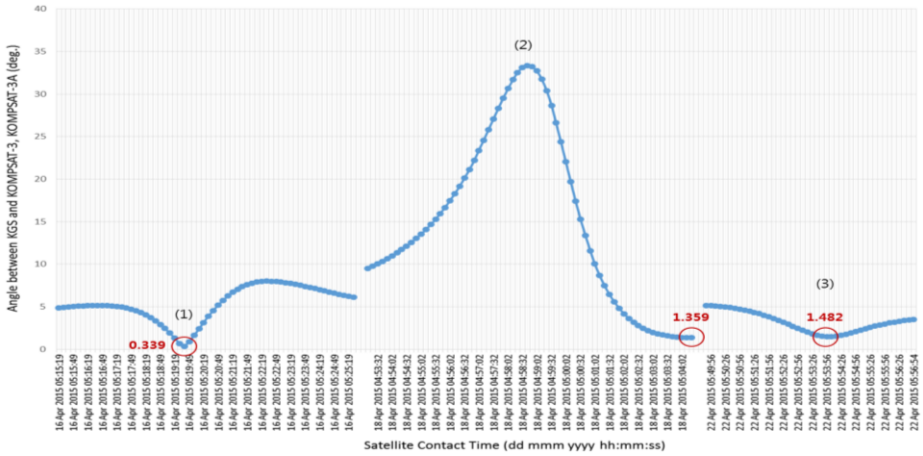

Figure 1. Analysis on the Geometry Characteristics between KGS and two Satellites

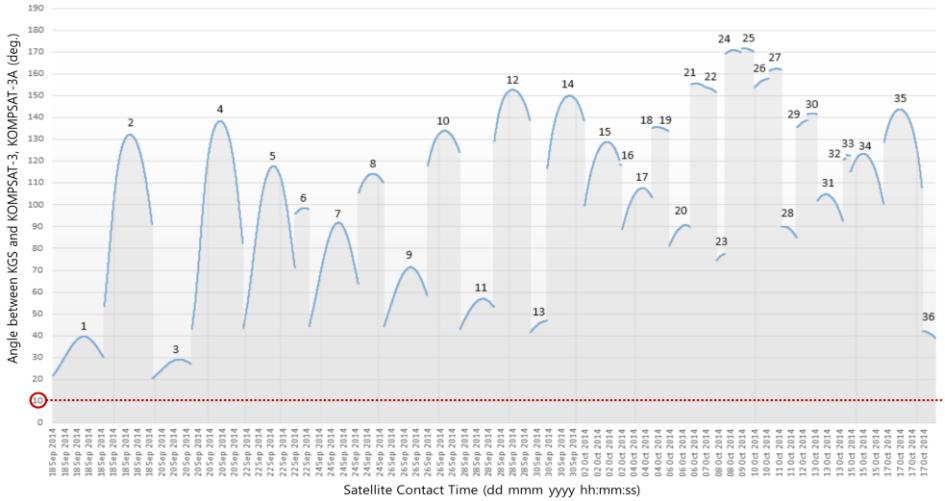

Figure 2. Design Example of Orbit Maneuvers Result