IAF ASTRODYNAMICS SYMPOSIUM (C1)
Virtual Presentations - IAF ASTRODYNAMICS SYMPOSIUM (VP)

Author: Mr. KOTA MALLESH BABU
ISTRAC/ISRO, India, malleshb.kota@istrac.org

Mr. GUBBALA KIRAN
ISTRAC/ISRO, India, kiran@istrac.gov.in
Mrs. VIJAYASREE MALLIKARJUNA KANDE
U R RAO SATELLITE CENTRE (URSC), India, vijaya@ursc.gov.in
Mr. LEO JACKSON JOHN
ISTRAC/ISRO, India, leo@istrac.gov.in

CHANDRAYAAN-2: ORBIT MANEUVER OPERATIONS

Abstract

Chandrayaan-2 (CH-2) is a Lunar Mission, designed and developed by Indian Space Research Organisation (ISRO), India. CH-2 was configured as a two module integrated system comprising of an Orbiter Craft (OC) and Lander Craft (LC). Orbiter Craft is second in its series of lunar exploration and carries eight payloads for science data collection. The maiden Lander Craft with four payloads is aimed to demonstrate soft landing on the surface of Moon. The Lander Craft, christened as Vikram was separated from the integrated module for landing on the surface of Moon, after integrated module reached the final orbit around the Moon.

CH-2 was launched by GSLV MK-III from Satish Dhawan Space Center (SDSC-SHAR), Sriharikota, Andhra Pradesh, India on July 22, 2019 at 09:29:26:300 UT and injected the Integrated module in an Elliptic parking orbit (EPO) of 170 x 45475 Km (Perigee x Apogee). Subsequently, apogee height was increased to 142276 Km through a series of four Earth Bound Maneuvers (EBN) which were carried out from July 25 to August 8, 2019. Later, a sling shot maneuver called Trans Lunar Injection (TLI) was carried out to propel the integrated module towards Moon. CH-2 was in Earth's sphere of influence (SOI) for 25 days. After entering SOI of Moon and at the closest approach point, a braking maneuver called Lunar Orbit Insertion (LOI) was carried out to capture the Moon in an elliptical orbit. Subsequently, four Lunar Bound Maneuvers (LBN) were carried out to place the integrated module in final polar orbit of 100 x 100 Km around the Moon followed by a small maneuver (OM-1) to trim the final polar orbit to image the landing site by Orbiter Craft on-board payload OHRC (Optical High Resolution Camera) for hazard map identification which was planned to be used by VIKRAM Lander during its descent.

CH-2 Orbiter propulsion system employs a unified bi-propellant chemical propulsion system using Mixed Oxides of Nitrogen (MON-3) and Mono-Methyl Hydrazine (MMH), with pressurized Helium to provide required high specific impulse during maneuvers. All maneuvers were carried out using 440 N liquid engine and 22 N AOCS thrusters in regulated mode. Liquid engine was used mainly to increase/decrease the Apogee altitude and later were used to control the attitude during burns to meet the desired orbital parameters. All maneuver operations were automated and executed through Liquid Engine Burn (LEB) sequencer which would be initiated 40 min before the operation. The sequencer initiated the integrated module to rotate from its nominal orientation, to ensure the thrust in required direction, followed by actual engine firing operation to impart the required velocity and restoring back to nominal orientation. Commands uplink for each of the maneuvers including safety logics was carried out one day in advance. During maneuvers there was no real time commanding and on-board accelerometers were used for thrust cutoff upon reaching the desired delta-V. The required total delta-V in Earth and Lunar

bounds is split into series of maneuvers and achieved, to have network visibility for each burn to the possible extent, perigee stability throughout Earth bound phase and Sun elevation at Landing Site (16 x 10 Km area) greater than 6 deg for OHRC imaging. This paper brings out the planning and execution of all the referred events.