

IAF SPACE SYSTEMS SYMPOSIUM (D1)  
Interactive Presentations - IAF SPACE SYSTEMS SYMPOSIUM (IPB)

Author: Mr. DHRUTI GAAN  
U R RAO SATELLITE CENTRE (URSC), India, dhrutiga@ursc.gov.in

DUAL-GIMBAL-ANTENNA SYSTEM FOR INTERPLANETARY MISSIONS

**Abstract**

Deep space interplanetary missions impose many challenges, starting from complex payloads to communication delays, occultation, and to downlink huge chunks of payload data within limited span of time. Objectives of these missions vary from orbiting other planets to landing on far-reached places of planets or observing celestial bodies from afar. So these spacecraft are equipped with many imaging and advanced scientific payloads. These scientific measurements generate huge data which need to be sent to earth stations for further analysis. High pointing and efficient data downlink system plays a huge role for the same. Dual Gimbal Antenna (DGA) system is a state of art development for payload data downlink in interplanetary missions to ground stations on earth. The subtended angle from these celestial bodies to a point on earth is very small. This calls for stringent pointing requirement in real time for on-board downlink antenna. DGA system is designed with 2 Brushless DC motors (one for Azimuth and other for elevation) in dual gimballed configuration. On-board algorithm generates reference trajectory on DGA frame for both motors based on satellite ephemeris, orbit time, attitude information and ground station coordinates. The motor positions are sensed by resolvers, thereby being controlled in close loop. It is capable of having a maximum rate of 15/s for the acquisition of initial reference. DGA electronics is realized on a single card, comprising of analog drivers, Resolver-to-digital converter (RDC) for resolver processing, current sensing circuitry, over-current protection circuit, BJT based H-bridges. Proportional-Derivative controller is implemented along with estimators for cogging, dither and other non-linear elements compensation. DGA on-board software caters for different operational modes and safety features. The operational modes include normal mode and offset mode. In normal mode, DGA follows reference trajectory being generated on-board. The offset mode is basically a ground based commanding, where DGA is commanded to an absolute angle along with duration of rotation. Safety features include, hardware and software based fault detections and corrections etc. This paper brings out the details of an integrated antenna pointing mechanism with attitude and orbit control system of the spacecraft for interplanetary missions.