

Implementation of TOPEX/Poseidon and Jason-1 Coordinated Navigation

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TOPEX/Poseidon (T/P) is a joint US/French mission designed to study global ocean circulation and its interaction with the atmosphere to better understand the Earth climate. Jason-1 is a follow-on joint mission officially scheduled for launch August 10, 2001. Jason-1 will use the same reference ground track as T/P. Repeating the same ground track is necessary in order to maintain the T/P performance. This choice is also essential to avoid any disruption or degradation in the use of the science data since it allows use of the T/P dedicated gravity field for orbit determination, to cross calibrate T/P and Jason over the same sites, and to interpret the Jason-1 measurements without any delay with explicit reference to T/P altimetric mean profiles.

After launch and separation from the launch vehicle, an acquisition phase will begin during which the Jason-1 navigation team at Toulouse, France will implement a sequence of orbit acquisition maneuvers to raise Jason orbit from its low injection orbit to T/P altitude. The two satellites will then be time-phased on the same ground track such that they pass a point on the ground at a time interval of less than 10 minutes but greater than 1 minute. A calibration/validation (CAL/VAL) phase will follow during which the two satellites will be maintained in this formation for cross-calibration purposes. As a coordination effort, the TOPEX navigation team at JPL is tasked with ensuring that relative navigation constraints are not violated during acquisition and formation flying.

After the CAL/VAL phase, T/P will be maneuvered to leave its orbit for Jason and drift to an orbit that produces interleaved ground tracks with a 1.4 degree longitude spacing from the Jason-1 tracks (current T/P tracks). Such a tandem mission will provide a unique scientific opportunity and cost effective approach to conducting new oceanic science investigations.

In December 2001, It will have been about four months since launch and Jason would have acquired its operations orbit and been about three months into the CAL/VAL formation flying phase. This paper presents analysis of coordinated navigation flight data in these critical four months of operational navigation. It describes the TOPEX navigation team effort after each CNES acquisition maneuver design and implementation to ensure that the two satellites do not violate relative navigation constraints and requirements. In case of violation, the paper also describes and analyze the actions taken for correction. Navigation flight data in the three months CAL/VAL formation flying (Figure 1) is also analyzed. Emphasis here is on maintaining the along-track separation.

Figure (2) shows the cost of phasing in the tandem mission. It relates the delta V required with duration of phasing for various options of interest to the science community. Maneuver sequences in these options are presented and compared. In all these options a maneuver or sequence of maneuvers will be implemented to begin the TOPEX drift and another one to stop it. The impact of whether the 1 N or the 20 N thrusters will be used in these maneuvers will be addressed.

Formation Flying

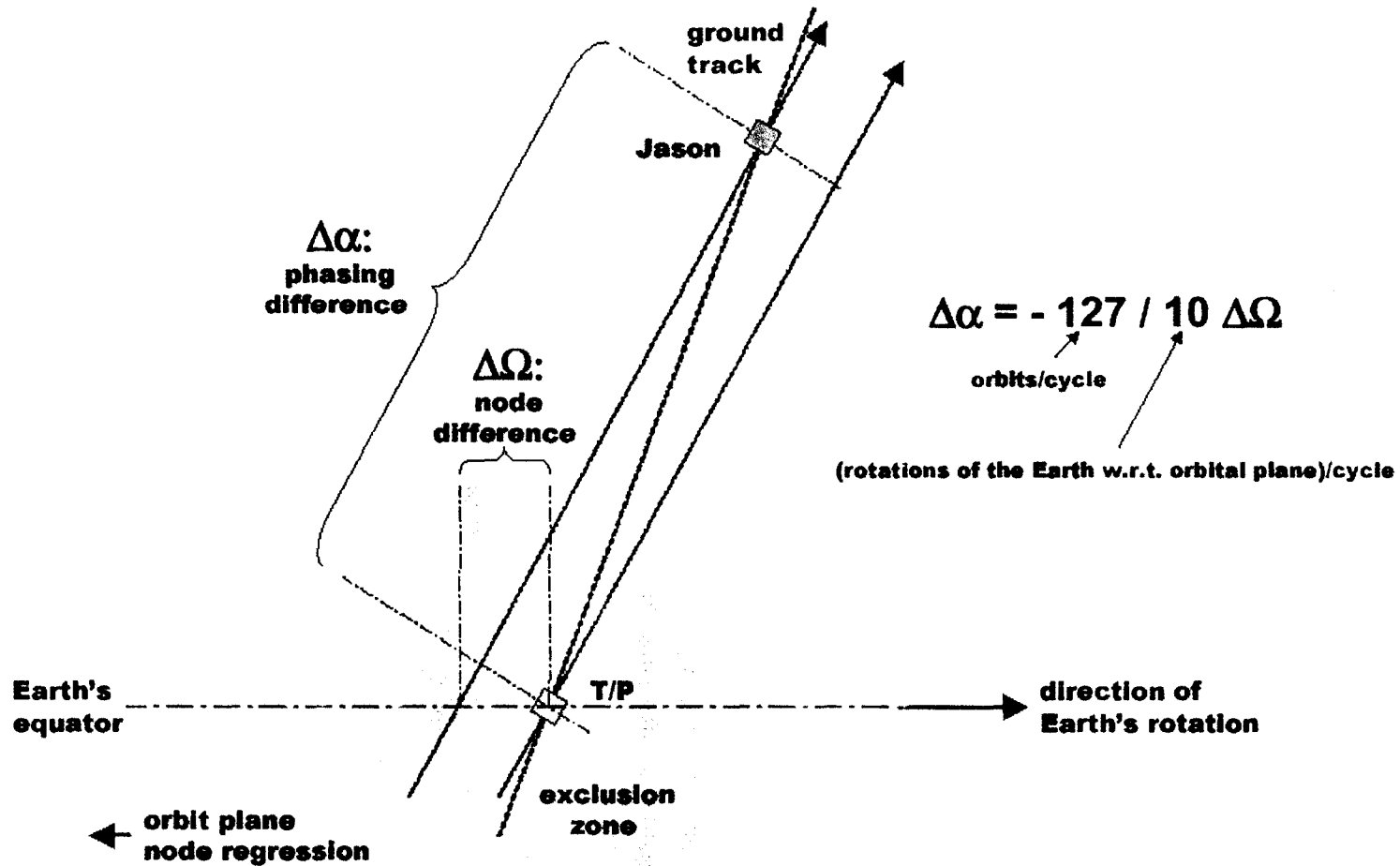


Figure 1.

T/P Orbit in the post CAL/VAL Phase

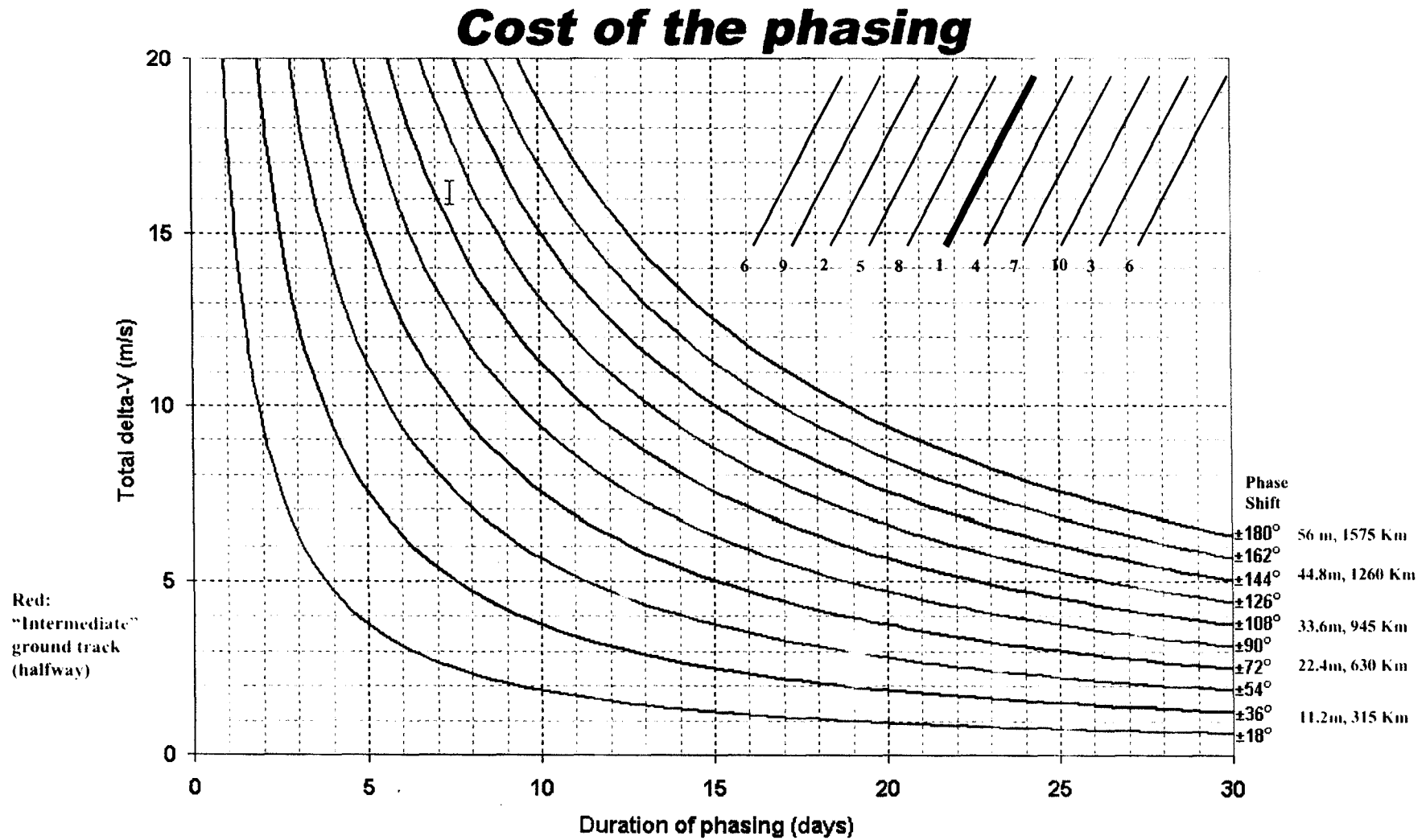


Figure 2.