

22nd IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)
Small Satellite Operations (3)

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CANX-4 AND CANX-5: PRECISION FORMATION FLIGHT MISSION ACCOMPLISHED

Abstract

In November 2014, only four months following launch, the CanX-4 and CanX-5 dual spacecraft formation flying mission achieved what has never been accomplished before, and successfully completed all of its mission goals with unprecedented precision and speed. This achievement—a series of autonomous formations with sub-meter control and centimeter-level relative position knowledge at the nanosatellite scale—was preceded by a rapid commissioning phase and orbit acquisition manoeuvres which brought the two satellites from a maximum range of 2300 km to a closest controlled range of 50 m during formation flight.

Launched on 30 June 2014 from Sriharikota, India onboard the Polar Satellite Launch Vehicle (PSLV), CanX-4 and CanX-5 were deployed separately following launch, after which a series of drift recovery manoeuvres were executed to bring the spacecraft within communications range of each other. Subsequently, the spacecraft used on-board propulsion, an S-band inter-satellite communications link and relative navigation using carrier-phase differential GPS techniques to perform a series of precise, controlled, autonomous formations from 1 km range down to 50 m separation. The achievements of CanX-4 and CanX-5 have set the high mark for small satellite formation flight, and the technologies and algorithms developed for this mission enable a number of future applications, from on-orbit inspection and repair to sparse aperture sensing, interferometry and ground-moving target indication. This paper describes the CanX-4 and CanX-5 mission and its exciting results, with an emphasis on launch, commissioning, relative orbit acquisition and phasing, and autonomous formation flight.