GN&C Translation and Rotation Control Parameters for AR&C (Category 2).

David M. Henderson
TRW Houston
Phone: 713-333-3133,
FAX 713-333-1875

Abstract:
Detailed analysis of the Automatic Rendezvous and Capture problem indicate a need for three different regions of mathematical description for the GN&C algorithms: (1) multi-vehicle orbital mechanics to the rendezvous interface point, i.e. within 100 nm, (2) relative motion solutions (such as Clohessy-Wiltshire type) from the far-field to the near-field interface, i.e. within 1 nm and (3) close proximity motion, the neafield motion where the relative differences in the gravitational and orbit inertial accelerations can be neglected from the equations of motion.

This paper defines the reference coordinate frames and control parameters necessary to model the relative motion and attitude of spacecraft in the close proximity of another space system (Regions 2 and 3) during the Automatic Rendezvous and Capture phase of an orbit operation.

The relative docking port target position vector and the attitude control matrix are defined based upon an arbitrary spacecraft design. These translation and rotation control parameters could be used to drive the error signals in the guidance system for control inputs to the vehicle flight control systems.
Measurements for these control parameters would become the basis for an autopilot or FCS design for a specific spacecraft.

The docking port relative position and velocity target vectors as outlined in this work couples the effects of the translation and rotation control activity. Based on analysis of these preliminary control parameters, it is recommended that guidance and control systems functions couple translation and attitude control in Region 3 for safe docking maneuvers. In Region 2, the relative range between the docking port targets is large enough so that translation and rotation guidance and control functions can be independent of one another.

Current Status:
Supporting engineering analysis proof-of-concept programs have been developed and are resident on the CRAY XMP computer system at JSC/NASA. These engineering analysis programs and concepts are outlined in the document, "Reference Equations of Motion for Automatic Rendezvous and Capture," by David Henderson, JSC/NASA Internal Note, to be issued in October 1991.

Source / Sponsorship:
This work is under development by TRW Houston under contract to NASA/JSC Navigation, Control and Aeronautics Division.