Glossary

Abbreviations and acronyms

AE Approach Ellipsoid (ISS traffic control and safety zone).

ATV Automated Transfer Vehicle: cargo transport vehicle, to be launched by the European launcher Ariane V and docking to the ISS, European contribution, for servicing the ISS.

CAM collision avoidance manoeuvre: fixed boost manoeuvre moving the chaser for all approach conditions safely out of the vicinity of the target. To be initiated in case of danger of collision.

CC control centre.

CCD charge coupled device.

CCSDS Consultative Committee for Space Data Systems.

CoM centre of mass.

CRV Crew Return Vehicle.

CTRL control function.

CW Clohessy–Wiltshire.

DCM direction cosine matrix.

DGPS Differential Global Positioning System.

DOF degrees of freedom.

DRS data relay satellite.

EPOS European Proximity Operations Simulator: stimulation facility for optical rendezvous sensors.

ESA European Space Agency.

ESTEC European Space Research and Technology Centre (ESA establishment).

ETS-VII Engineering Test Satellite no. 7: developed and launched 1997 by Japan. Performed a rendezvous and docking demonstration with a sub-satellite.

EURECA European Retrievable Carrier: spacecraft developed by ESA, brought into orbit in 1992 and retrieved from orbit in 1993 by the US Space Shuttle. EURECA was developed for multiple use, but has been flown only once.

EVA extra-vehicular activity.

FDIR failure detection, isolation and recovery.

FDI failure detection and isolation.

FOV field of view: extension of measurement range in directions normal to the line of sight.

GDOP geometric dilution of precision: quality criterion for the geometrical constellation of four navigation satellites selected for measurement.

GEO geostationary orbit.

GLONASS Global Orbiting Navigation Satellite System.

GNC guidance, navigation and control: automatic process of determining the present and implementing the desired position, attitude and rates.

GPS global positioning system: satellite navigation system based on orbit and time information broadcast by Navstar satellites.

GUI guidance function.

Hermes Project for a European spaceplane to carry crew and cargo to and from the Columbus Man-Tended Free-Flyer. Abandoned in 1993.

HTV H-II Transfer Vehicle: cargo transport vehicle, to be launched by the Japanese launcher H-II and to be berthed to the ISS by the ISS manipulator arm; Japanese contribution for servicing the ISS.

H/W hardware.

ISS International Space Station: permanent orbital station with components provided by the USA, Russia, Europe, Japan and Canada. First module launched November 1998, 'assembly complete' configuration planned for 2004.

IVA intra-vehicular activity.

KOZ Keep Out Zone (ISS traffic and safety control zone).

Kurs Russian navigation system for rendezvous and proximity operations.

LEO low Earth orbit.

LOS line of sight.

LVLH local vertical/local horizontal.

MIB minimum impulse bit.

MIMO multiple-input–mutiple-output.

MMI man–machine interface.

Mir Russian (Soviet) permanent orbital station: first modules launched in 1986, decay and burn-up in the atmosphere in 2001.

MTFF Man-Tended Free-Flyer: European project for a man-visited space station abandoned in 1992, also known under the name Columbus Free-Flyer.

MVM mission and vehicle management.

NASA National Aeronautics and Space Administration (USA).

NASDA National Space Development Agency (Japan).

NAV navigation function.

Progress Russian cargo transport vehicle, launched by the Russian Soyuz launcher and docking to the Mir Space Station. Also used for servicing the ISS.

PRN pseudo-random number.

RA relative attitude.

RAAN right ascension of ascending node: angle measured in the equatorial plane from the line of the vernal equinox to the line of the ascending node of the orbit.

RF radio-frequency.

RGPS Relative Global Positioning System using the differences of GPS raw data measured on chaser and target to obtain relative position with improved accuracy.

RSC Energia Rocket Space Corporation 'Energia': Russian space company, responsible for the development of the Mir Space Station, of the Russian part of the ISS and of the Soyuz and Progress vehicles.

RV rendezvous.

RVD rendezvous and docking: process of approach and attachment of a chaser vehicle to a target vehicle.

RVD/B rendezvous and docking or berthing: general term to cover the approach and both types of mating processes, i.e. docking and berthing.

RVS rendezvous sensor.

SA selective availability: process of degradation of GPS data for non-military use.

S/C spacecraft.

S/W software.

SISO single-input – single-output.

Soyuz Russian crew transport vehicle launched by the Soyuz launcher and used to transport crew to and from the Mir Space Station. Also planned for crew transport to and from the ISS.

SPAS Shuttle Pallet Satellite: family of spacecraft developed by MBB (DASA) and brought into and retrieved from orbit several times by the US Space Shuttle.

TBD to be determined.

TC telecommand: command sent from a remote control station via radio link to the spacecraft.

TDRSS Tracking and Data Relay Satellite System.

TEA torque equilibrium attitude.

TM telemetry: data sent by the spacecraft via radio link to a remote control station.

w.r.t. with respect to.

Terminology

apogee highest point of an orbit around the Earth.

approach corridor safe corridor in the vicinity of a target vehicle, which the approaching vehicle must not exceed.

ballistic coefficient ratio of mass to drag coefficient, indicating the sensitivity of a vehicle to the effects of the residual atmosphere.

berthing attachment in space of one vehicle or module to another one, effected by a manipulator arm. The berthing process includes the capture of one vehicle by the manipulator of the other one, the transfer from the capture position to the berthing port, the insertion into the berthing mechanism interfaces and the structural connection.

berthing box virtual volume in space, in which the capture of the according interfaces (*see* grapple fixture) on one vehicle by the manipulator on the other vehicle takes place. The manipulator transfers the captured vehicle from the berthing box to the berthing port (berthing mechanism interface).

berthing mechanism mechanism providing mechanical guidance, structural interface and latching functions for the attachment of one vehicle or module to another by aid of a manipulator arm.

capture first connection of two bodies, preventing subsequent escape.

capture range range of approach velocities, lateral and angular misalignment and rates for which capture is assured by the mechanism.

chaser active vehicle in the rendezvous process, approaching the target vehicle.

close range rendezvous part of the rendezvous process, which includes the transfer to and acquisition of the docking axis, or to the berthing box approach line, and the final transfer to the docking port or berthing box.

closing possible trajectory elements within the close range rendezvous to reduce the distance to the target.

control process deriving and producing the actuation commands, which shall change the actual state of a vehicle to comply with the required nominal one.

de-berthing process of disengagement of the physical interfaces between two berthed vehicles, i.e. the release of utility connections, structural and capture latches, and the removal by a manipulator arm from the berthing location to a departure location.

delta-V (ΔV) velocity increment added to the present state of a vehicle in orbit in order to change the trajectory.

departure manoeuvre(s), moving the departing vehicle (chaser) out of the vicinity of the staying vehicle (target station).

departure corridor safe corridor in the vicinity of a target vehicle, which the departing vehicle must not exceed.

docking attachment in space of one vehicle to another, effected by one vehicle's reaction control system, guided and controlled by the onboard GNC system or remotely by human operators.

docking mechanism mechanism providing mechanical guidance, capture, attenuation of impact energy, structural interface and latching functions for the attachment of one vehicle to another, effected by the reaction control system of one of the vehicles.

docking/berthing mechanism mechanism providing mechanical guidance, capture, attenuation of impact energy, structural interface and latching functions for the attachment of one vehicle or module to another by both methods, i.e. effected either by the reaction control system of one of the vehicles or by a manipulator arm.

far range rendezvous part of the rendezvous process which brings the approaching vehicle from the end point of phasing (first aim point) to a point much closer to the target, from where the close range rendezvous process with a fixed sequence of manoeuvres can commence. The major function of the far range rendezvous is to reduce the position and velocity dispersions commensurate with the decrease of distance to the target.

final approach final translation on the docking axis or approach line to docking port or berthing box.

first aim point end point of phasing, usually acquired by an open loop manoeuvre. The first aim point is, in most rendezvous strategies, located a few kilometres below and a few tens of kilometres behind the target.

grapple fixture mechanical interface for capture by the end effector of a manipulator arm for berthing (note: the grapple fixture is not part of the berthing mechanism).

guidance process defining the nominal state of a vehicle over time, i.e. the present and future nominal positions, velocities, attitude angles and angular rates to be assumed by a vehicle.

H-bar coordinate in the direction of the angular momentum vector of the orbit.

Hohmann transfer transfer from a lower to a higher circular orbit or vice versa by two tangential boosts, separated by half an orbital revolution.

hold point point where the velocities w.r.t. the target are nominally zero. For a longer duration and without excessive propellant consumption, such a point needs to be located on the target orbit.

J_2-**effect** effect of the oblateness of the Earth on the orbital evolution.

mating general term describing the process of attachment of one vehicle or module to another, whether performed by docking or by berthing.

navigation process determining the actual state vector of a vehicle by measurements and the expected future state by propagation of the actual state.

node intersection of an orbit with the equatorial plane. The ascending node is the one where a satellite crosses the equator in the northern direction.

perigee lowest point of an orbit around the Earth.

phasing first part of the rendezvous strategy after launch, in which the chaser reduces the phase angle to the target (catches up) and arrives at an orbital altitude close to it.

plume volume of exhaust gases of a thruster in action.

port location on a vehicle providing mechanical, sensor and utility interfaces for connection of another vehicle or module.

qualification the sum of all verification and validation efforts in terms of analysis, simulation, physical testing and comparison with already flown or qualified designs, to ensure flight worthiness of an item or system.

R-bar coordinate in the direction of the radius vector toward the centre of the Earth.

reception range range of approach velocities, lateral and angular misalignment and rates for which the mechanical guidance and capture functions of the mechanism are designed (*see* capture range).

rendezvous general term describing the process of bringing one spacecraft into the close vicinity of another spacecraft or a celestial body.

RV-control system the hardware and software items forming the onboard system responsible for the implementation of the automatic rendezvous approach up to mating.

separation process of achieving a physical distance between two vehicles or modules after undocking or de-berthing.

state vector set of values describing the kinematic condition of a body w.r.t. a particular coordinate system. The state vector typically contains the values for position and attitude and for translational and rotational velocities.

target passive vehicle in the rendezvous process: it does not perform position changing manoeuvres to facilitate the rendezvous.

trajectory gate the margins in position and velocities at a particular point of the trajectory, e.g. at a particular distance from the target. A trajectory gate can be used, e.g., as a criterion for success probability of the further approach evolution up to mating.

undocking process of disengagement of the physical interfaces between two docked vehicles, i.e. the release of utility connections, structural and capture latches.

V-bar coordinate in direction of the orbital velocity vector (circular orbits).