

This document contains an overview of changes to the Orbiter software in inverse chronological order. For a more detailed list, see the 2006 Edition log.txt document.

Build 29. 9. 06 (2006-P1 Edition)

- Extensive rewrite of Orbiter's dynamic state propagation code. New integration methods (Runge-Kutta and symplectic methods up to order 8) for both linear and angular state updates are now available. Integration parameters are user-definable.
- Multiple virtual cockpit camera positions are now supported and implemented for Atlantis and Delta-glider.
- New Atlantis orbiter model by Michael Grosberg and Don Gallagher.
- New virtual cockpit implementation for Space Shuttle Atlantis, including functional multifunctional displays (MFD) and payload bay operations (Panel R13L).
- Faster simulation shutdown options.
- Camera control support in playbacks.
- New "Extra" tab in Launchpad dialog for advanced and addon-provided configuration options.
- Various new API functions.
- Various bug fixes.
- Support for TrackIR head tracker.

Build 4. 5. 06 (2006 Edition)

- Re-implemented planetary surface texture manager. In addition to the "global" resolution levels 1-8, resolution levels 9 (16384x8192) and 10 (32768x16384) are now available which support local coverage
- Patch mesh resolution has been detached from patch texture resolution. A patch can now search through the texture hierarchy and utilise a sub-area from a lower-resolution texture tile.
- Support for "specular ripples" from water surfaces. Coastline rendering has been improved.
- Earth and Mars level 10 textures are supplied in the Orbiter distribution.
- Support for recording and playback of simulation sessions. Flight data stream format is published in RecorderRef document. Flight data streams can be generated by external programs and allow to utilise Orbiter as a visualisation tool.
- Onscreen annotations can be edited into flight recordings.
- Several playbacks are provided in the Tutorials and Playback scenario folders.
- New "Scenario editor" module allows to create, edit and delete spacecraft, modify the scenario date, and save modified scenarios. API extensions allow to add vessel-specific custom pages to the editor.
- Orbiter now calculates gravity gradient torques based on spacecraft principal moments of inertia. Tidal locking of spacecraft in orbit is now possible.
- Re-implemented model of angular motion. Euler's equations are now integrated with RK4 method. Conversion of angular velocities into rotation matrix updates now via quaternion mechanism.
- Force vectors acting on spacecraft can now be visualised in the simulation window.
- Generic "glass cockpit" view mode is now mouse activated and provides buttons for operating MFD instruments, navmode and RCS mode functions.
- New "External MFD" module allows to open additional MFD displays in external windows.
- Major Saturn moons are now controlled by analytic perturbation code.
- New spacecraft lighting model recognises planetary shadows and atmospheric spectral dispersion during sunrise/set. Support for vessel light beacons.
- Updated textures and configurations for several planets and moons. New KSC surface tiles with land-water mask.
- Numerous additions to the API.

Build 16.1.05 (2005 Edition)

- Virtual cockpit support, including active MFDs and instruments, mouse-activated controls, animations, viewpoint-corrected HUD.
- Viewpoint direction can now be rotated in virtual cockpit and other cockpit view modes. Support for camera rotation via mouse-drag.
- New delta-glider external mesh, including high-resolution textures. New delta-glider virtual cockpit.
- DG-S (scramjet version) added, as a reference implementation for air-breathing supersonic engine support.
- Gravity calculation for nonspherical bodies.

- Vessels and surface objects defined by meshes can cast shadows on the ground. In 32-bit modes shadow appearance can be improved (semi-opaque) by stencil buffering.
- MFD upgrades: Orbit MFD can now display parameters in equatorial frame of reference, Map MFD supports zoom and track, Align Plane MFD supports target plane definition by parameters.
- More functionality for ground camera: convert current camera pos to ground observer mode, specify position with equatorial coordinates.
- Corrected spectral dependence of specular reflection from planet surface w.r.t. angle of incidence.
- New rendering algorithm for planetary atmospheric haze improves visual realism from orbit.
- Improved rendering of planets with clouds and ring systems. New configuration parameters for planetary atmospheres.
- Planets seen through an atmosphere are now tinted with the background colour.
- Added more tiles to KSC.
- Modified "pixel block" rendering of planets (reduced blockiness and correct colours at 16bpp)
- Keyboard mapper for custom key assignment. Key associations can be modified in keymap.cfg.
- New callback interface for vessel modules. VESSEL2 interface now includes callback methods, removing the need for standalone (ovc) callback functions.
- New planet module API interface. Planet modules now create an instance of a CELBODY-derived class and respond to callback methods.
- Updated planet ephemeris code. Offset between heliocentric and barycentric coordinates is now included. Each planet now has its own module, accessing the VSOP driver (vsop87.dll).
- New lunar ephemeris code. Now uses ELP2000-82 perturbation solution. This removes inconsistencies in state vector calculations (also fixes the lunar surface sliding bug).
- New ephemerides for Galilean Jupiter moons. Now use analytic perturbation code (GALSAT), eliminating long-term stability problems.
- Orbiter can now be run in demo/kiosk mode: Automatic reset after a given maximum simulation time, automatic launch of demo scenarios, preventing users from accessing configuration tabs in the launchpad dialog.
- Improved orbit stabilisation code. Stabilised trajectories are now based on osculating elements w.r.t. primary gravity source. Only perturbations are propagated dynamically.
- Various bug fixes and small additions.

Build 17.12.03

- Various bug fixes.
- Specular reflection from water surfaces: modified colour distribution
- Cloud shadows projected on planetary surfaces supported
- Planets are now rendered at larger distances.
- Orbiter now uses the Hipparcos star database with 100000+ stars.
- Ecliptic and celestial grids can now be displayed with the F9 ("Planetarium") function, as well as planet and vessel labels. New Ctrl-F9 dialog for selecting display features.
- TransX MFD upgraded to v3.05.
- Mouse wheel supported for changing camera-target distance.
- Level 9 textures for polar regions are now supported. Surface base texture tiles are now supported for the southern hemisphere.
- Celestial body info has been moved from the simulation window to the info dialog (Ctrl-I). Vessel thrust ratings are now also displayed in the info dialog. Onscreen info-blocks in the top right and top left corners of the simulation window have been cleaned up.

Build 5.11.03

- New more realistic atmospheric flight model supports multiple airfoil definitions for each vessel, and aerodynamic control surfaces. Control surfaces can be animated.
- User-configurable particle system support (emissive and diffuse) for exhaust gas, contrail and reentry flame rendering.
- Support for planetary texture resolution level 9 (effective texture resolution 16384 x 8192 at equator). Level 9 texture tiles are user selectable via TileManager tool. pltex supports level 9 texture tile generation. Orbiter ships with level 9 textures for Earth (Florida/Caribbean in standard texture pack, full land coverage in separate super-highres pack).
- Kennedy Space Center area has been revised. More accurate position of surface tiles and more hires surface coverage.

- Redesigned Habana Spaceport including runway.
- New Moon textures by Jens Meyer. New Venus textures by James S. Williams.
- Improved atmosphere models, including altitude-dependent temperature profiles.
- New ISS model contributed by Andrew Farnaby (Project Alpha)
- New Atlantis model contributed by Don Gallagher/David Hopkins/Damir Gulesich. The RMS arm can now be manipulated easier via a dialog box (Ctrl-Space). Atlantis now utilises aerodynamic control surfaces.
- New vessel attachment interface. Used for modified Atlantis payload coding. Satellites can now be re-captured by the Atlantis RMS arm.
- New Deltaglider model by Frying Tiger, including animated control surfaces and radiator.
- HST model by David Sundstrom, LDEF model by Don Gallagher.
- Windows dialog boxes now work in fullscreen mode. API support for dialogs has been added. The Remote control plugin has been reworked, and a new FlightData plugin added. Atlantis now has a dialog box (Ctrl-Space) to help with RMS control.
- Updated masses for major planets, sun and Moon should give better consistency in numerical trajectory calculations (thanks to Duncan Sharpe for pointing this out).
- Generic support for runway objects in surface base configuration scripts. Includes ILS support for approach path and glideslope information.
- Orbit stabilisation mode to prevent numerical instabilities at high time acceleration.
- Duncan Sharpe's TransX MFD mode is now included as the standard transfer trajectory MFD with Orbiter.
- New ground-based camera modes (accessible via "Ground" tab of Camera dialog (Ctrl-F1). Ground observer sites can be added to planet configuration files. New preset view lists for quick access of camera modes.
- New Horizontal Situation Indicator (HSI) MFD for instrument navigation with VOR and ILS stations.
- Multiple quicksaves (Ctrl-S) are now possible during the simulation.
- MFD mode list now supports multiple pages. Vessel classes can disable MFD modes.
- New mesh animation interface supports hierarchical animation sequences to build more complex animations.
- Shuttle-A modified for 180° rotation of auxiliary engine pods.
- Numerous bugfixes.

Build 02.12.02

- Extensive modifications to the flight model, including improved ground contact handling. The delta glider can now take off from a runway. It also supports wheel brakes.
- Major changes to thruster definitions. Thrusters can now be addressed individually or in "logical group". Many restrictions have been removed. In particular, thrusters can now induce linear and angular moments simultaneously. This enhances realism, but requires more discipline by spacecraft designers.
- Introduction of fuel resources. Different thrusters can be attached to different fuel resources. Attitude thrusters now consume fuel by default.
- Vessel-vessel docking is now supported. Docking clearance is no longer required. Old-style space stations are still supported for the moment, but all stations should be converted to vessels asap.
- New vessel type "Dragonfly" designed for assembling structures in orbit. The Dragonfly comes with panels and electrical/environmental systems designed by Radu Poenaru, and mesh enhancements by Roger Long.
- Completely redesigned Shuttle-A by Roger Long. Rotating engine pods make use of new thruster interface. Includes panels.
- Revised target selection for navigation instruments such as Launch/Land MFD and Docking mode: data are now passed via tunable NAV receivers. NAV signal transmitters can be placed into spaceport scripts (e.g. locators for launch pads). New MFD mode (Shift-C) allows tuning of available receivers.
- New Information dialog (Ctrl-I) replaces the info display in external camera modes.
- Redesigned Surface MFD mode.
- Dialogs are now supported in fullscreen mode. Improved camera configuration dialog. Ctrl-F2 is now obsolete. Time acceleration dialog is now incorporated into the Orbiter core ("Warpcontrol" module removed)
- "Scenarios" folder now supports subdirectory structure. The directory structure is reflected in a selection tree in the Launchpad. This allows better grouping of addon scenarios.
- Added "focus-enable" state for vessels for restricted F3 selectability.

- Sun glare effects can now be turned off.
- Added scale transformation to `VESSEL::MeshgroupTransform()` method.
- Atlantis module: Now includes Robert Conley's functional arm with grappling and MMU capabilities.
- Atlantis module: improved cargo door animation sequence: starboard door now opens before port door, front radiators are deployed after doors are fully open.
- Atlantis module: extensive modifications to adjust new thruster model.
- Deltaglider module: Improved thruster manipulation in main panel. Added bottom panel for wheel brakes.
- Deltaglider now supports thrust vectoring for main thrusters via 1-axis gimbal mode.
- "Translation" animation mode is now supported.
- New Mir model, courtesy of Jason Benson (agent036)
- New VAB at KSC, courtesy of Valerio Oss.
- Now includes Robert Stettner's Uranus-Neptune-moons package, adding Uranus moons Miranda, Ariel, Umbriel, Titania, Oberon, and Neptune moons Triton, Proteus, Nereid
- New generic components for surface bases: `BeaconArray` and `RunwayLights`, for improved runway/taxiway illumination, including approach path indicator.
- Fixed bug which caused angular velocity divergence at high time accelerations.

Build 19.4.02

- Support for custom panels. Use F8 to toggle between onscreen instruments and panel view. Initial implementation for Deltaglider. Panels can be scaled and scrolled. Multiple panels per vessel are supported.
- The Delta glider now comes with a completely new mesh, generously provided by Roger "Frying Tiger" Long. It contains moving parts for landing gear, nose cone docking and airlocks.
- Preliminary API interface for custom MFD modes. An ascent profile recorder is provided in `orbitersdk\samples\CustomMFD` as an example.
- Mouse interface for panels implemented. Among other things, MFDs can now fully be operated via the mouse (in panel mode).
- Switched key event handler for buffered keys from Windows message loop to DirectX. This may have an effect on key mapping on some keyboards.
- Implemented additional navcomp modes: "Turn prograde" (key: "["), "Turn retrograde" (key: "]"), "Turn orbit-normal" (key: ";") and "Turn orbit-antinormal" (key: "'")
- Fixed bug which caused Orbiter to run out of file handles.
- Fixed bug which caused initial velocity offset in vessels created by modules.
- Fixed bug which caused invalid initial orbital elements in moons defined w.r.t. the equatorial frame of the parent planet.
- More API functions. The API reference manual now contains 80+ pages!
- Earth surface texture now uses the "Blue Marble" map from the NASA Visible Earth project.
- Orbiter now supports rendering of emissive city light textures on planet night sides. City light textures for Earth are included.
- Support for reflective ocean surfaces. Included for Earth.
- F3 now allows to switch to any vessel anytime.
- Reference objects for Orbit and Docking HUD can now be manually selected with Ctrl-M.
- Atlantis module: SRB thrust at separation adjusted to 5% max. SRBs now fall behind immediately after separation.
- Numerous minor bug fixes.

Build 14.1.02

- Bugfix: ShuttleA and ShuttlePB can lift off again with hover thrusters.
- ShuttlePB now implemented as module.
- Bugfix in Atlantis module which caused crashes during liftoff.
- Bugfix in SDK which resulted in inconsistent state vectors.
- Additional SDK functions, including retrieval of orbital elements.

Build 22.12.01

- Fixed a bug which prevented the Deltaglider from taking off.
- The flight model realism can now be selected via the "Complex flight model" box in the Parameters tab. As a result, the original and MK2 versions of the Deltaglider have been merged.

- The manual is now provided in PDF format (Doc\Orbiter.pdf), so it can be viewed with Acrobat Reader and does not require MS Word.

Build 21.12.01

- This version features Orbiter's first "realistic" spacecraft type: Space Shuttle Atlantis, based on Javier Fernandez' superb model. This is also a reference example for the extended API interface. Features include:
 - Realistic behaviour of solid rocket boosters (SRB). SRBs fire as soon as the main engines reach full thrust, and can not be turned off once ignited. SRBs separate 126 seconds after ignition.
 - Main tank can be jettisoned.
 - Mesh animation: Payload bay doors and landing gear can be operated.
- Fixed bug causing crashes when turning off object shadows.
- Extensive additional API functions, including a vessel interface.
- The extended flight model is now default for the DeltaGlider, the Glider Mk2 class has been removed.
- Improved and debugged the shippedit utility in the orbitersdk\tools directory.
- The full source code for the Atlantis module is included in the SDK. This should provide a good starting point for the development of complex customised spacecraft.
- Preliminary implementation of runway touchdown for Atlantis.
- Added specular reflection effects (e.g. shiny solar panels). Can be enabled from the launchpad.

Build 10.9.01

- Improved planetary positions. Orbiter now uses VSOP87 perturbation terms for Mercury to Neptune. VSOP87 code is encapsulated in a separate module with public interface, so can be replaced by the user.
- Improved lunar position using perturbation terms. Accuracy is now sufficient to recreate eclipses.
- Adjusted Earth's sidereal day by ~1sec to 23h 56m 4.09s. Sunrise and sunset times should now be fairly accurate.
- New integration scheme improves stability at 1000x time acceleration.
- Orbiter now supports programming interface (preliminary version). Added an SDK (software development kit) package which includes headers and libraries for addon development.
- Planetary texture tool (pltex) has been moved into the SDK package.
- Support for cloud layers added: Earth clouds are now rendered as a separate layer down to ground level.
- Atmospheric "horizon glow" support added.
- Modified Sun texture.
- More eye-candy: Nicer engine exhaust flare.
- Saturn moons added: Mimas, Enceladus, Tethys, Dione, Rhea, Titan
- ISS mesh improved (plus new docking port)
- Added Mir station.
- Added Transfer orbit MFD mode.
- Orbit MFD now supports open ($e \geq 1$) orbits.
- Fixed bug in Orbit MFD which caused crashes when selecting planets as targets.
- Fixed teleport bug when selecting new docking target while docked.
- Fixed bug which kept main engine going when out of fuel.
- Fixed bug which caused jumps in vessel position.
- Fixed bug causing crashes in Orbit sync MFD.
- Target selectable in Docking MFD (Shift-T)
- Added MFD parameter menu support (Shift-`)
- Mesh format has changed slightly – modellers and mesh converter developers should check out the format in the '3DModel' SDK document.
- "Derailed trains" bug fixed.

Build 6.7.01

- "Launchpad" startup dialog for improved parameter selection. Includes video mode, joystick parameters, simulation parameters and scenario load.
- Modified configuration interface: Spacecraft parameters now in scenario file, instead of individual .cfg files. Spacecraft references in Solsys.cfg no longer required.
- Online help via Launchpad (preliminary).

- Pause function (Ctrl-P) implemented, optionally with movable external camera.
- New flight model (experimental, currently only used by GliderMk2 class): Modified atmospheric flight characteristics, modified rotation mode.
- Improved Map MFD: moons and ships can now be selected as orbit targets (Shift-T); reference planet/moon is user-selectable (Shift-R); removed bug in display of orbital planes.
- Improved Orbit MFD: Selectable reference (Shift-R), extended target selection (Shift-T), indicator for G-field contribution of reference, auto-reference selection (Shift-A), removed bug when switching reference.
- Improved Docking MFD: works now for vessels which do not dock along the longitudinal axis.
- Improved Docking HUD: Negative velocity marker ('+'), and direction indicators for offscreen target and velocity markers.
- Improved Orbit HUD: Direction indicator for offscreen prograde marker.
- Docking to other stations than ISS is now possible.
- Improved eccentricity calculation fixes problems with launch from Mars.
- Added Jovian moons Io, Europa, Ganymede and Callisto.
- Attitude fine control (10% max) for keyboard implemented (Ctrl+Numpad key combinations). Linear forward/back attitude mode (Numpad-6/9) implemented.
- New vessel class: Balázs Patyi's nifty PTV single seater is now included in Orbiter, with some interior design by myself.
- Time deceleration key is now 'R' instead of 'Ctrl-T', by popular demand.

Build 3.5.01

- New instrumentation for rendezvous and docking manoeuvres with orbital stations: "Synchronise Orbit" (Shift-Y) to intercept the station, "Docking" (Shift-D) for final approach. Also new "Docking" HUD mode.
- Attitude thrusters can now be engaged in parallel pairs (translational mode). Switch between rotational and linear mode with Numpad "/" key. Mode indicator added to HUD.
- Corrected axis of rotation (obliquity and longitude of Sun's transit) for all planets.
- Added Mars moons Phobos and Deimos.
- Inner/outer radius of Uranus ring system corrected.
- Orbital elements for secondary bodies (moons and orbital stations) can now be specified with either the ecliptic or the parent body's equator as frame of reference (config file option 'ElReference').
- New external camera modes: target-relative, absolute direction and global frame. See manual for description. (F2 to toggle or Ctrl-F2 for menu – note that the menu for external view targets is now accessed via Ctrl-F1).
- Instrument modes can now be selected via a menu (Shift-F1).
- Instruments can be made opaque for better readability (MFDTransparent entry in Orbiter.cfg).
- Target object for Orbit MFD can now be selected with Shift-T.
- Selection lists rewritten and cleaned up.
- Extensive additions to the manual, including all new instruments and associated manoeuvres, and a detailed check list for a complete flight from launch to docking at the ISS.

Build 13.3.01

- New resolution level for planetary surfaces: 8192x4096 (!) This requires some serious 3D hardware (around 32MB texture memory and DXT1 texture compression support). Earth, Moon and Mars textures at this resolution level are provided as separate downloads. The standard ORBITER distribution contains textures up to 4096x2048.
- Re-organised planet texture resolutions. 8 levels are now supported: 64x64, 128x128, 256x256, 512x256, 1024x512, 2048x1024, 4096x2048 and 8192x4096. The following have been dropped: 512x512, 1024x1024 and 3072x1536.
- Included planetary texture tool (pltex) to allow users to generate their own texture maps from planet surface bitmaps.
- Added Uranus and Neptune.
- Saturn has new surface texture.
- Saturn and Uranus have rings now. Shadows are partly implemented (planets cast shadows on rings but not vice versa).
- Added generic mesh as surface base object type to allow inclusion of custom objects. Removed remaining inconsistencies in surface base definition file format.
- Added section on planetary surface textures to the manual.

Build 13.2.01

- A star catalogue containing ~16000 bright stars is now included. The actual number of rendered background stars can be set in Orbiter.cfg via option "NumStar". Star brightness can be adjusted with option "StarBrightness".
- Display of constellations can be toggled with F9 ("planetarium mode").
- Orbital elements for ISS improved.
- First lunar surface base opened.
- New instrument "Align orbital plane" (Shift-A) included. This aids in the initial stages of rendezvous and transit maneuvers.
- Updates to the manual. Now contains a "Basic Flight Maneuvers" section to explain some of the fundamental navigation methods.

Build 9.1.01

- Limited fuel: Each spacecraft now contains a limited supply of fuel. The ship's mass decreases during flight as fuel is burnt. The "Mass" entry in the ship and class configuration files is now interpreted as "empty mass". Two new options have been added: FuelMass and Isp (fuel-specific impulse). Fuel level is displayed on the HUD above thruster settings. The Orbiter.cfg now has an option "UnlimitedFuel" to ignore fuel consumption. A ship is automatically refuelled after touching down on a landing pad.
- Selectable ships: Whenever the user-controlled ship has safely touched down on a surface base landing pad, the user can jump into any ship currently parked at the same base by pressing F3. Try flying the glider to Cape Canaveral, hop into the little transporter, and return it to Habana.
- Blue sky: Background colour is adjusted to simulate light scattered in the atmosphere when the observer is located within a planetary atmosphere. Currently very simplistic (homogeneous, direction-independent)
- Additions to the Map Virtual Instrument (Shift-M): Projections of orbital planes of ship and selected orbital station are now plotted.

Build 20.12.00

- Major rewrite of the atmospheric flight model. The glider should now actually glide in the atmosphere. Still more work to be done for ground contact/takeoff scenarios.
- Delta glider now has trim control (Ctrl-Keypad2 and Ctrl-Keypad8) to manipulate flight characteristics in atmospheric flight. Added visual trim control display to HUD.
- Full support for dynamic surface object shadows.
- Modifications to surface base configuration files. Object lists are now better structured, making it easier to generate custom bases. See documentation for format.
- Turned off generic texture maps for Earth for the time being.
- Some joystick configuration options available via Orbiter.cfg.

Build 6.12.00

- Included Doc directory which had been left out in the first release.
- Added "H-level" (L) navigation computer mode which keeps the ship level w.r.t. the horizon. Also important for other high-level modes.
- Added "HoldAlt" (A) navigation computer mode which maintains current Altitude above ground by modulating hover thrusters.
- Improvements to the surface base visuals.
- Preliminary object shadows.
- Some modifications to configuration files.

Build 27.11.00

- First released version.