

# Space Shuttle Ultra

## User Manual

### Version1.25

## 1 Introduction

This addon is based on the Space Shuttle Deluxe. On top of the features included in the original Space Shuttle Deluxe, it simulates some of the displays in the shuttle and simulates some of the systems in the real shuttle, including the APU/HYD system. The Flight Checklists provide checklists for some of the aspects of shuttle operation, but are incomplete. Checklists used for actual shuttle missions can be found at <http://www.nasa.gov/centers/johnson/news/flightdatafiles/index.html>, and provide a good reference for other procedures. The DPS Dictionary is a good reference for the DPS displays (although only a few of these are simulated at the moment).

## 2 Inverse Kinematics RMS

The RMS supports both single joint motion and Inverse Kinematics. Inverse Kinematics operation changes multiple joint angles to allow the EE to translate or rotate along a particular axis. This makes controlling the arm faster and easier than using Single Joint operations. The RMS can be used to grapple objects while they are still attached to something else (either the shuttle or another vessel). The RMS must be rolled out of the payload bay and unlatched before it can be used. Detailed procedures are included in the Flight Checklists.

## 3 APU/HYD System

This addon provides a simulation of the Shuttles APUs (Auxiliary Power Units) and the hydraulic system. The APUs provide power for all the hydraulic system on the orbiter. The hydraulic system is used to move the aerosurfaces and speedbrake and gimbal the main engines. The APUs must be turned on shortly before launch and again before entry, just as on the real shuttle. Detailed procedures are included in the Flight Checklists.

## 4 launch

A full launch autopilot is now included. It controls SSME throttling, OMS assist, ET Separation and inserts the shuttle into a specified orbit. Pressing B will turn the autopilot off. Once turned off, the autopilot cannot be turned back on. Pressing 'C' will enable/disable automatic SSME throttling.

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## 5 ET Umbilical Doors

The OMS Engines must be armed before they are fired. This is done by setting the appropriate OMS ENG switch on panel C3 to the ARM/PRESS position. After shutdown, the switch should then be moved back to the OFF position. The CRT MFD provides an autopilot for OMS firings similar to that used by the real shuttle. See the CRT MFD Manual for more information.

## 6 SSMEs

Like the OMS Engines, the SSMEs must be ‘armed’ before launch. See the Flight Checklists for detailed procedures. NOTE: In the T-9:00 scenario, the engines are already ‘armed’.

## 7 Air Data Probes

During entry, the Air Data Probes should be deployed at ~Mach 4. While the Air Data Probes are deployed, extra information (altitude in feet, speed in knots) is displayed on the HUD. See the Flight Checklists for detailed procedures.

## 8 CRT MFD

The CRT MFD, included with this addon, simulates a number of displays on the actual shuttle. It also simulates some of the functions of the shuttles GPCs (General Purpose Computers). See the CRT MFD manual for more information.

## 9 Camera Views

This addon includes the four payload bay cameras and the docking port centerline camera. Also, the new Payload camera control panel is available. To access it, press ctrl-Space, then select Payload camera operations. To rotate a camera, select it with the Camera radio button, then use the rotation controls to pan the camera.

## 10 Speedbrake

The speed brake can be opened and closed in 5-degree increments. Pressing ‘,’ will open the speedbrake and ‘.’ will close it. Ctrl+B will fully open/close the speedbrake. The current and commanded speedbrake positions are displayed on the HUD.

## 11 Scenario Parameters

WING\_NAME name to be painted on wing and nose of shuttle

PAYLOAD\_MASS mass of payload in kilograms

ASSIST start time of OMS assist (in seconds), end time

THROTTLE\_BUCKET speed (in fps) at which to start throttle down, speed at which to start throttling up

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AUTOPILOT target inclination (in degrees), target LAN (not used), target alt. at MECO (in m), target speed at MECO (in m/s), target flight path angle (in degrees)

ENGINE\_FAIL engine number (0=center, 1=left, 2=right), time of failure (in seconds)

## 12 DAP

SSU simulates most of the RCS and translation autopilot modes. **As a result of the DAP simulation, external autopilots such as Attitude MFD or Orbiters default autopilots will behave oddly when used with SSU.** A description of each mode is given below:



**A/B/PRI/ALT/VERN:** These buttons are used to select the DAP CONFIG. The DAP CONFIG settings can be edited in the SPEC 20 display (see the CRT MFD manual for more details). The PRI and ALT modes use the RCS thrusters at 100 percent for rotations; the VERN mode uses the RCS at 10 percent for rotations (in real life, a completely different set of thrusters is used). For translations, the thrusters always fire at full thrust.

**AUTO:** In this mode, the attitude autopilot (ITEMs 18 and 19 in UNIV PTG) controls attitude. Any manual inputs will cause the mode to change to INRTL.

**INTRTL:** The shuttle will maintain a constant inertial attitude. The autopilot will only control axes in the DISC RATE rotation control mode.

**LVLH:** The shuttle will maintain a constant horizon-relative attitude. The autopilot will only control axes in the DISC RATE rotation control mode.

**FREE:** This mode puts all three axes in PULSE mode. Only manual inputs can be used to control the vehicle; the autopilot has no effect in this mode.

**Translation:**

**NORM:** the thrusters fire continuously to respond to user input.

**PULSE:** the thrusters will fire to produce a pulse equivalent to the V specified in the selected DAP CONFIG.

**Rotation:** In all modes, an input greater than 75 percent will cause continuous thruster firings.

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DISC RATE: an input of up to 75 percent will cause the shuttle to rotate in the appropriate direction at a rate equal to the ROT RATE parameter in the selected DAP CONFIG.

PULSE: an input of up to 75 percent will cause the thrusters to produce a pulse equal to the ROT PLS parameter in the selected DAP CONFIG.

Reentry: Before reentry, the Major Mode should be set to 304 to disable the on-orbit DAP. In MM304, the RCS thruster commands will directly correspond to manual input.

## **13 Changes from last version (V1.06)**

VC mesh now includes all panels

Improved RMS simulation

Realistic DAP

ODS simulation

Added meshes for FSS, RSS and MLP

## **14 Credits and Miscellaneous**

This addon is derived from the Space Shuttle Deluxe addon. Large parts of the launch autopilot were copied (with minor modifications) from kwan3217s PEG MFD. Most of the attitude control code was copied from AttitudeMFD V3.

This addon is open-source and is released under the GNU Library GPL. Feel free to modify and redistribute it.

DISCLAIMER: The SSU team is not responsible for any crashes or other problems caused by this addon. Use at your own risk.