

AlignPlane II MFD v1.2

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I- Introduction

This MFD refines the default AlignPlane function of Orbiter Space Simulator v031105 (Copyright © 2003 Martin Schweiger).

This MFD enables the performance of very accurate plane change maneuvers in one shot. Given targeted inclination (INC) and Longitude of Ascending Node (LAN), the MFD will compute the Attitude, time and thrust duration needed for the burn.

AlignPlane II provides a full FDAI (Flight Director Attitude Indicator - based on the Apollo one) for moving to the proper attitude and an AutoPilot function which monitor the execution of the Burn.

AlignPlane II should works for orbits around any Planet, including Earth's Moon. Range of values heavily depends on the Specific impulse of the SpaceCraft, the higher it is, the bigger the maneuver can be. You have also to check that the required DeltaV is not higher than DeltaVMax. I have tested it mainly with the DeltaGlider, DeltaGlider III and Space Shuttle Atlantis around Earth and Venus.

If the request cannot be achieved in one shot, you have to perform several burns.

Two solutions are usually provided for such Burn maneuvers. AlignPlane II always displays the closer to your position.

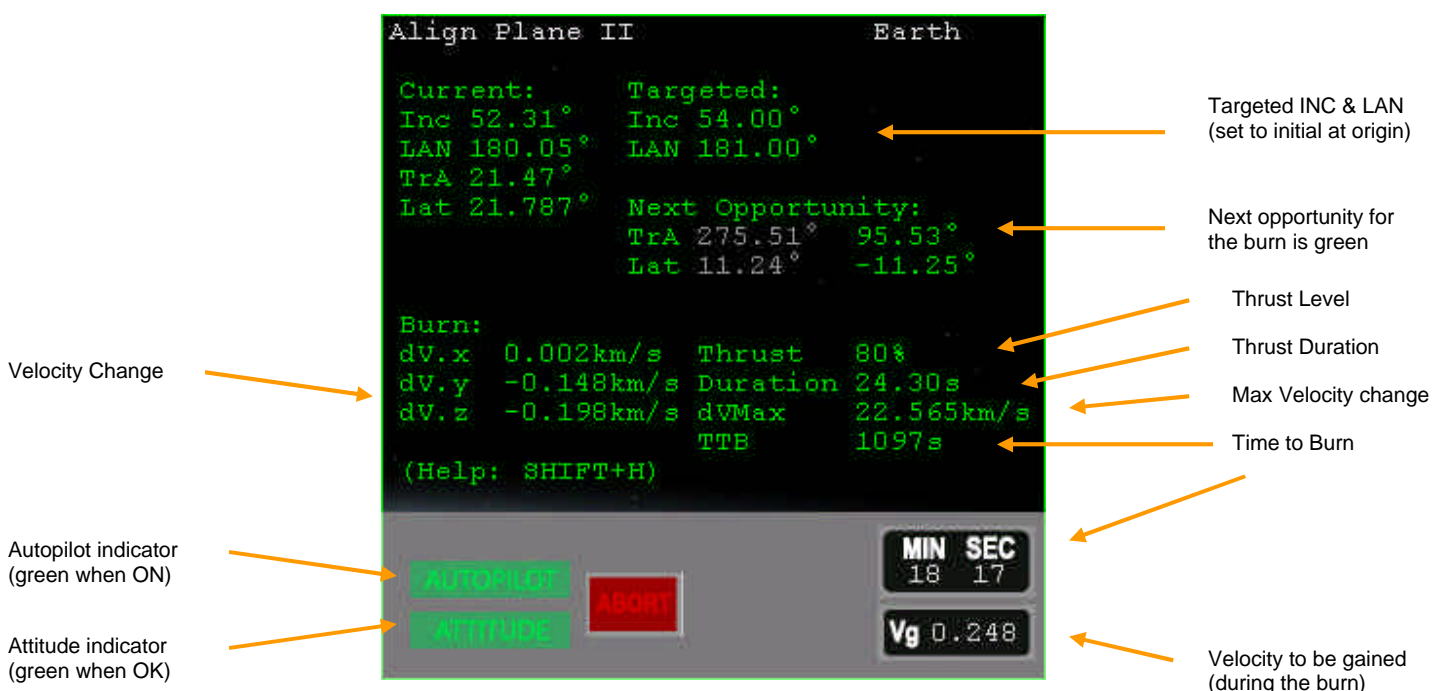
AlignPlane II has been designed to minimise side effects on eccentricity and Perigee or Apogee distances during maneuvers

Today, the graphic interface will work with DeltaGliders (I, II or III) panels only. If you are using another Spacecraft, you have to switch to normal mode with F8.

With regard to version 1.0, you will notice that the frame rate will not drop down anymore when using the FDAI.

II-MFD display

Press **SHIFT+N** to display AlignPlane MFD on the screen.



III- MFD Interface

INC

SHIFT+I: enter the targeted inclination in degrees.

This will open an Orbiter input box. If you want to enter 65", then just do SHIFT+L 65 ENTER. If you want to enter decimals like 65.34°, do SHIFT+L 65 34 ENTER. Valid values are between 0 and 179.99.

LAN

SHIFT+L: enter the targeted Longitude of Ascending node.

This will open an Orbiter input box. If you want to enter 155", and then just do SHIFT+L 155 ENTER. If you want to enter decimals like 155.78°, do SHIFT+L 155 78 ENTER. Valid values are between 0 and 359.99.

TLV

SHIFT+T: change Thrust Level for burn.

This will open an Orbiter input box. If you want to enter 40%, and then just do SHIFT+T 40 ENTER. Valid values are between 0 and 100.

This parameter specifies the Main Engine Thrust Level for the burn. For small corrections, try to lower the level for getting an acceptable Burn Duration (few seconds). Default value is set to 80%.

RUN

SHIFT+R: proceed to computing.

Pressing this button will compute opportunities for burn e.g. corresponding velocity change (and attitudes regarding x,y,z axes), time for the burn and thrust duration. This is not the maneuver itself. It will just give you the nominal trajectory conditions.

PLT

SHIFT+P: AutoPilot ON.

This will activate the AlignPlane MFD AutoPilot. Once activated, the AutoPilot will manage the start of the burn as well as its duration

At T-60 a Beep will indicate the last minute. At T-30 AGS (Abort Guidance System) is turn on and the AutoPilot starts to check the correct attitude. From that moment, any wrong attitude will cause an Abort. At T-5 the countdown beeps. At T-0 the burn starts.

Pressing again the AutoPilot button (or SHIFT+P) when ON will cause an abort of the burn procedure!

FD

SHIFT+F: switch between the main screen and the FDAI screen.

The FDAI is used to properly align the spacecraft to the correct attitude **before** the maneuver. Just use pitch, yaw (and optionally roll) in order to move the orange needles to the neutral positions! You can use SHIFT+S for better precision when you are close to the correct attitude.

The Attitude indicator will turn green when the correct position is achieved in both axes. For better control, the Attitude indicator may turn orange when the attitude start to move from requested. You have then to realign the needle before an abort command is issued by the Autopilot. This could happen with the Space Shuttle where the engines may induce a small pitch movement during orbital maneuvering.

SCL

SHIFT+S: switch between the different value of the FDAI scales.

The values are 5° or 50° for roll full-scale error, and 5° or 15° for full-scale pitch/yaw error. This is indicated in the ERR box of the FDAI (upper left).

The values are 1°/sec, 5°/sec or 10°/sec for pitch/yaw rate, and 1°/sec, 5°/sec or 50°/sec for roll rate. This is indicated in the RATE box of the FDAI (upper right).

Please look at the FDAI.pdf documentation for additional information.

SHIFT+H: display a fast help screen. Use SHIFT+H again to come back to the previous screen.

IV-Example

Let's take the Default Orbiter Scenarios "MK4 in Orbit". You may press F8 to disable the MK4 panel in order to have a better display. The Actual values are 52.31° for Inc and 180.05° for LAN. Our targets are 54.00° for Inc and 181.00° for LAN. Therefore, we have to perform the following steps:

1. enter the targeted Inc and LAN:

SHIFT+I 54 ENTER then SHIFT+L 181 ENTER

2. proceed to computation:

SHIFT+R

The result tells you that a Velocity change of 0.248 km/s is needed, corresponding to Burn duration of 24.29 s at 80% Thrust.

The next opportunity will come when True Anomaly is 95.53° (corresponding to Latitude of 11.25° south). We don't mind about the second opportunity in grey.

The Burn is supposed to start in about 19 minutes.

- [2bis. change Thrust Level (optional):

If the Burn duration is too small (eg lower than 1 s), then lower the Thrust Level with SHIFT+T 20 ENTER (lower to 20% of max thrust). This is not the case here anyway.]

3. move the spacecraft to the correct attitude:

Press SHIT+F to activate the FDAI. You have to pitch and yaw your spacecraft so that the Pitch and Yaw needle are well centered. The roll is not important here, but you can of course move to a zero roll position for better lisibility of the 8ball. Notice that the Attitude Light is ON, meaning that the position is correct! See fig 2.

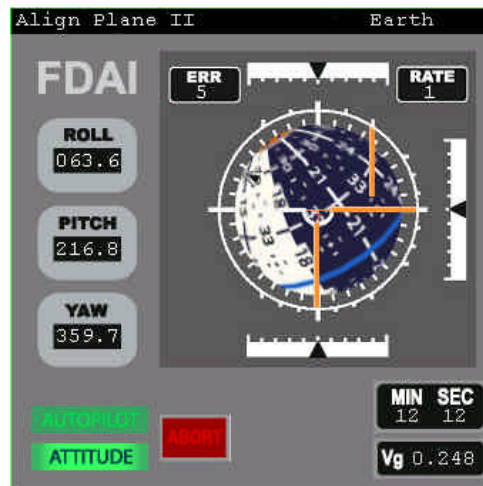


fig 2.

Note: A useful function: when you are close to zeroing the needles, you may use SHIFT+S in order to change the sensitivity of the FDAI to 5° ERR and $1^\circ/\text{sec}$ RATE.

4. set AutoPilot ON.

SHIFT+P

5. Wait for the Burn:

At the end of the Burn, you should get the requested values.

V-Credits

This release makes use of Daniel Polli's OrbiterSoundSDK and Chris Knestrick's GravBodyData.h. Special Thanks to both of them and of course to Martin Schweiger for the incredible Orbiter sim.

You are free to copy and distribute this MFD or reference it on my web site.

Enjoy.

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