How to achieve a Circular orbit With the Space Shuttle

Made by: MJR (Michael J. Rodriguez)

Table of Contents

Setting up a scenario

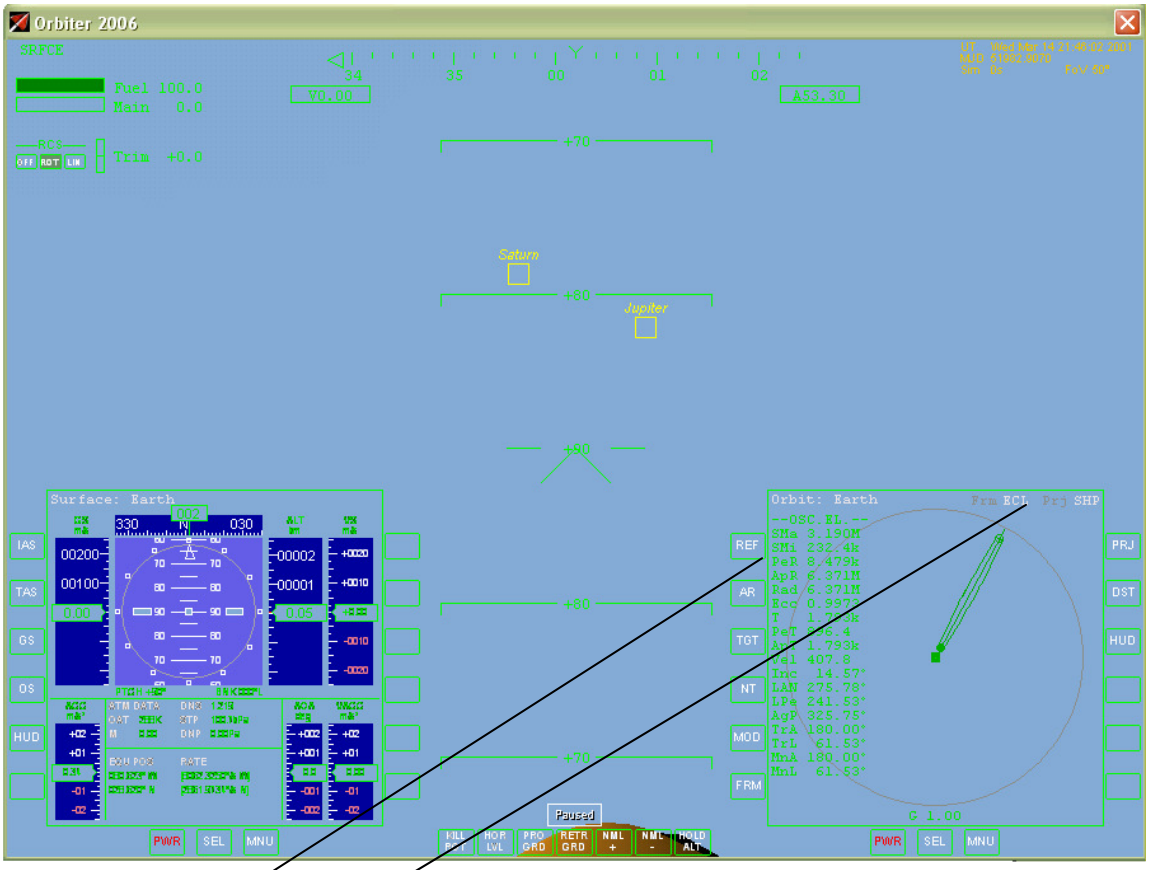
I made this particular tutorial to help you newcomers achieve an orbit with low *eccentricity*. We will be using the stock space shuttle Atlantis for this tutorial. Make sure you are familiar with the controls before you start. I recommend you tinker with it for a bit and then return to this point.

Here in this picture I am in the *VC*. I would recommend that you not use this because of the limitations of visual telemetry. When you get better though I definitely suggest you use the VC. It provides realism and feels like you are in the pilot's seat. On page two you will see what I am talking about. I would also suggest that you set up surface MFD on the left side and Orbit MFD on the right. On the Orbit MFD, you can change the projection plane and distance display by clicking PRJ and DST. It makes it a whole lot easier to read your data.

Next, make sure you know what type of orbit you want. So plan ahead. We are going to do a very basic *LEO* in this tutorial because it takes experience to complete *polar orbits,* and *geostationary orbits.* Our target *apoapsis* will be somewhere around 300km, and our target *periapsis* will be somewhere around 280km. We want our eccentricity to be low. Anywhere beyond 100km the shuttle's wings are useless because the fewer molecules.

Setting up a scenario (part 2)

Don't worry about that though. Make sure you remember all of this. If you have to read it multiple times. Do so.



PeR should read negative after you press DST.

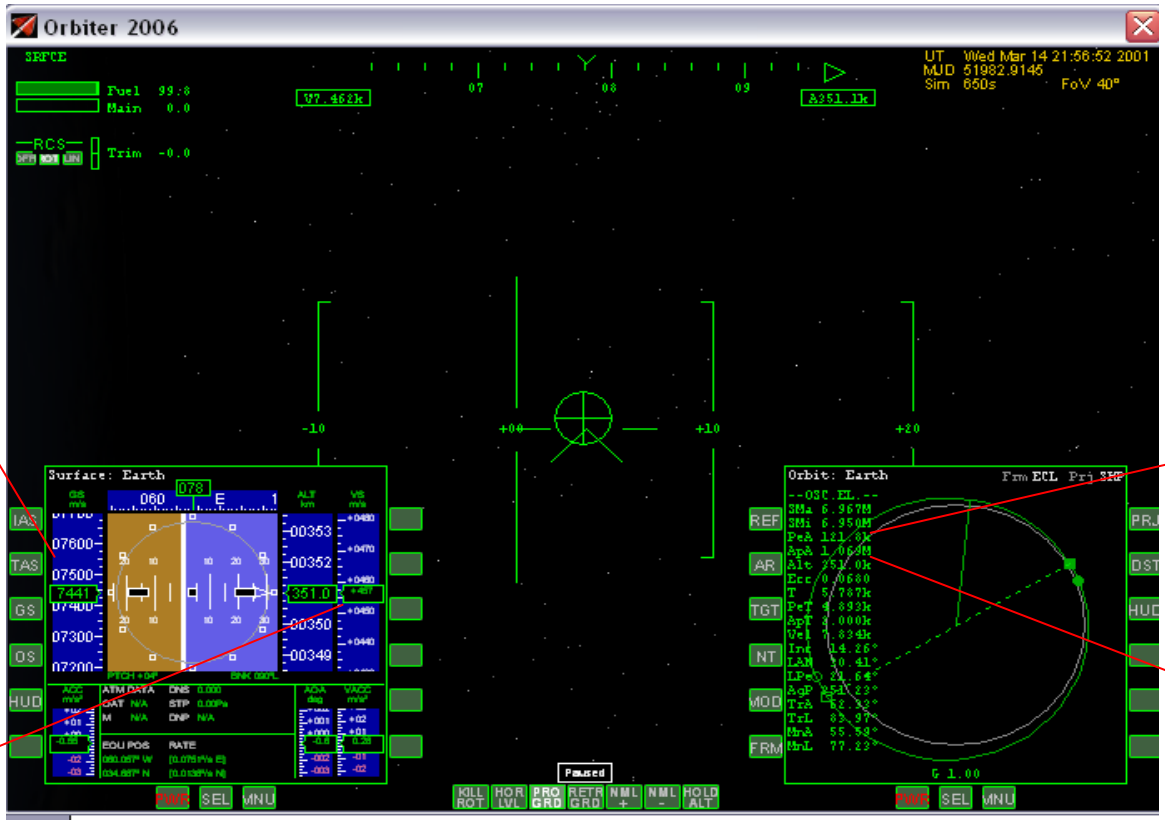
And the PRJ should read be placed by SHP if not already.

What I also need to mention is your launch heading. These first couple of launches doesn't pertain to this, but later on you will usually launch at forty-two degrees which is the regular heading for a launch to the ISS.

Now you should be ready to launch the shuttle. Press the + sign on the numpad to activate the SSMEs. Now roll about ninety degrees and slowly pitch down. Take a look at the Surface MFD and make sure that you're *V/S* is not accelerating too high. A high vertical speed will result in a orbit looking like he picture on page three. Also in my

opinion, there is no precedent way to launch and the launch plan. Anyway, Just like I said, “Keep your V/S at a minimum, but enough to gain PEA.”

Lift-off!!!



Do you see how the vertical speed played a role in this launch? It was too high which resulted in an ApA of 1.069M. This is how it is supposed to be done. Pay close attention to the telemetry in the next picture.

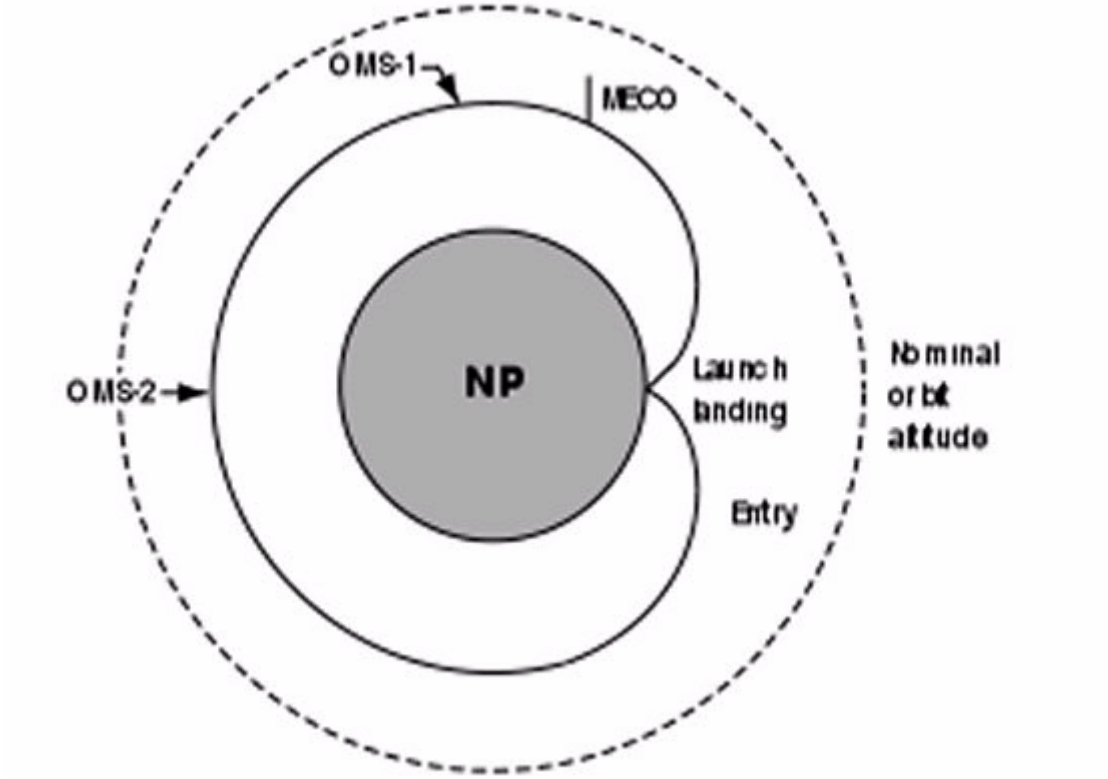
Notice now the vertical speed is a lot lower than the first picture. That resulted in a more stable orbit with an apoapsis of 364.4km. Do not worry if you don't get it the first or second try. Always

OMS burn

persevere and practice to get better. This next page will be about orbital maneuvers or the key commands for the shuttle. You also have to memorize these to make the flight easier.

Moving on, let's say that your PeA is too low. What do you do? That is very simple. Perform an *OMS* burn. An OMS burn is basically an extra boost to your orbit. Now lets wait until we reach our ApA. When you do, turn *prograde* and burn your engines for a few seconds. This should circularize your orbit. I personally would extend my PeA to a range of 290km. Lets also say that your ApA is too high. Do the opposite of what I just explained to you. Wait until you reach your PeA and burn *retrograde*. This lowers your ApA to a reasonable distance. Lower it to about 300km.

In this next page I will explain to you on how to open the Cargo Bay Doors manually and the Ku-Band Antenna manually. Here is a diagram of the OMS burn…..



Confusing? You will get the hang of it. Over time things will get so much easier than you can imagine.

Orbital Maneuvers/Commands

Here is some basic key commands for the Shuttle. The K key and the G key are just shortcuts. Here is the manual way of opening the Cargo Bay doors. Make sure you switch to VC mode and payload operator. You can do this by pressing F8, then Ctrl-Left.

Payload bay door opening sequence

- Set the PL BAY DOOR switch to STOP.
- Set the PL BAY DOOR SYS 1 and SYS2 switches to enable.
- Set the PL BAY DOOR switch to OPEN.
- Wait until the OP/CL status of the talkback indicator shows OP.
- Set the PL BAY DOOR switch to STOP.
- Set PL BAY DOOR SYS 1 and SYS 2 switches to disable.

Payload bay door closing

- Make sure that the radiators, Ku-Band antenna are all stowed first.
- Set the PL BAY DOOR switch to STOP.
- Set the PL BAY DOOR SYS 1 and SYS 2 switches to enable.
- Set the PL BAY DOOR switch to CLOSE.
- Wait until the OP/CL status of the talkback indicators show CL.
- Set the PL BAY DOOR switch to STOP.
- Set PL BAY DOOR SYS 1 and SYS 2 switches to disable.

Radiator Deployment Sequence

- The payload bay doors must be fully open.
- Set the PL BAY MECH PWR SYS 1 and SYS 2 switches to ON.
- Set the LATCH CONTROL SYS A and SYS B switches to REL.
- After 30 seconds, set both latch control switches back to OFF.
- Set the RADIATOR CONTROL SYS A and SYS B switches to DEPLOY.
- After 50 seconds, set both radiator control switches back to OFF.
- Set both PL BAY MECH PWR switches back to OFF.

Radiator Stowing Sequence

- Set the PL BAY MECH PWR SYS 1 and SYS 2 switches to ON.
- Set the RADIATOR CONTROL SYS A and SYS B switches to STOW.
- After 50 seconds, set both radiator control switches back to OFF.
- Set the LATCH CONTROL SYS A and SYS B switches to LATCH.

- After 30 seconds, set both latch control switches back to OFF.
- Set both PL BAY MECH PWR switches back to OFF.

Orbital Maneuvers/Commands (Part 2)

Period key is the right wheel brake.
Comma key is the left wheel brake.
Ctrl-space is to show RMS controls.
Press J to Jettison the *SRBs*.
Press K to open the Cargo Bay doors.
Press G to activate the landing gear.
Press Ctrl-B to activate the split-rudder speed brake.
Press Ctrl-U to deploy or retract the Ku-Band antenna.
Press Ctrl-L for the Payload door radiators.

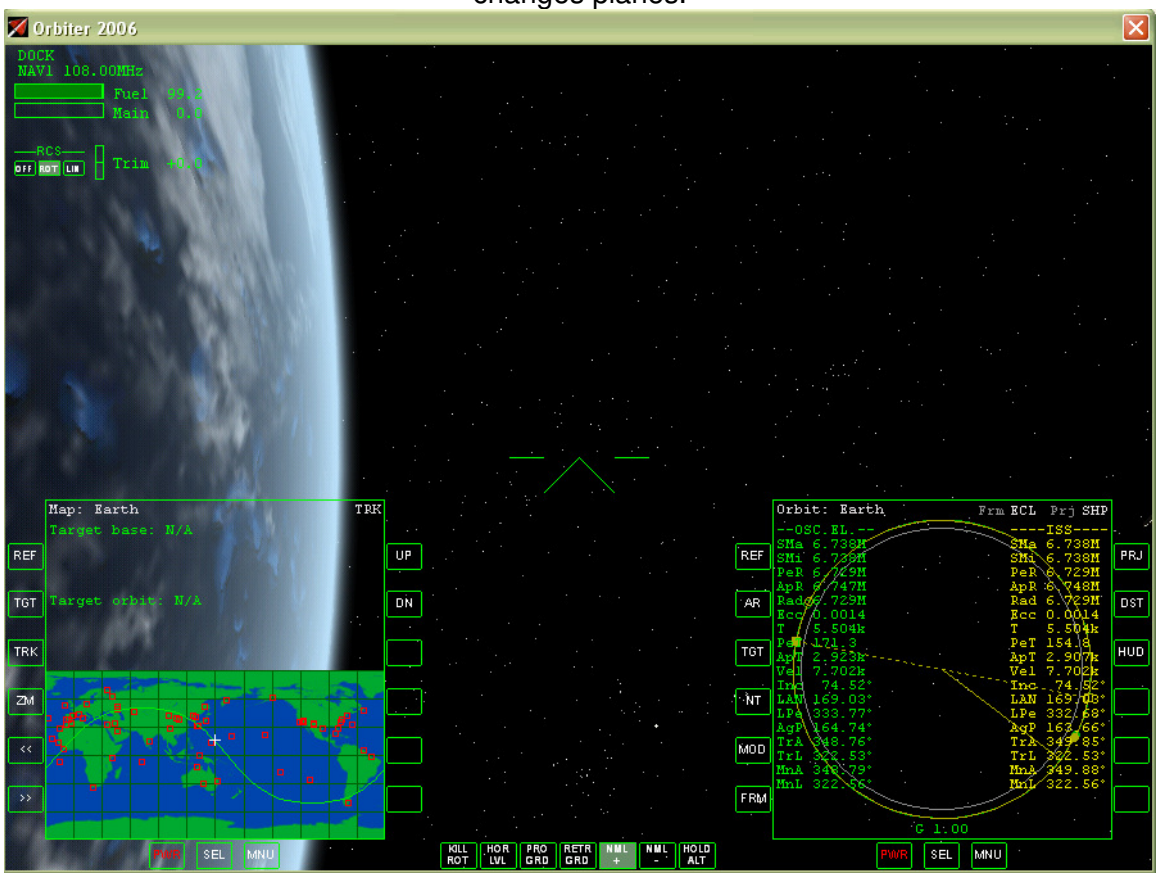
These are the basic controls for the Shuttle.

On other third-party add-ons such as Shuttle Fleet 4.1.X, use more advanced was of flying. For example, it uses GPC MFD as a launch auto-pilot to get into orbit. What is the fun in that? When you get better to the point where you can do it almost flawlessly I would then use the AP. SSU, which is the Space Shuttle Ultra, uses a more advanced approach to flying. You have to start up APU and perform every start up sequence right or else you won't have a very good flight. When you get better at flying the default Shuttle you can later venture on to one of these two alternate paths. There is a lot more than just everything I just told you, but this is the basics and most vital to how well you will end up being in this sim.
On this next page I will explain to you about your de-orbit planning. This is probably the most difficult feat that you will succumb to so far. This means that you will be thinking ahead of your current situation.

Also you will have to be patient. This part took me a very long time as well so don't feel outcasted by this. Practice, Practice, and Practice.

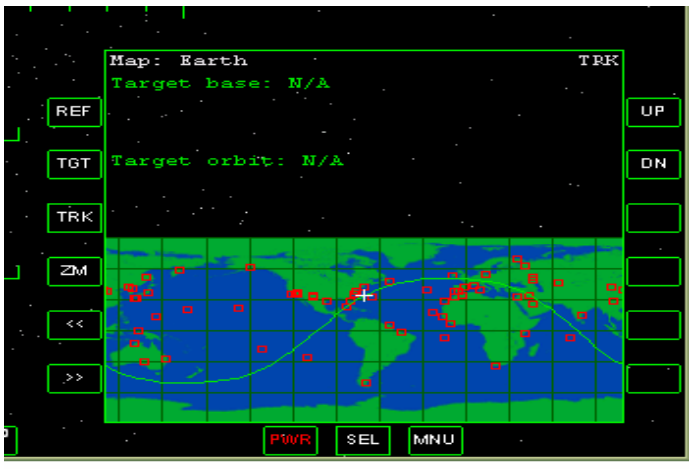
De-orbit burn planning

Now we are ready for deorbitng. Before we do that we need to plan ahead of time. What base do you want to land at? How much fuel do I have left? Am I ready for the burn? Once you answer those questions, you can begin.
If your orbital path is not coinciding with the target base, then wait until your orbit changes planes.



Here is how it should look if we were aiming for KSC…..

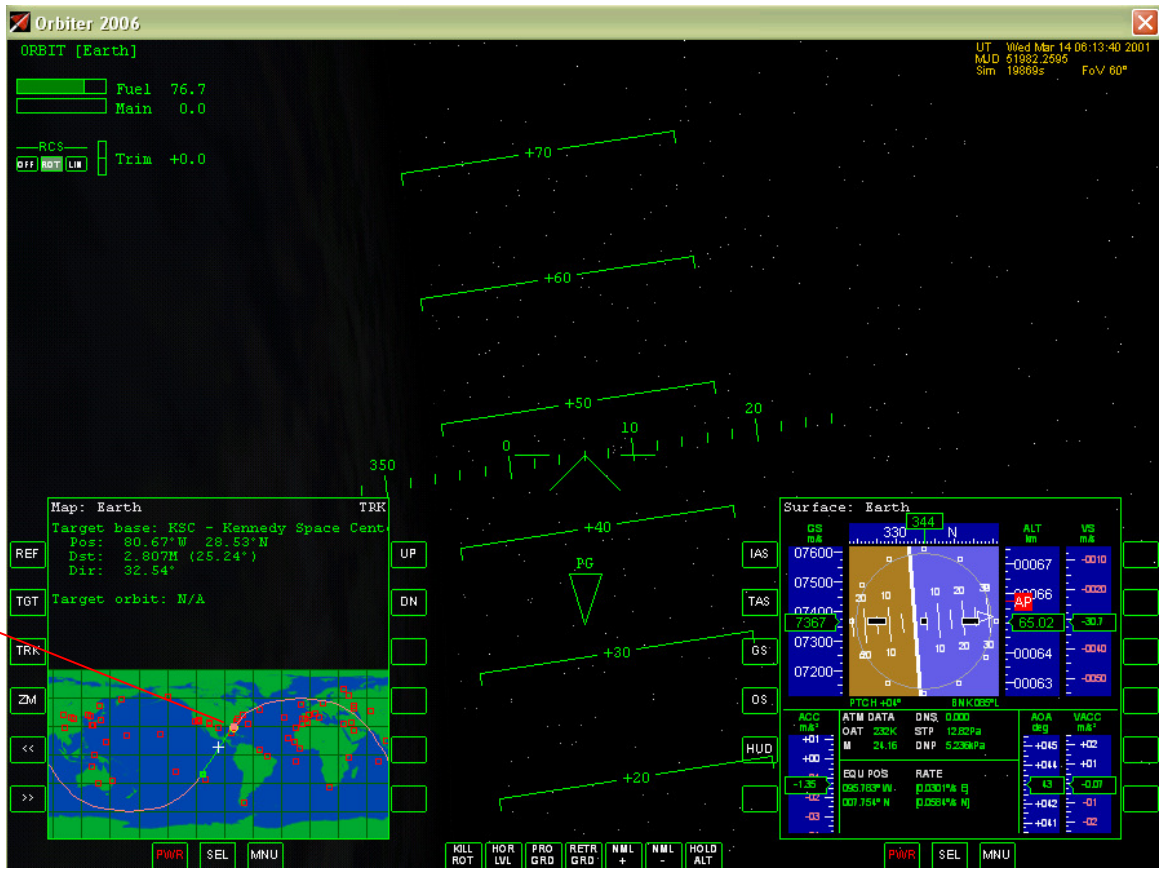
On this picture to the right, you can see how my plane of orbit is right on the dot with KSC. Once this happens to you, you should perform a de-orbit burn soon. Probably one orbit before the green line is on the base. Make sure that when the burn is complete that the red square that



will be set over your target base. In this case, over Kennedy Space Center. The red square shows where you should end up and your estimated landing location.

De-orbit Burning

This is the real thing now. Like I explained earlier, you have to make sure that after your burn is done that the red square is on the designated base you would like to land at. Here is what I am talking about……



The red square is on the dot.

As you can tell on the picture, deorbit is going well. After reentry though we need to prepare for the landing. If you have trouble with this, use AutoFCS from the shuttle fleet and you can basically copy the maneuvers and you will eventually know how to deorbit by heart.

Approach Phase

Now it is time for approach. At this point in time you should be done with reentry and at atmospheric flight. Angle yourself to the right of the runway and whenever you come to a lower altitude you should pull right to the runway so you won't overshoot it. Use the HSI MFD to land. Tune in to KSC at 134.20 in your NAV receiver stack. Then switch to HSI MFD and line yourself up with the runway. It should look something like this…

Our next and final phase of this flight will be landing. If you do not know if you are lined up at the runway, check the HSI MFD located on the left. Our next phase and last part of the flight is the landing. Make sure that your gear is deployed and if your speed is too high, use your split rudder speed brake by pressing Ctrl-B. You are almost done now. Hang in there, only about 1 minute left in this flight.

Landing on final flare

This is the tricky part because if you pitch up too much you can stall and you won't have a second chance. Hence the name, flying brick. Okay, when you are lined up with the runway check the *PAPI* indicators to insure that you are on glide scope.

- Four white lights means you have a glide scope too high to land.
- Three white lights and one red light means to pitch down some.
- Two white lights and two red lights ensure that you are on a proper glide scope.
- Three red lights and one white light mean to pitch up because you are decreasing altitude way too fast.
- Four red lights mean to pitch up immediately.

If you do not know where the PAPI indicator is, look at the beginning of the runway. Usually it is placed on the right or left of the runway, but I think that it is placed in the front of the runway on Orbiter.

Here is an example of a glide scope on an right path……
(This is not Orbiter)

Pilot's Approach on Glide Angle

Notice how like I said on the third bullet that two red lights and two white lights tell you that you are on the right glide scope. This pilot knows what he is doing.

Landing On Final Flare (Part 2)

By the time you are about to land make sure that your landing speed is somewhere around 100 m/s or somewhere closes to that. If it is over this speed use your airbrake to “bleed” speed. When you know that you are on the right path it should look somewhat like this picture.....

When you are at this stage, ten seconds before you land you need to flare up.

The reason why you need to flare up is so that your vertical speed decreases and speed won’t be too high and crush your gear.
When you touchdown with the runway you need to press comma and period to activate both of your wheel brakes. If you find you’re self veering off the runway use 1 and 3 on the numpad to use your rudders to

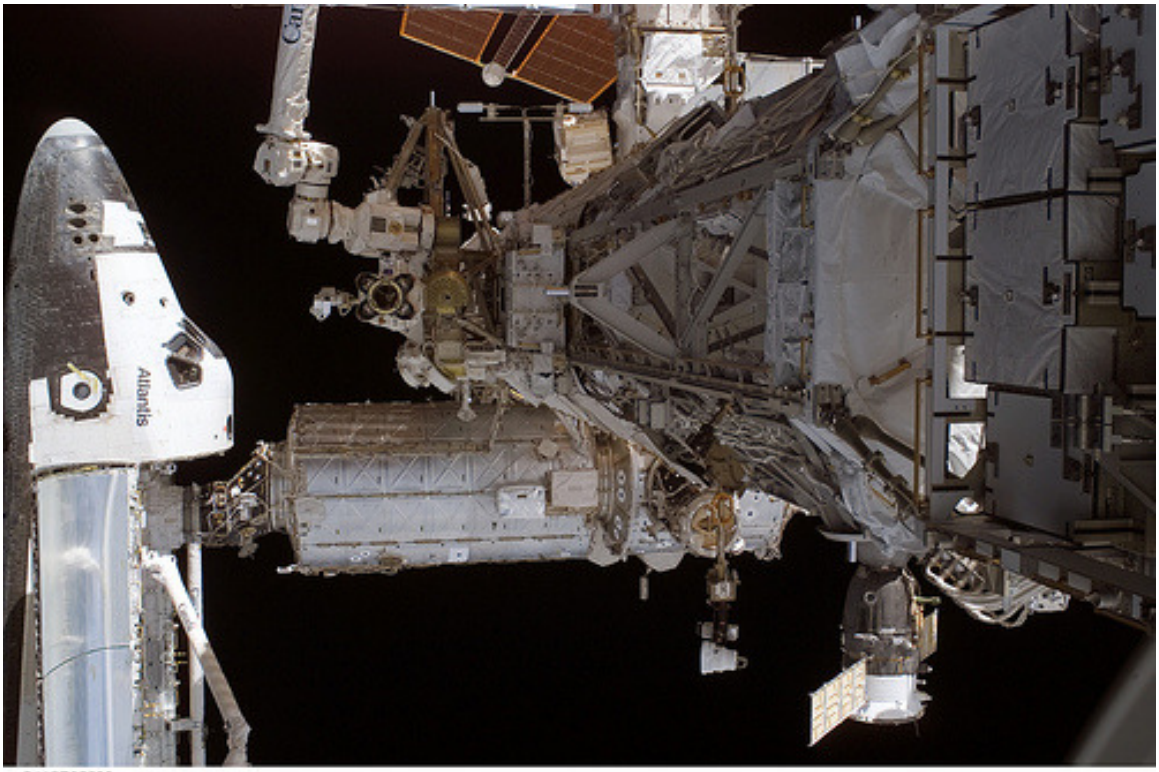
stay straight.

Space Terms 101

1. Eccentricity- the eccentricity of an astronomical orbit used as a measure of its deviation from circularity.
2. VC- Virtual cockpit.
3. LEO- Low earth orbit.
4. Polar Orbit- A **polar orbit** is an **orbit** in which a satellite passes above or nearly above both poles of the body being orbited on each revolution.
5. Geostationary orbit- Of, relating to, or being a satellite that travels above Earth's equator from west to east at an altitude of approximately 35,900 kilometers (22,300 miles) and at a speed matching that of Earth's rotation, thus remaining stationary in relation to Earth.
6. Apoapsis- The point in an orbit farthest from the center of attraction.
7. Periapsis- The orbital point nearest the center of attraction of an orbiting body.
8. V/S- Vertical speed.
9. OMS- Orbital Maneuvering System.
10. Prograde- having or being a direction of rotation or revolution that is counterclockwise as viewed from the north pole of the sky or a planet.
11. Retrograde- having or being a direction of rotation or revolution that is clockwise as viewed from the north pole of the sky or a planet
12. SRB- Solid Rocket Booster.
13. PAPI- Precision Approach Path Indicator.

What is to come...?

I made this tutorial to help you guys who cannot get into a proper orbit. You will be seeing more tutorials from me (MJR) on orbit hangar. If you have requests email me at doughboy94@live.com. I will be glad to help you out. If you have any questions email me as well. Nice flying!



S115E05689

I hope that you guys enjoyed this tutorial and found it helpful. If you think anything needs to be changed or edited just email me.