

Surveyor Addon for Orbiter

Author Jim Williams

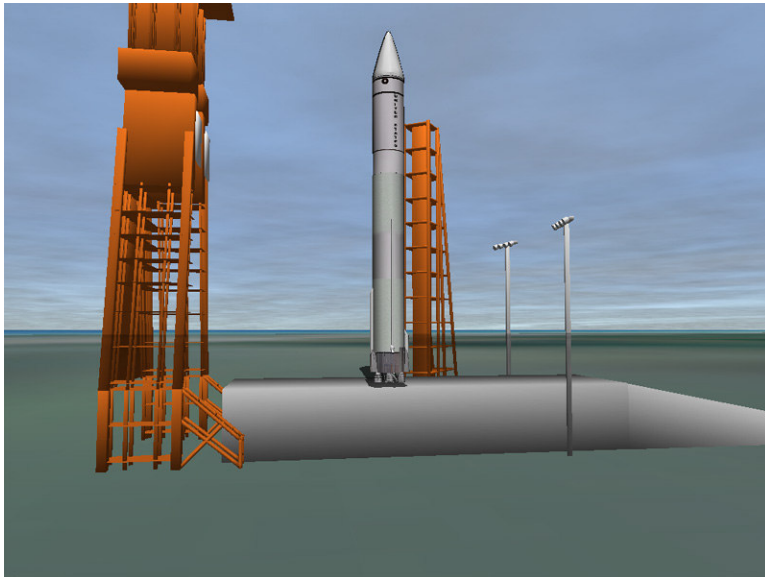
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For ORBITER Space Flight Simulator 2005 Edition (c) 2005 Dr. Martin Schweiger

What is this?



The Surveyor program consisted of seven unmanned lunar missions that were launched between May 1966 and January 1968. Five of these spacecraft, *Surveyor 1*, 3, 5, 6, and 7 successfully soft-landed on the lunar surface. In addition to demonstrating the feasibility of lunar surface landings, the *Surveyor* missions obtained lunar and cislunar photographs and both scientific and technological information needed for the Apollo manned

landing program. Four spacecraft, *Surveyor 1*, 3, 5, and 6, returned data from selected mare sites from Apollo program support, and *Surveyor 7* provided data from a contrasting rugged highland region.

The Orbiter version brings to you the historical flight of this unmanned lunar landing probe. The flight plan should bring you within 10,000 km of the Lunar surface. With one mid course correction, and enough practice, you can land it the moon.

2. WHATS REQUIRED?

The ORBITER simulator program, located at <http://www.orbitersim.com>
Vinkas Multistage and Spacecraft DLL add-on. The latest is included in this package.

OPTIONAL: Rob Conelys Earth_1962 addon located at
http://prdownloads.sourceforge.net/mscorbaddon/earth_1962_26.zip?download

3. KNOWN BUGS

- 1) Only one known at this time. In one step of the flight process, your vehicle may start to tumble unexpectedly. If this happens, you will be unable to recover and must start the scenario again. This may be due to a problem in Multistage.dll, but it is not known at this time. Fortunately this is a very rare occurrence.
- 2) While not a “bug”, you may notice the time in the scenario is not the date or time of the real launch. I picked a date and time that gives you an optimum flight path to the moon based on the flight plan. If you don’t like looking at an incorrect date and time, simple press “I” to remove the information, and pretend. :D

4. INSTALLATION

Simply unzip the archive in your ORBITER directory. All filenames are unique to the ORBITER STANDARD INSTALLATION.

5. OK, WHAT NOW?



Start ORBITER and go into your scenarios list. You will have a new folder called Surveyor In this folder, are three scenarios, one for use with Rob Conelys Earth_1962 add-on. The other is a scenario that places your vehicle on a default Orbiter launch pad. If you do not have the Earth_1962 add-on installed, use the Surveyor7 scenario.

The third is a scenario that puts Surveyor on a flight path to the Moon. No midcourse correction is needed.

6. UNINSTALLING

Simply delete the files installed.

7. DISCLAIMER

USE THIS ADD-ON AT YOUR OWN RISK. While the filenames contained within this archive are unique to the STANDARD ORBITER INSTALLATION, I cannot guarantee that it will not overwrite any other files using similar filenames from other third party ORBITER Add-ons.

This add-on has been tested and while it works under our testing, it may not work as planned on your particular installation. Results may vary.

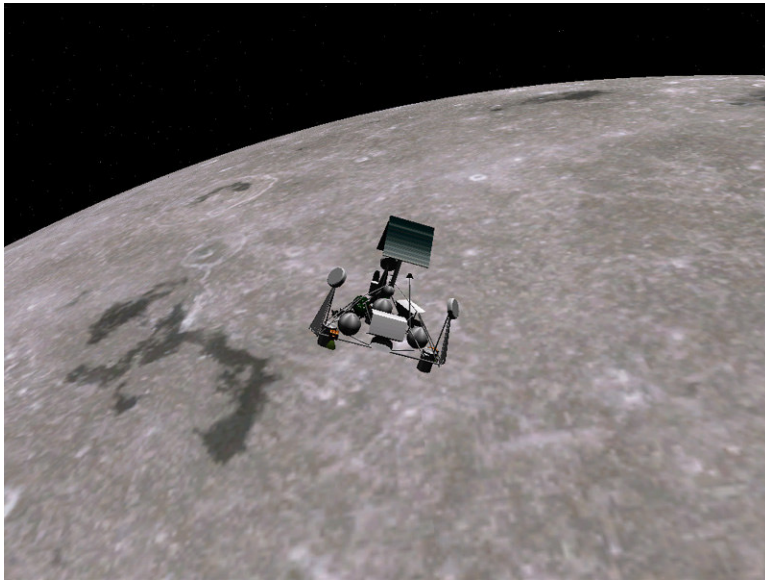
8. Flying Surveyor



Flying Surveyor is rather straightforward. When you start the scenario, you have a launch window of 60 seconds to start the auto launch sequence. The reason you have a 60 second launch window is because while you're sitting there admiring the rocket on the pad, the Moon is in motion. Just like any other real life launch, you have a certain time to launch; otherwise you will need to wait for the next launch window to arrive. Since this version of Surveyor has a specific flight plan, you either need to wait 24 hours for the next window, or modify the flight plan to take advantage of another

opportunity.

To start the auto-launch sequence, press “P”. Your main engine and booster will ignite within 2 seconds and liftoff will occur. The auto launch sequence will place your Surveyor probe and Centuri booster in LEO (Low Earth Orbit). After Atlas separation, a coasting phase will begin to bring the spacecraft to apogee. Once at apogee, the Centuri booster will ignite to place itself in LEO. Once in LEO, you will need to shut down the auto launch sequence by pressing “P” again.



If you do not do this step, Surveyor will continue to pitch down and will not be in proper attitude when the TLI (Trans-Lunar Injection) burn takes place.

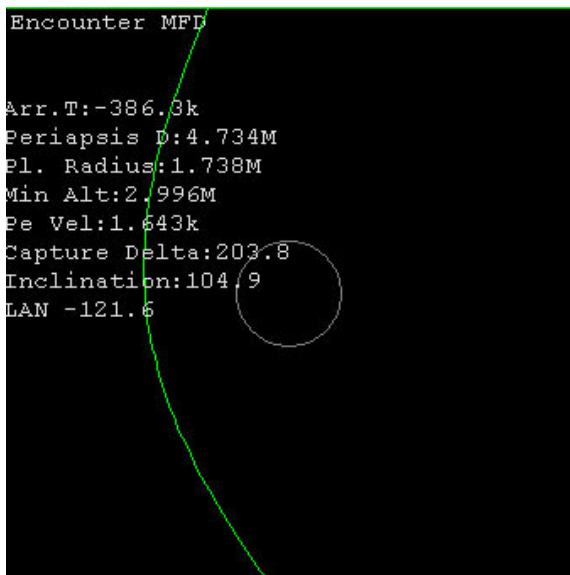
While in LEO, you can either manually fly Surveyor PROGRADE, or, if you want to have Orbiter do this for you, press the “[” key. Your spacecraft **has** to be PROGRADE at the time of the TLI burn!

After about 9 minutes in LEO, the Centuri booster will automatically restart to begin the 90 second TLI burn. Once the TLI burn is finished, the Surveyor payload is jettisoned from the Centuri booster via a 1.5 second burn of a posigrade engine. Once Surveyor is jettisoned, you will need to press “J” to jettison the posigrade engine, and to activate the retro engines. You will arrive at the moon within 4 days.

NOTE: *If you do not press “J” to activate Surveyor after TLI and booster jettison, you will not be able to reorient the spacecraft or use the main engine.*

WARNING: *Do not use time acceleration above 10x during any portion of the powered flight or coasting phase! Once you break free of Earth after TLI, you can accelerate the time.*

8a. Tips on Flying Surveyor



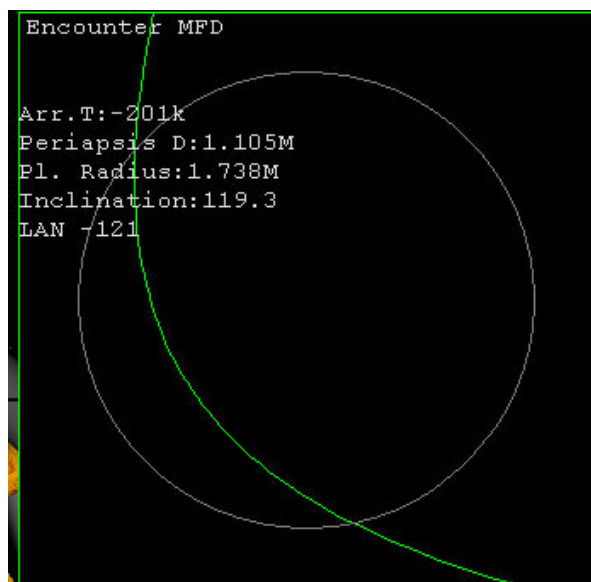
A) After TLI burn, you can use Transfer MFD or TransX (in encounter mode) to get an idea of how well the Atlas/Centuri performed. Your results will vary each mission. The amount of the mid course correction burn you need to do is dependant on how well your launch vehicle performed at launch. If you see that you are within 8,000 km of the Moon, you can do a mid course correction burn later in the flight to bring Surveyor within striking trajectory.

B) Your mid course correction burn will be dependant on your distance from the Moon after TLI. You can use Encounter MFD to see how well you did. See example on the above.

The **Min Alt** reading is important. This is the minimum altitude you will achieve if you do nothing for the rest of the flight. In the example, it is within 2,996 km of the lunar surface. Not bad at all!

Your goal in the mid course correction is to make that number drop. You will need to reorient Surveyor and perform the mid course correction burn. If you reoriented your spacecraft correctly, the MIN ALT number will start to decrease. If you see it INCREASE, then you're not in the correct attitude. Stop thrust and try another attitude.

WARNING: Like the real Surveyor, you have very limited fuel! Once you deplete your fuel, you will be unable to reorient the spacecraft again! Your mission is over.

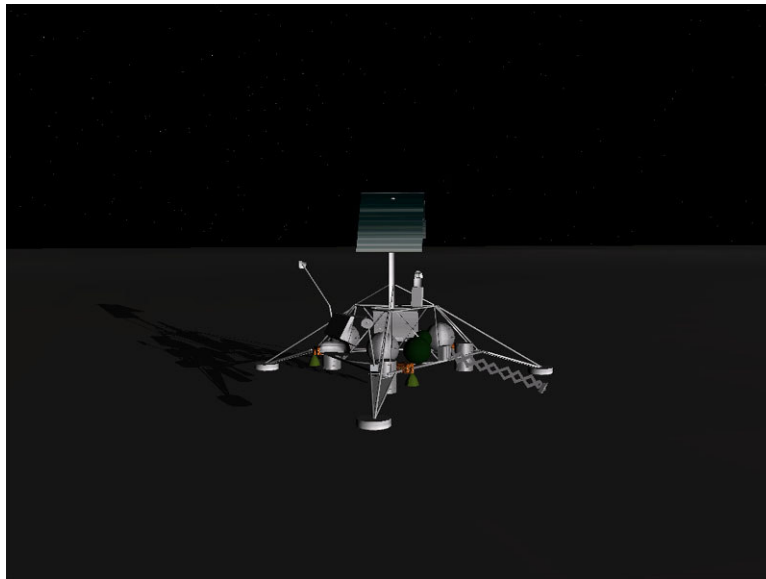


If you are doing a successful mid course correction, the MIN ALT will start to drop and the circle in the middle will start to get larger. When Encounter MFD shows you something like the example on the right, KILL thrust. The green line is your trajectory, and the circle is the Moon. In the example on the left, you are on a direct flight path to the Moon!

C) As mentioned, the best way to see how well you did is by pulling up the Encounter MFD or TransX (in Encounter mode). TransX is included in the latest version of Orbiter. You may download a copy of Encounter MFD from Duncan Sharpe's website <http://www.orbitermars.co.uk/>

Refer to the documentation for TransX or Encounter MFD for information on the usage of these utilities.

D) If on the rare chance you should find yourself overshooting the Moon after Centuri burnout, you can turn the spacecraft RETROGRADE (press “[”) and burn your Surveyor retro engine for a few seconds to bring you closer. If you come up a little short, then fire the Surveyors engine while flying PROGRADE.



8b. LANDING SURVEYOR

Landing Surveyor is the challenge. As each flight is unique, there is really no clear cut way to make a tutorial to land. Then best way to land is practice, practice, practice. It took me literally dozens of trips just to land it once successfully.

There is a scenario included that has the TLI burn and course correction burn already done for you. You are 3 days away from lunar landing. You can time accelerate to 10,000x and get there in less than 2 minutes if you wish. You can use this scenario to practice your landing skills. This scenario is pretty predictable, and you tend to land on the same spot each time. Once you have mastered this, then you can try your hand at a launch, TLI burn (which are automatically done with the flight profile), mid course correction, and landing. Of course, you can always try a full mission with your first attempt. The choice is yours.

While you are coasting to the Moon, you will notice that Surveyor is still in its stowed/coast configuration. You maintain this configuration during the entire coasting phase to the Moon. In this configuration, you have access to the main retro engine. In the real Surveyor, this was a solid fueled engine, but in this version, you can start/stop the engine on command. You can use this engine for your mid-course correction burn. Depending on your particular trajectory, usually only one 10-20 second mid course correction burn is all that is required to get your craft in striking trajectory. Sometimes two or more other burns are required, depending on how your flight did.

When you get within a reasonable distance, you will want to turn Surveyor 90 degrees, retro facing the surface. Bring up your SURFACE MFD and check your AIRSPD and VSPD indicators.



You want to bring down the AIRSPD to as near ZERO as possible as you descend using the retro engine. If your AIRSPD is too high, you will end up bouncing along the surface of the Moon when you land. Not good for your lander. Orbiter will eventually stop the craft bouncing along the surface, but in real life the lander would be destroyed.

VSPD is also important. This is your vertical speed. A negative number means you're descending, a positive value indicates your ascending. You will want to make this value small when you finally get near the surface.

Around 1-2 km above the surface, you can dump the retro engine by tapping the "J" key. This will also turn the stowed, cruising Surveyor configuration into its landing configuration. Now you use the vernier engines to slow your descent even further for a soft lunar surface touchdown.

WARNING: *Your vernier engines are powerful, but also have very limited fuel! (Less than 20 seconds worth) Use these engines ONLY when you are on your final descent to the surface.*

If your VSPD and AIRSPD are slow enough when you're about 50 feet from the surface, you can cut your verniers and let the lander slowly make a soft touchdown to the surface. If you have enough fuel for your vernier engines after landing, you can simulate the "hop on the surface" that NASA did with one of the Surveyor landers. Be careful though, the verniers are potent and you don't have much gravity on the Moon!

9. BUG REPORTS

Just drop me an email at webmaster@moonport.org and I'll take a peek. Make sure to give me the who, what, where, when, and hows when the problem occurred so I can try and replicate it.

10. CREDITS

- * Thanks go to Dr. Martin Schweiger for creating the best Space Flight simulator for the PC.
- * Tim Lutton, Surveyor, Atlas/Centuri meshes
- * Rob Conely for Earth 1962
- * Vinka for the Multistage.DLL

Enjoy!

- Jim Williams
- <http://www.moonport.org>