ORBITER
Space Flight Simulator
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Orion Version 1.2

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Thanks to:
Hendo and Daver, for the CVE-Lite code on which this is based, and for patiently answering far too many questions.
Daver, for the Trinity code, which isn't used directly, but some ideas moved to this add-on.
Hendo, for the parachute mesh, taken from the Soyuz-TMA project.
Rob Conley (estar) and the Gemini team, for the Gemini EVA astronaut.
Rodion, for the Gemini EVA astronaut mesh.

And, above all, many thanks go to Martin Schweiger, for actually developing the simulator I used to daydream about in astrodynamics classes!
http://www.orbitersim.com

Unpacking:

Use Winzip to put each subfolder in its matching Orbiter folder.
The von Braun Space Taxi (from my Colliers' add-on) is included in this file. It's okay to overwrite it.
Rodion's Gemini astronaut mesh is also included, and will overwrite the older gem-eva.msh included with your stock Gemini add-on, if you haven't already upgraded to Rodion's mesh.

Introduction:

Welcome to the Orion 1.2 add-on! This is a faithful attempt to model the 10-meter and 20-meter Orion concepts from NASA studies circa 1965, shortly before the study program was ended. I'll discuss nuclear pulse propulsion a bit more at the end in the Notes, but the short short version: yes, they were serious, and yes, it could work.
For now, what you need to know is this: this add-on includes TWO Orion spacecraft (the 10-meter and 20-meter model), PLUS an auxiliary landing craft (the Ford Aeroneutronic Mars lander). The 10-meter model is a capable Mars craft; the 20-meter model can reasonably go to Saturn and back. They are, after all, fusion-powered spacecraft; think of them as a bit like Vespucci but with a lot more flash and noise, and a '60's-retro feel.

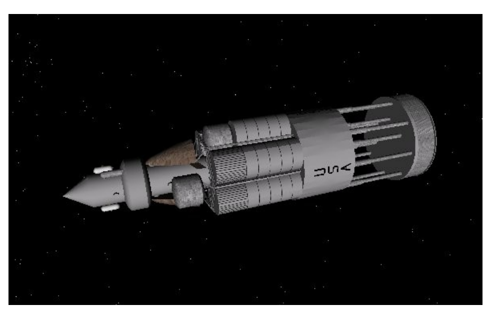
What's New:

Changes from Version 1.1 are minor; the changes have been mostly bug fixes and adaptations to Orbiter 2006. The docking-port management keys are gone, since Orbiter 2006 core functionality will now handle multiple docking ports. The starting time of the earth-orbiting scenarios has been adjusted slightly so that the scenario doesn't start in darkness. Saturn scenarios have been added for the 20-meter Orion.

Orion Operation:

"God was knocking, and he wanted in *bad*"
<u>Footfall</u>, Larry Niven & Jerry Pournelle

The 10-meter and 20-meter Orions operate in a very similar manner, though of course the specifics (size, mass, efficiency, payloads) change considerably between the versions.



You start in orbit. Orions were conceived to operate in pairs for mutual support, so there's an identical ship a kilometer or two away. I've varied the payloads on each ship; you can select whatever loadout you like. Orion vehicles were reusable, and payloads would change dramatically for different missions. The use of CVE-Lite custom payload extensions allows you to do the custom outfitting yourself, in the scenario file.

Fly the spacecraft to your chosen destination using the navigation MFD of your choice. You can either hop back and forth between ships, or just fly one and quit, then edit it back into the scenario file when you reach your destination. Or bag the mutual-support idea entirely. Whatever you like.

Keys:

J - Jettison the next payload in line.
E - EVA in a Gemini-surplus suit (see EVA section)

Docking Ports
Port 0 is on the nose of the spacecraft
Port 1 is on the front right side of the spacecraft
Port 2 is on the front left side of the spacecraft
Port 3 is on the top of the spacecraft (just behind the hab module)
Port 4 is on the bottom of the spacecraft (just behind the hab module)
Port 5 is on the right of the spacecraft, just behind ports 3 + 4
Port 6 is on the left of the spacecraft, just behind ports 3 + 4

Thrusting – To engage the Orion's propulsion system, simply move the throttle past ¼ deflection (joystick, or CTL-+). Enjoy the sound and lights. Normally, moving the throttle will vary the thrust in Orbiter (at least for one clock cycle, before the program could fix it for you). To combat this, the Orion drive is a user-programmable thruster that just checks the position of your throttle. Thus, the throttle doesn't actuate your thruster directly in the conventional manner; instead, it sets in motion a single bomb event, which takes about a second and a half to conclude. If the throttle is moved back below ¼ deflection in that time, no more bombs will be dispensed. If it is, thrusting will continue. One disadvantage of this system is that the main thruster's acceleration value will NOT be displayed in the upper left of the HUD, as is conventional.

Thrust Vectoring – Simply by ejecting and detonating the bombs off-center, an Orion could vector its thrust and turn. This also has the effect of damping angular momentum, as a bomb ejected while rotating will tend to turn the vehicle in the opposite direction. These two thrust-vectoring effects are modeled in this add-on using the normal controls. Of course, you only get to change your thrust-vectoring inputs once per bomb cycle....

RCS – With the high efficiency of the main drive, and the high mass of the Orion spacecraft, a conventional chemical-rocket RCS would require a comparatively large amount of fuel. To cut down on this, the rotational thrusters are replaced with gyros or momentum wheels, which expend no fuel but use electricity to slowly pivot the entire ship. This is modeled in Orbiter as very-efficient thrusters, with the sound turned off. (Momentum wheels still need conventional RCS to de-spin occasionally, so some fuel is still consumed, and when you run out, you're done.) Translational thrusters are conventional chemical thrusters, feeding from a second tank. Use it sparingly, as a lot of fuel goes only a little way! Also, you'd like to be able to transfer that fuel to landers, etc.

Fuel – The first tank is atomic bombs; the second is chemical propulsion. The Orion feeds from the first, the RCS from the second. Using FuelMFD to transfer between the two, or to on/offlload atomic bombs into auxiliary craft, is flat-out cheating.

Safety Zone – An operating Orion drive is obviously a bit dangerous to be around too closely. Actually, this is true of most any rocket, and in direct proportion to how useful a rocket it is. Since an Orion is really efficient and really powerful, it is really really useful, and that makes it a really really bad neighbor.

The 10-meter model has a 1200-meter safety zone.

The 20-meter Orion has a 2000-meter safety zone.

Inside the safety zone, bad things will happen. Except, that is, to any vehicle protected by an Orion pusher plate, within a 45-degree cone of protection. So your docked vehicles won't be scraped off by your own explosions, for example.

Inside the safety zone, and not protected by a pusher plate, one detonation will heavily damage a vehicle. This is simulated by setting the fuel state to ZERO. The craft survives; you can rescue the survivors with the offending Orion.

Provided, that is, that you don't hit it again. A second hit, or the first hit on any vehicle with no fuel, OR any hit within HALF the safety zone, will destroy any unprotected vehicle. This is done by setting its state to "landed"; with no fuel, you're stranded on the nearest planetary surface. The target vehicle is not actually destroyed because it causes problems with the API when two Orions are operating and the number of scenario objects is decremented.

The purpose of all this is simply to make you aware of the clearance zones around your spacecraft. It came about after I successfully used an Orion main drive to rendezvous with the ISS; I want to prevent antisocial behavior like that.

Artificial Gravity – To combat the effects of zero-G on the Orion's interplanetary flights, the ship was designed to spin, end-over-end, like a tomahawk speeding towards a target. This meant that the nose of the ship would be "down", the exact opposite of the situation during boost, so the interior had to be laid out in an interesting fashion.

Carried Payloads – CVE-Lite is used to carry the many and varied payloads to the planets, strapped to the spine of an Orion. One key difference from most CVE-L implementations is that the Orions force a rotation to the jettisoned payload, so that (for example) the landers stow the right way and don't jump when you jettison them.

In the default scenarios, the landers are placed right next to docking ports 3 and 4. Jettisoning them will "unstow" them and allow you to transfer to them and use or undock them normally. Landers stowed elsewhere will float free like all the other payloads will.

If you have an oversized or additional hab module (the second vehicle in both default scenarios), it should be specified last in the jettison sequence. Be careful not to jettison these! They should remain attached, but there's no good way to do this in the program.

See the **Payloads** section for more info about defining the CVE-Lite payloads for the Orion.

Between the Orion's thrust vectoring, the "free" RCS, and the CVE-Lite for carrying payloads until they are needed, it is relatively easy to carry payloads to and from the planets, even asymmetrically. The so-called "docking bug" is not much of a problem.

An Orion has three main parts. Moving from aft to front, they are:

Propulsion module – Has the massive pusher plate, and two stages of shock absorbers. The rings just in front of the plate would compess, and then of course the large shock absorbers would take the rest of the impact and spread it out into a usable push. Just in front of the shock absorbers is the bomb dispenser and the bomb-storage area.

Magazine storage – Additional "fuel" in the form of bombs, in six stacks spaced around a central spine. When not boosting, these would be transported to the propulsion module to be more immediately ready. The empty magazine could then be ejected. Some payload storage can be traded off against magazine storage in this area.

Personnel area – The spine continues into the main habitation area. Docking ports and payload stowage are obviously visible, attached to the spine. A large pressurized hab module dominates this section, looking like a marshmallow on a stick. Above the hab is the command section. This section is heavily shielded, with a thick radiation shield at the back, where it joins the hab. There are no hatches in this aft shield; two side tunnels provide access from the hab to the command section. During boost and solar flares, the entire crew will muster in the command section due to the radiation shielding. The command section can be jettisoned in an emergency, but this is not modeled for Orbiter.

These three sections would be launched separately and assembled in orbit, after which they would remain as a more-or-less permanent unit. Each section of the 10-meter Orion would be a manageable payload for a Saturn V; the chief problem with the 20-meter vehicle is that it requires a much larger launcher.

An alternative launch profile is "lofting"; the entire 10-meter Orion is stacked atop a Saturn V S-IC first stage, and lofted on a suborbital trajectory. Near apogee at 200 km altitude, the Orion would use its drive to boost to a circular orbit. This has obvious problems; additionally, a second Saturn V launch would probably be needed to replenish the bombs and add the payloads.

Ground-launched Orions were studied much earlier in the program, but not for NASA. The NASA-study Orions had no aerodynamic fairing, and a thrust/weight a bit less than ideal, and other problems that precluded launching directly from the ground. It will still work in Orbiter, though, if you want to try for fun.

Sorry, but launching the Orion is not really possible with any included scenario or booster.

Aeroneutronic Lander Operation:

Yes, once upon a time, Ford had a very active aerospace division with the name of "Ford Aeroneutronic". For the circa-1963 EMPIRE studies, Aeroneutronic designed the first, almost-modern Mars lander design. Since the Orion studies came shortly after this, the Aeroneutronic lander featured prominently, as a useful chemical-fueled lander. Orions can do a lot, but aren't so good for landing! Though designed for Mars, the Aeroneutronic lander is also useful for the missions of the 20-meter vehicle, because it can also land on Ganymede, Callisto, and the other large moons of the outer system.

The Aeroneutronic lander was a lifting-body design which landed on its tail; a parachute helped with the problematic transition from forward to tail-first-downward flight.

The design was not without its problems; specifically, it predated the Mariner 4 detailed measurements of the Martian atmosphere, and so overestimated the density of the atmosphere. To make the lander usable with Orbiter, it has been partially redesigned with bigger thrusters and a bigger parachute. Even so, it is not an easy-handling Mars lander.

Keys:

- **G** – Cycle the landing gear
- **K** – Extend/retract the airlock from the lower hull
- **O** – Toggle the nose rotation
- **E** – EVA from the ship
- **J** – Jettison stage
- **C** – Chute.
  - The first "C" will deploy the parachute from the top of the lander.
  - The second "C" will cut the attach point at the top of the lander, but not the one on the nose. The craft will be suspended beneath the parachute by its nose instead.
  - The third "C" will jettison the parachute. There's only one. Use it wisely.

<u>Docking Ports</u>

Dock 0 is the front dock (it's the front side port or, if the nose is rotated, it's right in front)

Dock 1 is the aft dock (the aft dock is right where the airlock is, and really has no use with the Orion. I included it only because other studies do have Aeroneutronic landers docked by their tails)

To employ the Aeroneutronic lander on Mars, fly a lifting re-entry. Be careful of your poor L/D and poor control effectiveness. You want to end up near your destination at Mach 5 and moderate altitude.

Pull up to establish a vector away from the ground. Deploy the parachute with "C". You may want to damp the oscillations with the KILLROT function of your RCS.

Once you're heading downhill, shift to tail-first with "C" again.

You're pointing against your vector now, to you can use the thruster to brake your forward motion. You'll need to, as unfortunately Mars' atmosphere won't do it all for you. Brake as required, then slow your downward motion as you prepare to land.

Deploy the gear. Jettison the parachute; it's not helping you much now. If you turned off the RCS for re-entry, turn it on now! Point up and stay pointed up.

Land. Whew!

When it's time to leave, hit "J". You won't move, but now you're flying the upper stage, and you can lift off with the thruster at your leisure.

The upper stage is actually a stage-and-a-half vehicle; partway to orbit, you'll drop a pair of drop tanks.

To employ the Aeroneutronic lander on a large moon like Callisto, you needn't bother with the parachute, of course. But you have a problem; propulsively braking requires more fuel than an aerodynamic one! What to do?

Fortunately, the Aeroneutronic lander will let you “borrow against” future fuel needs. That is, once the fuel in the lower stage is exhausted, it is not automatically jettisoned. You'll need it for its landing gear, after all. Instead, the plumbing is switched so that the thruster is now drawing from the drop tanks belonging to the upper stage. The thruster drops off-line when this happens, so try not to let it kill all your thrust at an inconvenient moment, or else be ready to catch it when it does.

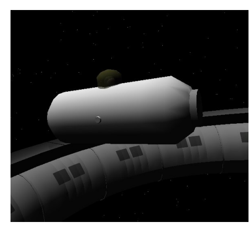
You'll have less fuel for the ascent with this system, but Callisto is smaller than Mars; you NEED less fuel for the ascent. Convenient, eh? If you exhaust the drop tank fuel also, you need to jettison and return to orbit; you can't land on the final fuel tank.

For moons that are smaller yet, save the lower stage and re-fuel once you return to the Orion; you now have a refuelable, reusable chemical lander.

The Airlock extends down to the ground to allow you to EVA from there when on the surface.

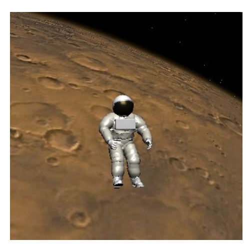
The folding nose is entirely my invention; I thought it would be useful to be able to dock to, move, and even land exterior payloads, on smaller airless worlds. You would not, of course, try this on Mars, but there's no internal logic preventing you from trying.

Space Taxi Operation:



The Space Taxi looks like a spacegoing propane tank, and this is a good indication of its level of complexity. It's simple and rugged. The Space Taxi is of course a refugee from the World of Colliers add-on; Orion studies featured a couple of them to enable personnel transfer between the Orion vehicles during interplanetary flight. I've added a second docking port, near the nose and pointing “down”.

Space Suit (EVA) Operation:



Since the studies were in the Gemini era, a Gemini suit seemed most appropriate.

An EVA suit is spawned by hitting the “E” key on an Orion or Aeroneutronic lander. Once it's spawned, there's no easy way of destroying it, so you're stuck with it.

To walk around on a planetary surface, controls are the same as NASSP.

1 turns you left
2 walks backwards
3 turns you right
4 walks to the left
6 walks to the right
8 walks forward

Since the Orion requires a Gemini suit without a tether and with the ability to walk around on the surface, I appropriated the one I made for my not-yet-released Lunar Gemini project.

Payloads:

“'Making eight kps relative, Cohortarch,' Fermore said. 'Twelve hundred seconds of burn to go; then a quick whip-round and it's a month to Mars.' Minimum-burn, for pulsedrives.”
The Stone Dogs, S.M. Stirling

Most CVE-Lite payloads have the same facing as the mother ship when jettisoned. This makes sense for most rockets, but some changes were needed for the Orion. Since the Orion's payloads hang radially about the ship's spine, it became necessary to force a rotation of some jettisoned payloads for everything to work right.

First, we need the mesh to display properly before jettison. Since the meshes are added to the ship at this time, they HAVE TO face exactly the same way as the ship. So, we need a mesh that is rotated properly. The file convention here is, where AeroneuAll.MSH is the default mesh, AeroneuAll_180.MSH is the same mesh rotated 180 degrees about the Z-axis (shipedit will serve to make more meshes if you need). We will reference this upside-down (or whatever) mesh for display, then, when we jettison the vessel, it will create an instance of the jettisoned vessel, which of course is NOT upside down. This will require us to rotate the mesh about the Z-axis....

To accomplish this rotation, the Orion includes a jettison routine that looks at the newly jettisoned payload, checks the class name, and forces a rotation about the Z-axis when applicable.

If the class name starts with “zrot” the routine will force a rotation around the Z-axis. The position relative to the ship's spine will be checked, and the amount of rotation applied will turn the jettisoned vessel's +Y axis pointing towards the spine (“head-in”).

If the class name starts with “zrot180” the routine will operate in the same way, but will then add an additional 180 degrees of turn about the Z-axis, so as to point “head-out”.

If the class name does not start with either of these key words, the payload string will work exactly as any other CVE-Lite payload string.

I've put together a few odds and ends you might carry along with you in your journeys with the Orion. The sample scenarios use them all; examine them for more insight.

vbSpaceTaxi – The von Braun Space Taxi should be loaded in the payload list at the bottom, so that it jettisons first. This is because it gets used in interplanetary flight, for personnel exchange between the ships of the expedition. The Space Taxi, unlike the lander, needs to rotate heads-away from the ship, to keep the bubble from being inside the ship. vbSpaceTaxi_180 is a 180-degree rotated mesh to allow this.

Aeroneutronic Lander – The lander is the reason there is a Z-rotation routine built into the Orions; it wouldn't do to have the lander #2 (on the -Y side) appear upside-down when you jettison it! To display properly before jettison, the CVE list needs to reference a mesh that is rotated 180 degrees; hence AeroneuAll is the mesh for the Aeroneutronic lander, and AeroneuAll_180 is the same but upside-down. AeroneuAll_90 and AeroneuAll_270 are for additional placement on the “sides” of the ship (used on the 20-meter vessel).

OrMPL – A generalized “mission payload” for the Orion. Basically a tin can full of stuff you'll need when you get to destination. Mass may vary; I've used 10500 KG. Each OrMPL has a docking port at each end so you can move it around with a vbSpaceTaxi or an Aeroneutronic Lander.

OrMPL20 – The same, but designed on a larger scale for the use of the 20-meter Orions. A 20-meter vehicle could use an OrMPL intended for the 10-meter vehicle, but not vice-versa; it would stick out of any payload fairing and might not be protected by the pusher plate.

8ManHab – A duplicate of the hab module on the 10-meter Orion. You can stack more ahead or behind the existing one.

20ManHab – A duplicate of the hab module on the 20-meter Orion. Stack more ahead or behind. Additionally, with a 10-meter vehicle, you can “replace” the 8-man hab with a 20-man one by covering up the existing hab with the larger one.

Notes:

"Someone said, "Here we lie, waiting for an atom bomb to go off under our asses--'
'There has to be a more graceful way to say that.'"
Footfall, Larry Niven & Jerry Pournelle

Perhaps the most frustrating thing – in physics, in energy policy, and in space propulsion – is that even after decades of work, we still can't generate a proper fusion reaction. Paradoxically, we have also been able to generate fusion reactions at will that whole time. Trouble is, the only fusion reactions we know how to make are not self-sustaining and come in an inconveniently large minimum size, and have a few other problems. We call them "H-bombs".

Starting around 1958, the staff at General Atomics in San Diego decided to work with the fusion reactions we could make. Their studies, first done for the Atomic Energy Agency, later the USAF, and finally NASA, remain the definitive look at nuclear pulse propulsion.

Harnessing propulsion force in pulses rather than a continuous push has a long history. Your automobile does it, in a sense. So does any firearm or artillery piece. In fact, pulsed propulsion has a longer history than does the continuous kind. The temperature problems tend to be less, for example; (pulsed) piston engines were available long before (continuous-burning) gas turbines, entirely due to the need for high-temperature metals in turbines.

The General Atomics studies looked first at detonating an atomic bomb inside a thrust chamber and ahead of a nozzle. This would trap all the bomb's power into rocket thrust, in a pulsed mode. Unfortunately, to avoid melting the thrust chamber, it would have to be extremely large.

Instead, external detonation was examined, with the thrust generated with a pusher plate. With shaped charges, much of the energy could still be captured, even though the pusher plate subtends a small arc as seen from the bomb.

The temperature excursions of the pusher plate would be surprisingly mild; coating the plate with a thin layer of water or grease (which would vaporize with each shot) would protect it entirely.

The result was a propulsion system of high efficiency and high thrust; 2 G's acceleration and 4800 seconds Isp were projected for the 20-meter vehicle. The 10-meter vehicle required smaller bombs which were by nature less efficient by mass; "only" 2400 seconds Isp was expected.

The 10-meter vehicle thus has enough delta-V to go to Mars and back comfortably, spending quite a bit to "accelerate" the trajectory and spend only 90 days or so in transit.

The 20-meter vehicle can go to Jupiter or Saturn, also on a faster-than-Hohmann transfer.

One question frequently asked of Orion is, "would it work"? Almost certainly. A sub-scale test model (propelled by chemical explosions) flew successfully. Certainly the General Atomics and Los Alamos bomb designers, who knew far more about nuclear bomb designs than the author, thought it could be made to work.

To be sure, there were challenges. One test would have had an entire Orion propulsion module upside-down, with a mechanism chucking 17000-lb discs of plastic explosive onto the pusher plate every second to test the structure and shock-absorption mechanism. Later tests would have to be performed in space, and the vehicle somehow recovered for analysis.

The biggest problems, of course, are the obvious ones relating to the use of nuclear bombs. It became illegal by treaty, though perhaps we could imagine an exception could be made. (But only if we we also imagine a Soviet Orion counter-project, perhaps). It would release radiation, but (assuming Orions are launched to orbit before starting) not very much. Improved bombs that used no fission trigger were postulated; if these could be developed, the radiation would be just about zero. Such bombs have not yet been developed even today, but that might just be because there was never a need, nor money spent on such a project.

EMP would be a bigger problem. At the time Orion was proposed, satellites would be few and far between; today, an operating Orion in LEO could cause billions of dollars in damage. A low-EMP bomb might (or might not) be possible, but is certainly not off-the-shelf!

It's safest to say that Orion was a creature of its time. Born when cars had tailfins but no seat belts, its time has gone. Until, at least, we can invent a less offensive way of generating fusion micro-pulses.

Finally, lest anyone complain about the nature of the propulsion system, let me point out two things: first, atom bombs used for propulsion are obviously NOT available to be used for more harmful purposes. And second, to paraphrase a fine signature line, “No atoms were split in the making of this add-on, but a number of electrons were greatly inconvenienced.”

Enjoy.

Programming notes:

“WHAM
WHAM
WHAM
quiet
'It sure sounds good in theory,' Tiny Pelz said.
'What does?' Franklin demanded.
'Firing bombs off center to compensate for rotation. Sure sounds good in theory.'”
Footfall, Larry Niven & Jerry Pournelle

The included code has parts that should be useful for ANY project that requires a pulsing thrust animation – from Orions to M2P2 to (BIS Daedalus) laser-fusion, to mass-drivers.

Slamcycle() drives the pusher plate animation and the changes the exhaust each cycle.

Vectorthrust() is the thrust-vectoring routine, WITH a term that damps out existing angular velocity. I liked it so much I kept it for the Aeroneutronic lander.

DestroyNeighbors() is just for anti-social drives like Orion; your mass-driver project can skip this one. ANY vehicle whose classname starts with “Orion” gets the benefit here of a protective pusher plate, so it's important for future Orion add-ons to begin with “Orion” if they're to interact properly. This routine searches for nearby vehicles and, if they're not shadowed by your own pusher plate or their own (if and only if they're an Orion), it will put the thump on 'em.

The payload-rotation magic is all handled in the keyboard handler routine for key J.

Things I tried that didn't work:

An Orion drive has a sinusoidal thrust profile; riding one is a lot like riding on a child's swing. For this simulation, thrust is constant. While there WAS code to vary the thrust level within Slamcycle(), I dropped it because it didn't work consistently at higher time compressions. So the thrust level is just at the calculated RMS average G-value...and it's hard to even notice the difference.

I tried jiggling the ship a little bit with the force of each explosion. Unfortunately, I couldn't consistently get the ship back to about the same heading and kill the velocity, and any residuals were really annoying. And it got much worse with time compression.

I wanted a joystick throttle to work as an on/off lever for the Orion. The throttle drives THGROUP_MAIN directly, but of course it will yield intermediate values for intermediate settings. Orions are very much on/off binary devices! While I could (and did) set the throttle to max each time cycle, there was always an annoying delay; moving the throttle around could still vary the thrust level, a little. By making the Orion a part of THGROUP_USER and just comparing to THGROUP_MAIN, I was able to get a drive that behaved the way I wanted.

I originally considered spawning an instance of Daver's Trinity (a nuke) and then moving the ship based on the position of any nearby detonating nukes. I bashed my head against a table until the idea went away, though. Setting interior thrust levels, even highly modified, is a MUCH simpler and more elegant way of solving the problem.

I had originally planned on adding a nuke animation, which is quickly ejected just before the detonation and flies to the detonation point. It wouldn't be too hard to add, but there's enough happening visually anyway that it just seems unnecessary at this point.

Known issues:

You can jettison a hab. Of course it really should be hard-welded to the hull.

Habs can cover docking ports, but the docking ports are still operable underneath.

The 90 and 270-degree-rotated landers of the 20m Orion don't lock straight to docking ports, so they drift forward...through the hab. Then, they'll dock to ports 1 + 2 – spinning around tailfirst in the process. Move the landers or rotate the Orion slightly during this process to prevent this.

The Gemini astronaut jumps a bit when spawned on the ground. I'm working on it.

The scenario dates are just absurd. The 1965 NASA Orion studies contemplated no flights before about 1975. Still, the original rallying cry of the Orion team was, “Saturn by 1968!” I just HAD to try to honor that. So, the Orions are ripped right from their study reports and placed in orbit almost at publication date, as if there was nothing more to it than that.

This doc is too long. That I don't ever expect to fix.

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The indispensable Astronautix.com http://www.astronautix.com/lvfam/orion.htm
Gorgeous pics, indispensable links page, and the guy even calls himself Sputnik! (Not me)
http://www.angelfire.com/stars2/projectorion/
Another site, both gorgeous and informative: Nuclearspace.com
http://www.nuclearspace.com/

Other media:

Part Time Models: http://www.up-ship.com/ptm/ptm1.htm
You can bet I'll be in line for a 10-meter Orion model!

Version history:

v1.2
- Revised directory structure for Orbiter 2006.
- Deleted docking port management (CTL-D) code since Orbiter 2006 does this
- Added Saturn scenarios.

v1.12
- Bug fix: RCS ceased operation when using tank fuel operating in keep-the-first-stage mode.

v1.11
- Bug fix: loaded CVEL payloads properly when launched as CVEL payload

v1.1
- Added specularity to meshes
- Revised Aeroneutronic lander for Orbiter 2005 – a bug in Orbiter caused a crash whenever a mesh (the drop tank) was added twice. Took the opportunity to substantially revise the Aeroneutronic lander code.

v1.01
- Minor bugfix – included OrMPL's with docking ports in the release file
- Included the LGPL and CVE-Lite docs – accidentally left out. Moved this doc in that folder
- Also took the opportunity to rename Landers 1-4 in honor of Lewis + Clark expedition members
- Added online sites to bibliography

v1.0
- Payload rotation based on class, not name
- Stock CVE-Lite codes behave normally now
- zrot and zrot180 .CFG's added to support new payload rotation routine
- Gemini EVA code modified so as to be less likely to jump around
- Gemini EVA scheme changed so as not to overwrite stock Gemini files (except mesh)
- Lander staging wasn't reliably transferring fuel depletion level on faster machines – fixed
- CheckCentralMessage() missing from 10m vehicle – fixed
- Aeroneutronic lander retextured with a better aft end
- Extraneous payload meshes removed from 20-meter magazine section
- Docking ports added to mission payloads and to lander aft end
- Gear sound added to lander

v0.9
- Payload rotation about the Z-axis on jettison
- Documentation added!
- Converted to CVE-Lite
- Aeroneutronic lander – improved aero, parachute, working fuel management
- Scenarios fixed

v0.1
- Most Orion functionality, under CVE (not Lite)
- Payloads don't rotate on jettison, so second lander appears upside-down
- Aeroneutronic lander doesn't work
- Beta