Unity

Created by Eric Winchester aka eveningsky339

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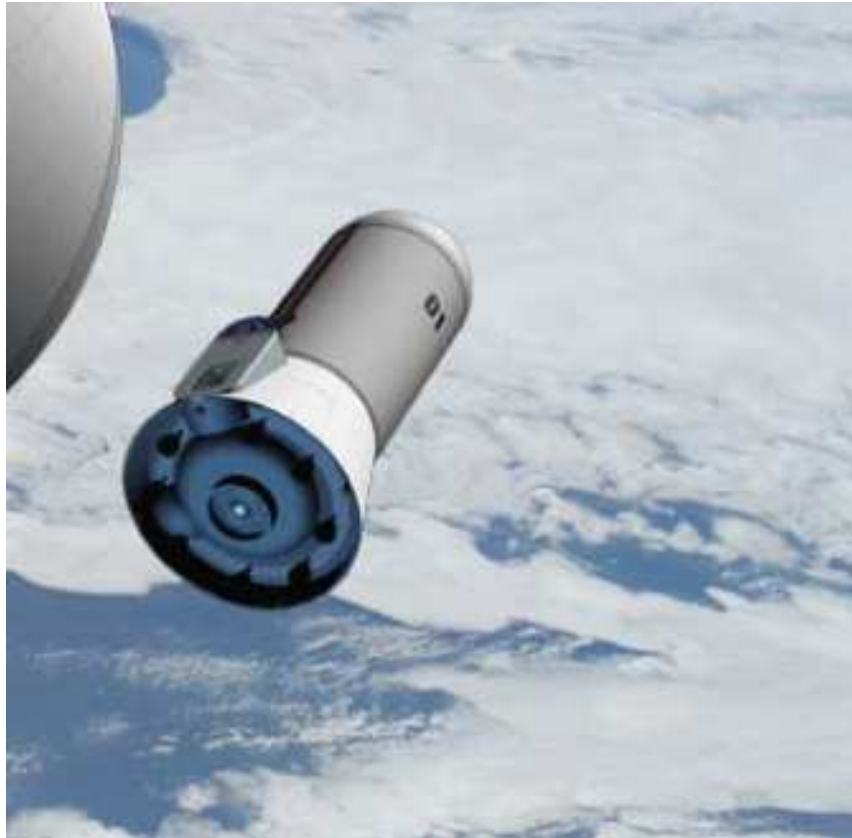
Required Add-ons

Velcro Rockets by Sputnik

- http://orbithangar.com/searchid.php?ID=3388

Introduction
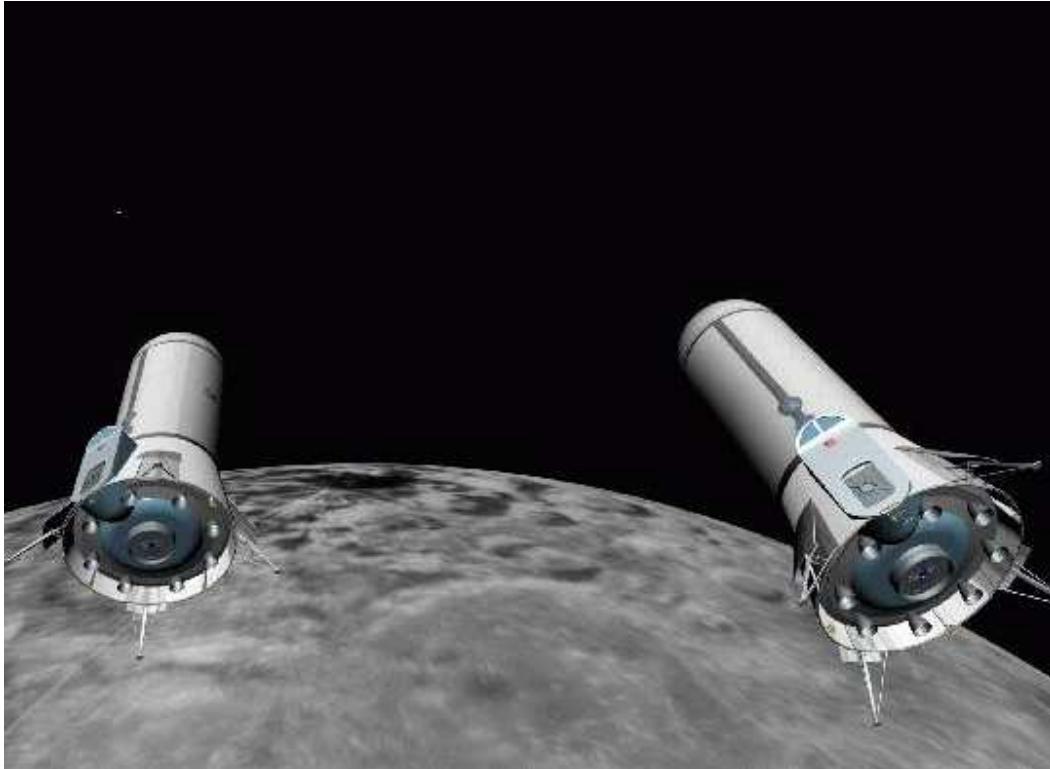
The Unity is a spacecraft loosely based on t/space's proposal for lunar exploration, the Spiral CEV. The spacecraft is direct-to-surface; there is no need for a separate lunar lander or for a lunar orbital insertion. Since this approach requires a significant amount of propellant, a separate Tanker with a capacity for over 50,000 kg of fuel is launched before the Unity. Before heading back home, the Unity refuels at the Tanker in order to have enough delta-v to make the trip. The Unity returns to LEO via an aerobraking maneuver, which the Tanker also utilizes to return home when it is low on fuel. The Unity raises its perigee and awaits an LEO spacecraft to pick up the crew, the tanker waits for an LEO spacecraft to fill it up before it heads back to lunar orbit. Both spacecraft are 100% reusable.

Acknowledgements

Thanks to all the members of orbiter-forum.com for patiently answering my questions regarding C++ and .dlls.

Thanks to sputnik for his Bristol Ascender code, which I have used for the custom HUD. He is also the creator of Velcro Rockets, which I have utilized for the launch of the tanker.

Thanks to Dan for his UMMU.

And of course thanks to Martin Schweiger for the amazing Orbiter spaceflight simulator!

The Ships

1. Unity

Unity is a lunar spacecraft which can hold 28,000 kg of LH2/LOX propellant. It also has enough living space for six crew/passengers to comfortably work and rest during the four-day trip to the moon.

The Unity is unlike t/space's Spiral CEV in one major respect. It has fixed landing gear as opposed to retractable landing gear. The Spiral's gear looks

awfully flimsy, so I included the fixed gear in order to give a stronger illusion of safety. That way the passengers won't complain.

The Unity has eight engines, so clearing LEO efficiently won't be a problem, even with the incredibly high gross weight. These same engines for the direct descent to the landing site (Sinus Roris). I am aware that since I have not included hover engines, this add-on is not compatible with Land MFD by lazyD. But have no fear, Lola MFD by the same author will do the trick.

Instead of using an obscene amount of propellant to brake back into Earth orbit, the Unity is designed for aerobraking.

A custom HUD is included. To the left of the screen is a G-meter which comes in handy when you are aerobraking. To the right is a radio altimeter, which accurately displays your altitude when below 2500 meters. It comes in handy when landing.

2. Tanker

The Tanker is basically a Unity with no hab area or landing legs. The space that would be taken up by a hab area is used to house a fuel tank that is twice as big as the Unity's. The Tanker holds a whopping 56,700 kilograms of LH2/LOX propellant.

The tanker has only four engines for longer and more efficient burns. In order to save propellant, it is tugged by a Delta III upper stage to a very high orbit with an apogee of about 36,000 kilometers.

When the tanker is low on fuel (15%), the remaining propellant is used to perform a TEI burn. The tanker aerobrakes back into LEO and sits in a parking orbit while LEO spacecraft launch to refill its tanks.

Controls

All the controls of the Unity are the same as the UMMU demo. Unity has six "seats" for the crew members.

S Display ummu information (# of souls on board and seats available)
A Open/Close the airlock (open by default)
E EVA from the spacecraft and return to spacecraft
1,2 Select crew member slot for EVA
ESC Eject
C Toggle ummu mesh

Important: Landing with a vertical speed greater than or equal to -8 m/s will kill your crew.

Overview of Operations

After the maiden flight of the Unity, the tanker is launched, tugged to geo-synchronous orbit to save fuel, and a TLI burn is performed. It inserts itself into orbit over Sinus Roris.

Meanwhile, the Unity's tanks are topped off and the crew loaded in LEO. The Unity performs a TLI burn and makes a direct descent to the landing site (Sinus Roris). After the crew spends some time happily hopping around, they load back into the Unity and ascend to the tanker. The tanker offloads enough fuel for the Earth return burn and course corrections.

The Unity undocks, performs the TEI burn, and then coasts back home. It returns to LEO via aerobraking maneuver in Earth's atmosphere. Afterwards, an LEO spacecraft (of your choice) comes and takes the crew back to the ground.

As time goes on, more Unity's are built and more tankers are launched to the Moon. At some point, two Unity's are sent to Sinus Roris. One purges itself of all remaining fuel, effectively becoming a 15-man lunar base. Lunar mining operations begin, producing propellant from the soil. More Unity's land and purge fuel, expanding the ad hoc lunar base. Soon ships are shuttling propellant up to the tankers, eliminating the need for tankers to return to LEO.

This forms a solid foundation for a long-term lunar colony on the moon.

Scenarios

1. Maiden Flight

You can't just hop into a spacecraft and fly around without testing it, now can you? This is a simple lunar flyby. Using the navigation program of your choice, perform a TLI burn and set your perilune to about 4000 kilometers. Be sure to take lots of pictures as you pass by for the folks back home. When the flyby is over and done with, make a course correction so that your perigee is about 45 km. Alternatively, use Aerobrake MFD to fine-tune your approach for the best apogee. Orient prograde for the aerobraking maneuver. Once you are back in space, raise your perigee above the atmosphere and wait for your pickup.

2. Tanker Launch

The Unity does not have enough fuel for a round trip to the Moon, even without the direct descent. Since most of your passengers have stated that they would like to come home rather than die on the lunar surface, a tanker must be launched before a manned trip can ensue. Simply press 'O' for the Nova's autopilot. When the main engines cut off, you should have about five percent fuel left. Orient prograde and burn until all your fuel is depleted. When that occurs, the tanker will jettison. A Delta III upper stage is acting as a space tug. Use it to set your apogee to about 36,000 kilometers. (It should already be about 30,000.)

Sit back and enjoy the coast up to apogee. When you get close, use the remaining propellant in the upper stage to raise the perigee as high as you can. You probably won't have enough to circularize, but don't worry about it.

Jettison the stage when it is no longer of any use. Then just use the navigation MFD of your choice for the TLI burn. Insert the tanker into a retrograde lunar orbit which passes over the landing site (Sinus Roris on the Map MFD.)

3. Unity Lunar Landing

It's time for the first manned mission to the surface of the moon since Apollo. Perform a TLI burn using the navigation MFD of your choice. As you get closer to the moon, adjust your trajectory so that it intersects the lunar surface near the landing site (Sinus Roris on Map MFD). When it's time for the direct descent, I recommend lazy D's Lola MFD to handle the landing for you.

Once you are safely on the ground, it's time for a moonwalk! Have fun hopping around.

When you are ready to head home, ascend to the tanker and take in a decent amount of fuel (17%) for the TEI burn and course corrections. Perform the burn, aerobrake, and then use the engines to raise your periapsis to a final parking orbit. Then wait for your ride home.

4. Unity Docked to ISS

The Unity is delivering supplies to the world's most famous space station.

5. Tanker Return to LEO

The tanker is low on fuel. Use the remaining propellant for a TEI burn and return to LEO via an aerobraking maneuver.

6. Lunar Base Resupply Run

Two Unity's have been purged of fuel and left at the landing site to act as a lunar base. After several weeks, it's time for a crew rotation. Take the Unity in LEO to the landing site and exchange crews.

7. Propellant Ferry Mission

The lunar base has expanded to include mining operations. Propellant is now mined from the soil, preventing the need for tankers to return to LEO for a refuel. A fully-fueled Unity is on staff as a propellant ferry. Ascend and rendezvous with Tanker #2, give it some fuel, and use your remaining propellant to return back to the base.

Known Bugs/Issues

- The G-meter on the HUD reads 0.90 when docked to the ISS. Not that you would need the HUD during a docking operation. I just thought I would point it out.

- The tanker's poor acceleration makes it incompatible with IMFD's autoburn function in LEO. However, it should work in the higher orbit detailed in the Tanker Launch scenario.

Developer's Notes
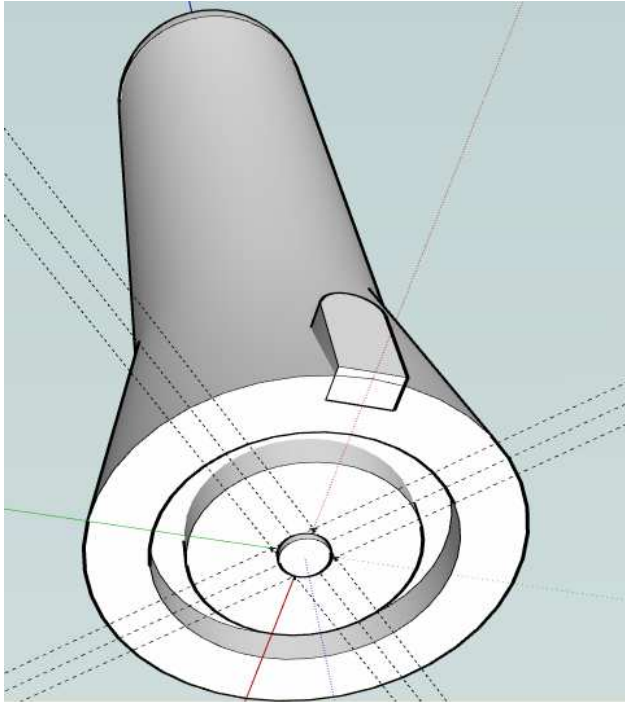
This has been quite a journey for me. Unity began as an ugly little cargo craft based on the Spacehab Apex in early October, when I decided to enter the world of add-on making.
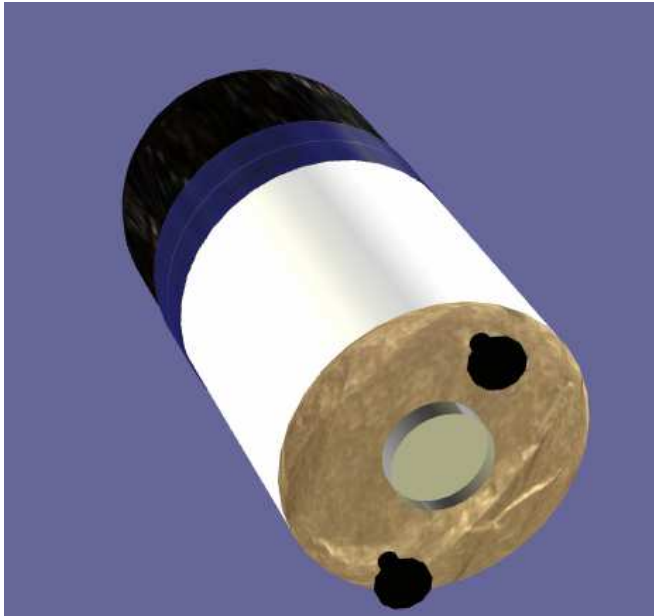
Hmm, the poor thing was hideous. Anyway, I had very little knowledge of anim8or and I was planning on simply making it a spacecraft3 vessel, like most beginning developers. Looking back, I realize that I would never have been able to upload the mesh and the textures properly with what little I knew about the Orbiter SDK.

As time went on, I decided to make some changes to the spacecraft to make it less atrocious.

Inflatable heat shield is much bigger now...

Still a face only a mother could love, but it was looking a little better.

I spent over a week trying to use my very limited knowledge of 3D modeling to make the Unity more bearable.
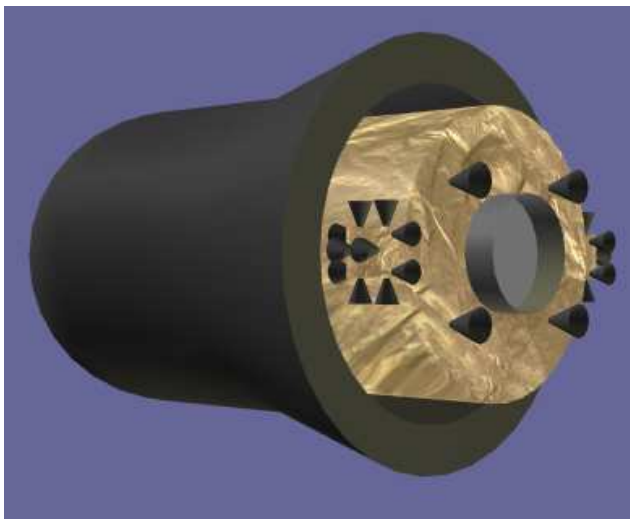
Deciding I would work on some better textures later (I didn't even know how to adjust/scale textures), I began the traumatizing process of scaling the mesh and putting it into Orbiter. I didn't know about the inherent flaw of the shipedit

program which removes the textures from the mesh file and I didn't even know that the mesh file was a text file at all. After several days of utter frustration, I decided to take a little break from the project.

In the meantime, I decided to learn C++ and write Unity its own .dll. I knew nothing of the various problems with Microsoft Visual Studio 2005 in terms of compiling with Orbiter and I knew little of C++. More frustration followed, and of course I still couldn't model worth a crap.

The dreaded "real life" intervened with some very stressful circumstances. I was forced to put Unity on the back burner for quite some time.

When mid-November rolled around, I had encountered t/space's Spiral 2 CEV proposal and I wanted to just start over. I gave up on anim8or and gave Google Sketchup a try. It was very easy to use, and soon I had a nice looking mesh ready to go. And then I found out that I needed the $600 version to export the mesh into a format other than sketchup. Oops.

I switched over to Blender and tried to model a new mesh using that program. Don't get me wrong, Blender is an excellent 3D modeling software, but I just couldn't get it.

It was now late November. I was obtaining a better grasp on C++ and learning how to actually use a compiler. It was with fear and trepidation that I returned to anim8or to redo the mesh, but by using Sketchup I had learned all sorts of new tricks. In an hour I had a perfectly functional mesh put together, compared to the weeks I had spent gutting out the little cargo ship when I first began.
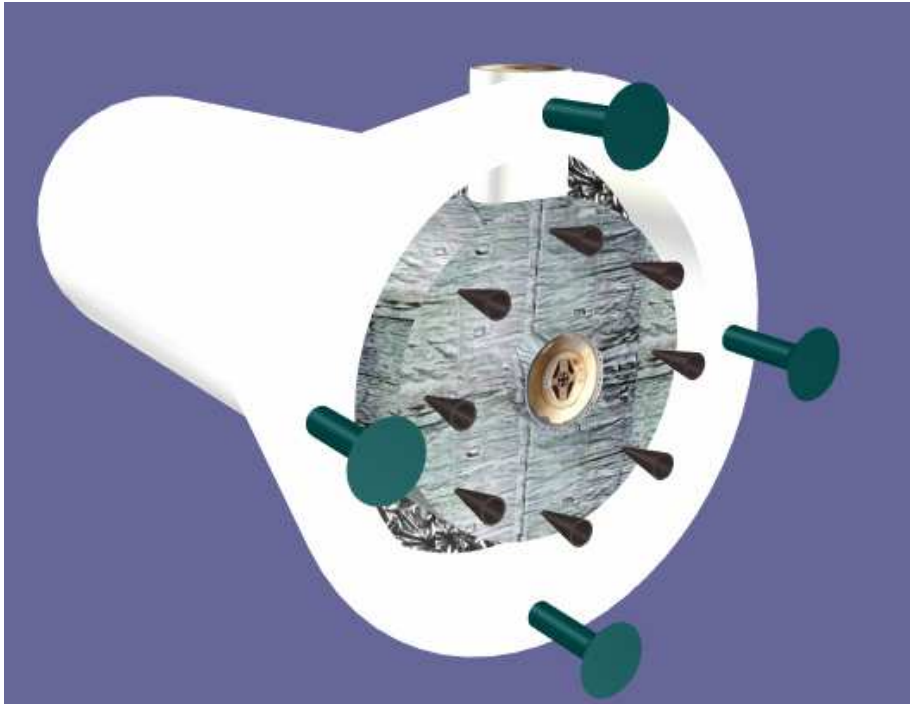
By constantly asking questions on orbiter-forum.com and sending a few PMs, I managed to iron out problems with the .dll and I soon I had a functional module put together. Over the course of a few weeks I implemented the UMMU support and the custom HUD.

From there, all that was left to do was debug the code, clean up the mesh a little, and write some scenarios and the documentation. Unity was uploaded to orbithangar.com on December 14, over two months after I began.

For my next project… well, you'll just have to wait and see, won't you?

-- Eric Winchester
Chattanooga, Tennessee, 12/13/08