DELTA V

An Orbiter Magazine

Welcome to the second edition of DeltaV.

We have had over 600 downloads from Orbiter Hanger alone for our first issue. This is a great result and I hope to top it with this release.

Many things have happened within the last year. Our add-on report should give you an update to what is happening in the Orbiter world. Orbiter ~~2008~~ 2009 is currently progressing through. There have been many reforms of the graphics engine that will expand the possibilities of Orbiter. With this it is entirely possible for DirectX 10 graphics. For those that don't know, there is both an OGLA engine and DX 9 engine in development.

Add-on-wise we have had the development and release of the XR2. I was privileged to be a beta tester for it. I immediately got the impression that this was a tight ship. The performance of the vessel was great, everything just felt right. We have an exclusive interview with the coder Doug Beachy (dbeachy1).

We have also had Greg Burch's Local Space Transport System rereleased. This includes new landers for his famous Space Station Building Blocks. The Space Shuttle Ultra is progressing well. The whole team is working to produce perhaps the most detailed space shuttle in Orbiter. They intend to reproduce as many systems and checklists as possible. They have built the Launch pads to detail never seen before. The shuttle systems will be replicated to the level of NASSP.

Well that is enough from me. Please enjoy this issue and if you can help with this project please contact me on Orbiter-Forum or Dan's Orbiter Forum.

TL8
DeltaV Editor

Don't Panic.

One Year Anniversary Report

On October 14, 2007, I purchased the domain, hosting account, and vBulletin software to create the newest community for ORBITER, Orbiter-Forum.com! From the beginning I pictured a forum that was reliable and full of features in which ORBITER users could share their experiences and teams could collaborate and communicate online about everything from general ORBITER discussions, to development, education, and off-topic discussions.

Before I established Orbiter-Forum, I already owned and administered another vBulletin forum for Formula 1 fans which I established one year before. With no previous experience in web design and development from HTML, PHP, to graphics design, I managed to teach myself everything I needed to know about vBulletin in order to administer a community. My first year with vBulletin was a lot of trial and error. By the time October 2007 rolled around I realized the ORBITER community was in need of a new forum. Since that time I and the entire staff have committed countless days, nights, and weekends to the design, development, and general maintenance of Orbiter-Forum which has become the Official forum for new ORBITER development used by Martin Schweiger and the entire beta team!

Looking back at the early days of Orbiter-Forum there were times I wondered just how popular the site would become. Looking at the site today it has exceeded all of my expectations! I am so proud and happy that I was able to give such a useful and much needed contribution to the ORBITER community. With the popularity of the community today we've had to move the site from a shared hosting account to a dedicated server at a drastic increase in monthly costs. Thanks to the generous members of Orbiter-Forum who were able to make donations through PayPal we have raise over $1,000 USD! I thank you all from the bottom of my heart for your support and for trusting us to keep the community going. We're in the process of bringing some sponsors onboard to ensure the long-term success of Orbiter-Forum in which we hope will secure the site financially for a long time to come.

After an amazing year at Orbiter-Forum I would like to thank all of our members who have not only donated, but also those who contribute to the discussions on the forum making everyday an exciting experience just visiting the forum to see what's been posted by who! Below I leave you with some site statistics both from our first month all the way to October 2008.

Most Sincerely,
Blake P. (Tex)
O-F Founder/Administrator

OCTOBER 2007 – Orbiter-Forum First Month Statistics:

Summary

Reported period	Month Oct 2007				
First visit	14 Oct 2007 - 04:04				
Last visit	31 Oct 2007 - 23:59				
	Unique visitors	Number of visits	Pages	Hits	Bandwidth
Traffic viewed *	619	2251 (3.63 visits/visitor)	45557 (20.23 Pages/Visit)	264899 (117.68 Hits/Visit)	1.93 GB (897.86 KB/Visit)
Traffic not viewed *			3479	5663	21.77 MB

* Not viewed traffic includes traffic generated by robots, worms, or replies with special HTTP status codes.

New Member Registration Statistics:

61 New Members Joined between October 14, 2007 to November 14, 2007
21 New Members Joined between November 14, 2007 to December 14, 2007
21 New Members Joined between December 14, 2007 to January 14, 2008
61 New Members Joined between January 14, 2008 to February 14, 2008
82 New Members Joined between February 14, 2008 to March 14, 2008

After the old Orbiter board hosted at M6 suffered so many failures and down time Orbiter-Forum grew at a rapid rate...

306 New Members Joined between March 14, 2008 to April 14, 2008
242 New Members Joined between April 14, 2008 to May 14, 2008
213 New Members Joined between May 14, 2008 to June 14, 2008
180 New Members Joined between June 14, 2008 to July 14, 2008
185 New Members Joined between July 14, 2008 to August 14, 2008
165 New Members Joined between August 14, 2008 to September 14, 2008
133 New Members Joined between September 14, 2008 to October 14, 2008
125 New Members Joined between October 14, 2008 to November 14, 2008

Some general Top Statistics as of November 25, 2008

Record Users Online – 201 on April 1, 2008
Top Poster – 'Urwumpe' with 4,317 Posts
Most Replied to Thread - [Space Shuttle Ultra Development Thread]
Most Viewed Thread - [XR2 Ravenstar – Mk II]
Most Popular Forum - [Off-Topic]
Average # of Users Visiting Daily - 250

OCTOBER 2008 – Orbiter-Forum Statistics:

One year after site was opened!

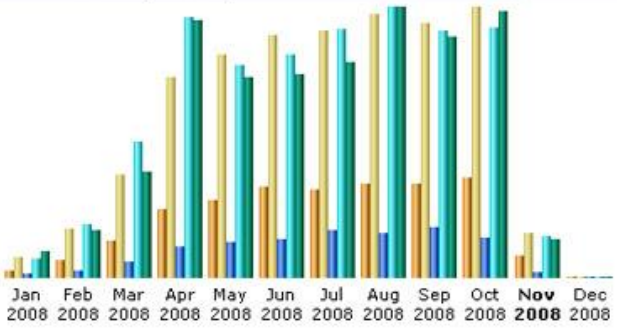
Summary

Reported period Month Oct 2008
First visit 01 Oct 2008 - 00:00
Last visit 31 Oct 2008 - 23:59

	Unique visitors	Number of visits	Pages	Hits	Bandwidth
Traffic viewed *	**16450**	**44767** (2.72 visits/visitor)	**848188** (18.94 Pages/Visit)	**5353149** (119.57 Hits/Visit)	**25.53 GB** (598.01 KB/Visit)
Traffic not viewed *			**214766**	**225381**	**2.73 GB**

* Not viewed traffic includes traffic generated by robots, worms, or replies with special HTTP status codes.

Monthly history



Month	Unique visitors	Number of visits	Pages	Hits	Bandwidth
Jan 2008	1227	3435	69113	410593	2.48 GB
Feb 2008	2944	8187	135993	1153909	4.53 GB
Mar 2008	6121	17128	340036	2923929	10.10 GB
Apr 2008	11276	33268	655818	5573799	24.58 GB
May 2008	12915	37030	767634	4557368	19.11 GB
Jun 2008	14938	40181	832742	4766940	19.50 GB
Jul 2008	14514	40879	997331	5330146	20.60 GB
Aug 2008	15572	43549	955471	5786049	25.83 GB
Sep 2008	15522	42067	1073129	5292667	23.08 GB
Oct 2008	16450	44767	848188	5353149	25.53 GB
Nov 2008	3606	7251	117379	880707	3.71 GB
Dec 2008	0	0	0	0	0
Total	115085	317742	6792834	42029256	179.07 GB

Countries (Top 25) - Full list

Countries		Pages	Hits	Bandwidth
United States	us	648754	4233330	19.34 GB
European country	eu	28152	175661	783.60 MB
Great Britain	gb	26102	146959	993.94 MB
Unknown	ip	25030	153982	739.04 MB
Australia	au	21109	86365	549.90 MB
Canada	ca	18385	130934	512.33 MB
Germany	de	16378	92741	500.08 MB
Netherlands	nl	7018	33858	234.61 MB
South Africa	za	6925	23671	230.61 MB
Italy	it	6740	34012	206.26 MB
Spain	es	5861	33894	190.65 MB
Austria	at	3322	21069	156.29 MB
Japan	jp	3263	10987	116.45 MB
Czech Republic	cz	3159	14360	98.59 MB
Belgium	be	2568	33354	122.74 MB
Portugal	pt	2410	12482	42.03 MB
Costa Rica	cr	2040	9961	55.98 MB
Poland	pl	1953	6829	176.42 MB
Sweden	se	1945	12653	51.22 MB
France	fr	1682	8854	42.84 MB
China	cn	1570	6106	51.01 MB
Switzerland	ch	1558	3988	84.60 MB
New Zealand	nz	1496	7716	41.31 MB
Norway	no	1161	7539	29.82 MB
Slovenia	si	1007	4363	26.82 MB
Others		8600	47481	300.51 MB

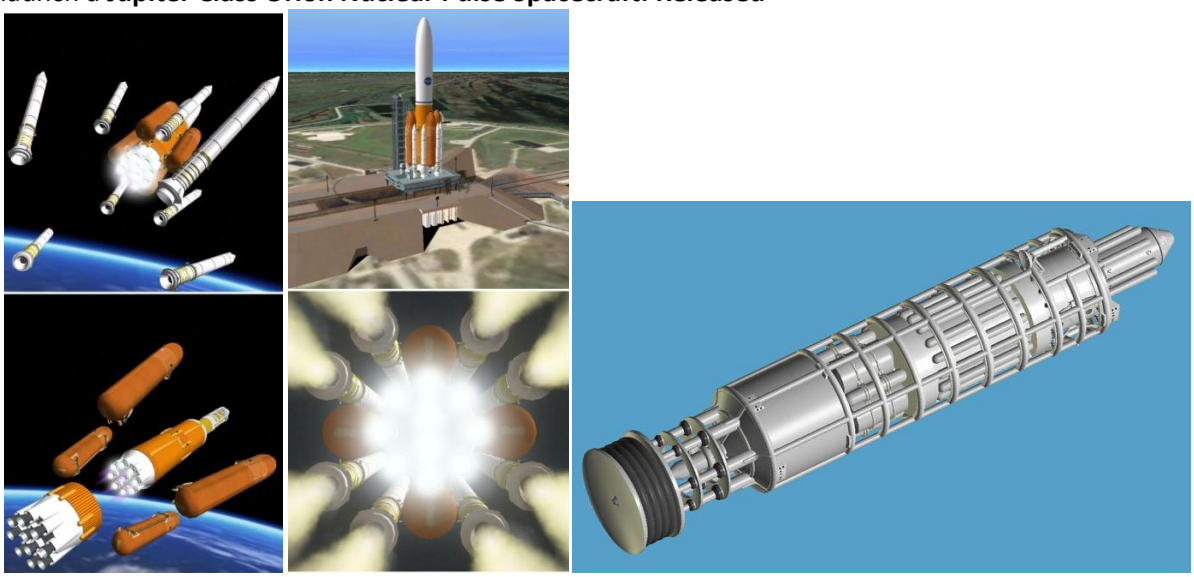
Operating Systems (Top 10) - Full list/Versions - Unknown

Operating Systems	Hits	Percent
Windows	5064237	94.6 %
Linux	112001	2 %
Macintosh	111768	2 %
Unknown	53245	0.9 %
Irix	4619	0 %
Symbian OS	4443	0 %
BSD	1188	0 %
Sony PlayStation Portable	858	0 %
Sun Solaris	368	0 %
Unknown Unix system	228	0 %
Others	194	0 %

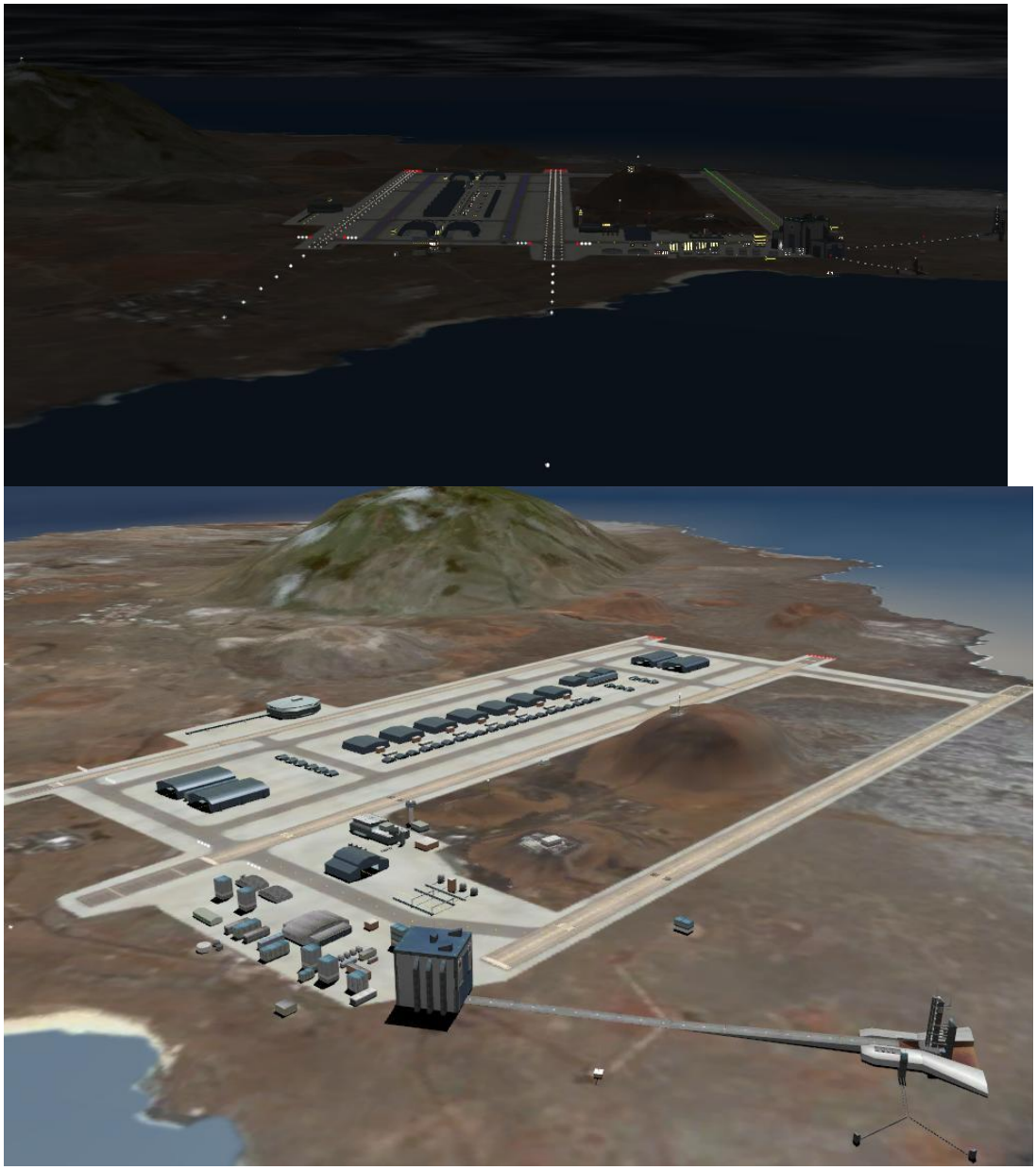
Add-on Update

This is a brief overview of add-on development in the past couple of months.

Andymc has restarted his Jupiter V-X add-on which can lift over 1000T to LEO. It is designed to launch a **Jupiter Class Orion Nuclear Pulse Spacecraft. Released**

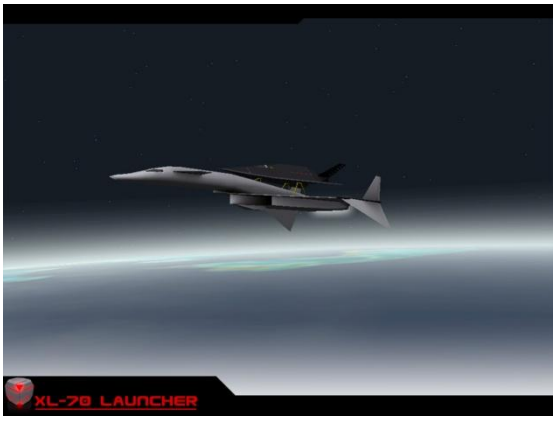


wehaveaproblem is continuing the development of **Wideawake International**. It features 3 runways plus cargo handling facilities. AIA also provides refuelling and vertical launch capabilities. **Released**

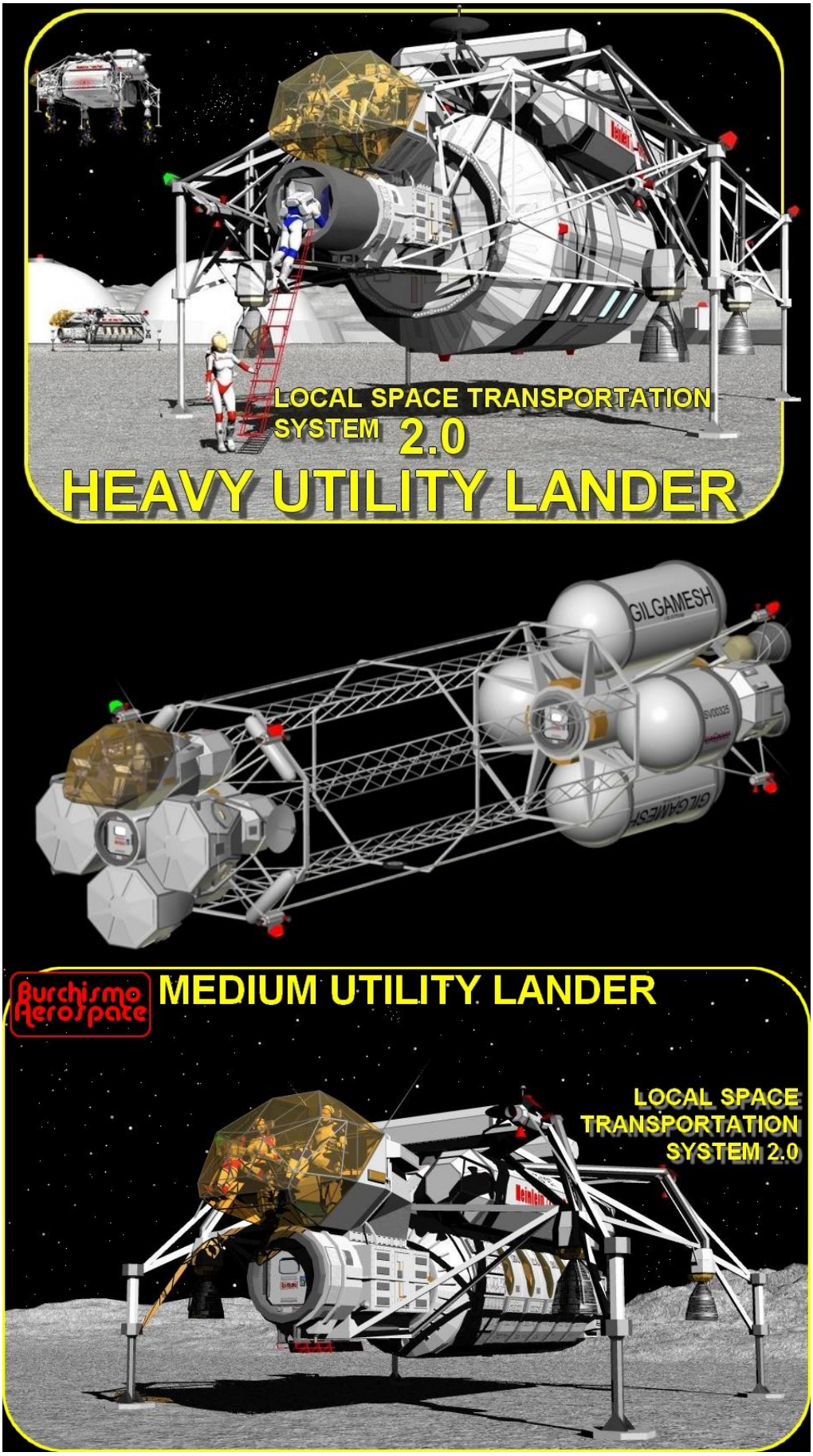


ICOVD are making slow progress for the ICOVD Windmill Class Interplanetary Ramjet

CigDriver has begun in the community by developing a space plane, Hyperdart. Currently it features a small cargo bay, a lander for lunar operations. It will have a custom DLL with UMMU and a detailed VC.

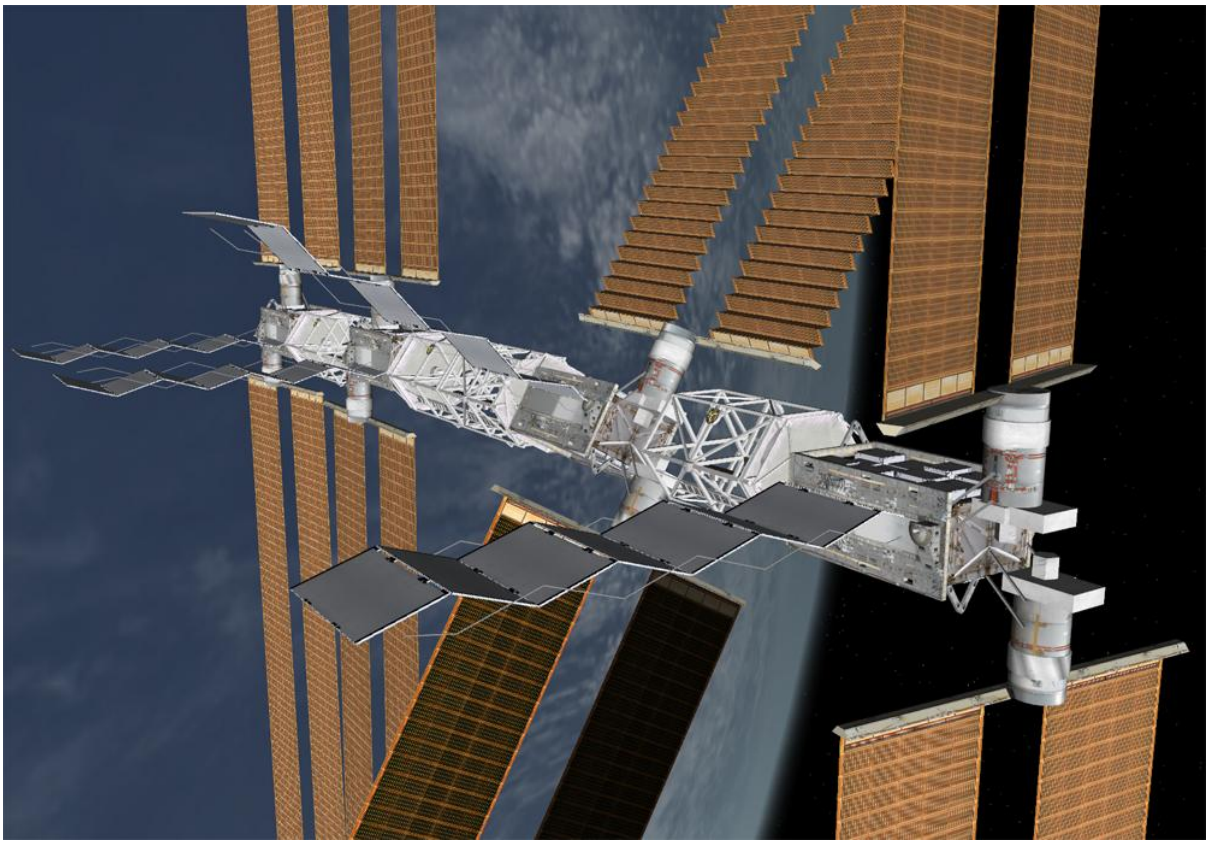


Greg Burch has begun redoing his Local Space Transport System. Currently released are an Intra-space Transport, a Medium Utility Lander and a Heavy Utility Lander.



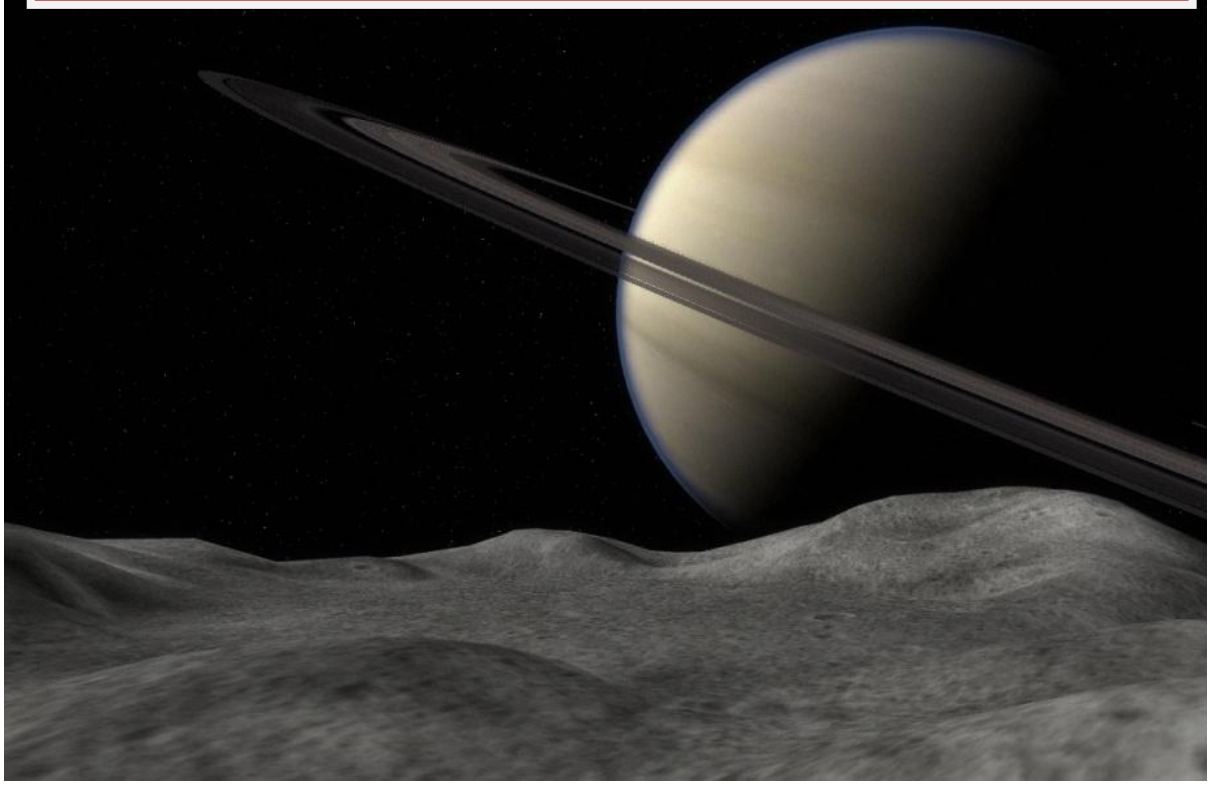
Our French friend Brainstorm has been developing the ESA Hermes. It will feature Life support management, Re-entry textures and other realistic features.

Also in France, Mustard has been modelling the P3/P4 Truss for the ISS. It will feature full unfolding animation and sun-tracking panels.

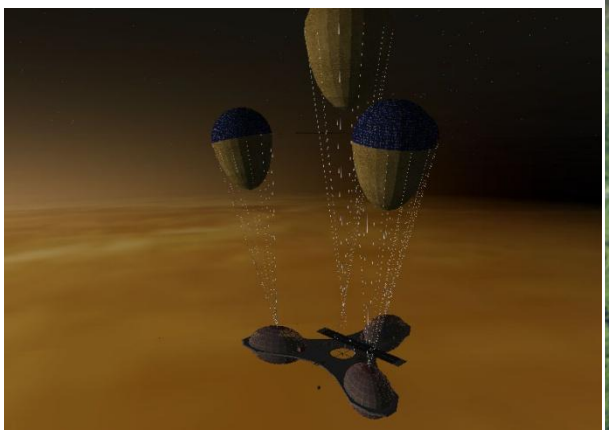


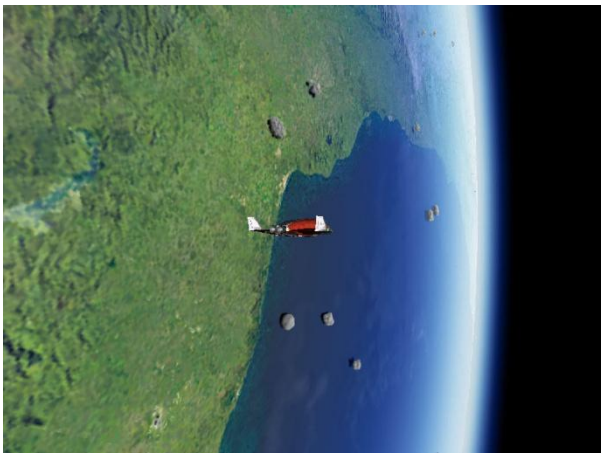
And finally, perhaps the most waited for add-on in 2008, Doug Beachy has released the long awaited XR2.

Orbiter Shipyard



From the creator of Orbiter Ultimate Experience, Orbiter Shipyard is an independent program that will be able to create customised DLLs for Orbiter. Coming from a very stupid thread, an offhand remark that seemed almost sarcastic has formed the most promising and advanced project for add-on developers.





Orbiter Shipyard will change the way add-on developers create their vessels. It is primarily aimed at users who are normally mesh modellers. These users have been lucky because of spacecraft.dll. This is a DLL that uses .ini files to define the spacecraft parameters. Over the years it has been modified and changed to suit the current standard. It is now in its 3 rendition. Out of Spacecraft.dll has spawned multistage.dll. This is used to define generally vertical launch systems. Unfortunately both these DLLs have similar problems. Generally they are incompatible with the Scenario Editor. They also present a problem to other add-on developers as they need to count for the generic-ness of the DLL.

I should point out now that OSB will not replace spacecraft3/multistage2. We have yet to see a full feature list and since it is still in development then I doubt we would see one until it was released. Currently there are still things that are better done in spacecraft 3. That said we can expect multiple updates and many new features added to the program throughout its life span.

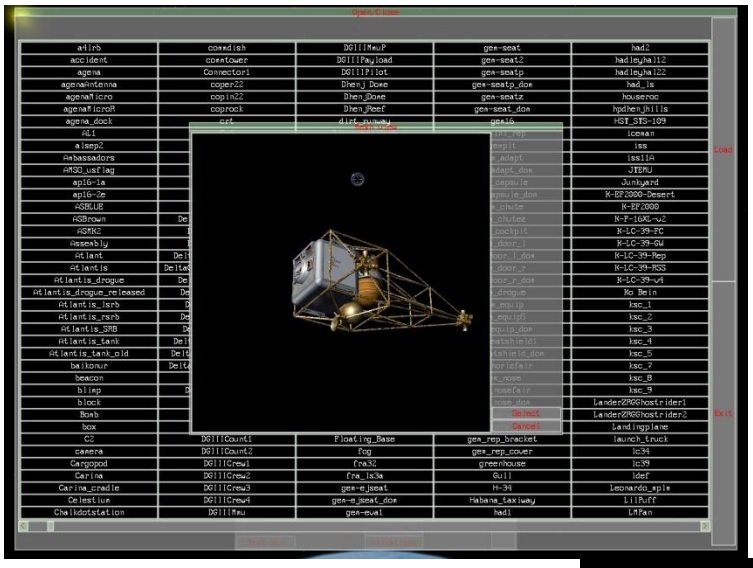
A current list of features:

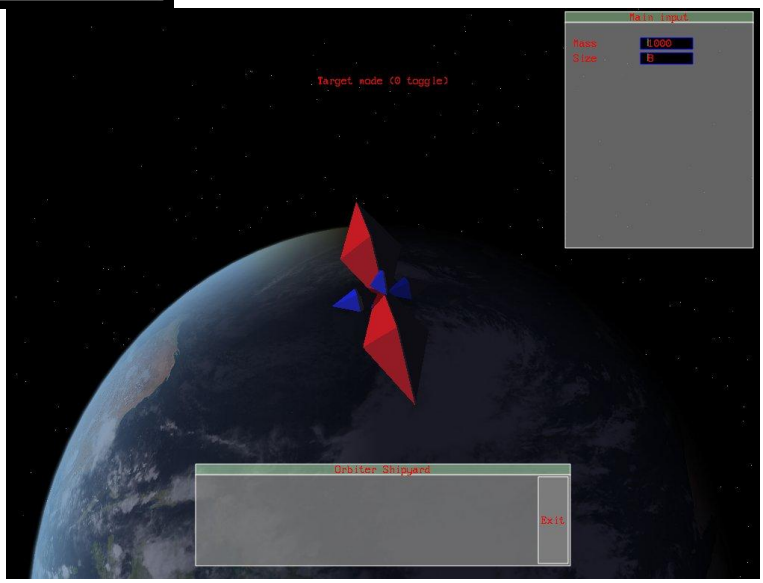
- Basic parameters (size, mass, pmi, cross section, rotation drag, touchdown points, etc, etc)
- Engine and fuel parameters (N fuel tanks, M engines, G engine groups, most of linking combinations)
- Engine exhaust streams
- Meshes and their visibility settings
- Animations (single-level tree, multiple components)
- Panels
- VC's
- Airfoils, landing gears, other meaning-filled animations
- UMMU and crew

The DLL that is generated will not need any other DLL to operate. It will use a normal cfg file and has none of the limitations of Spacecraft3.

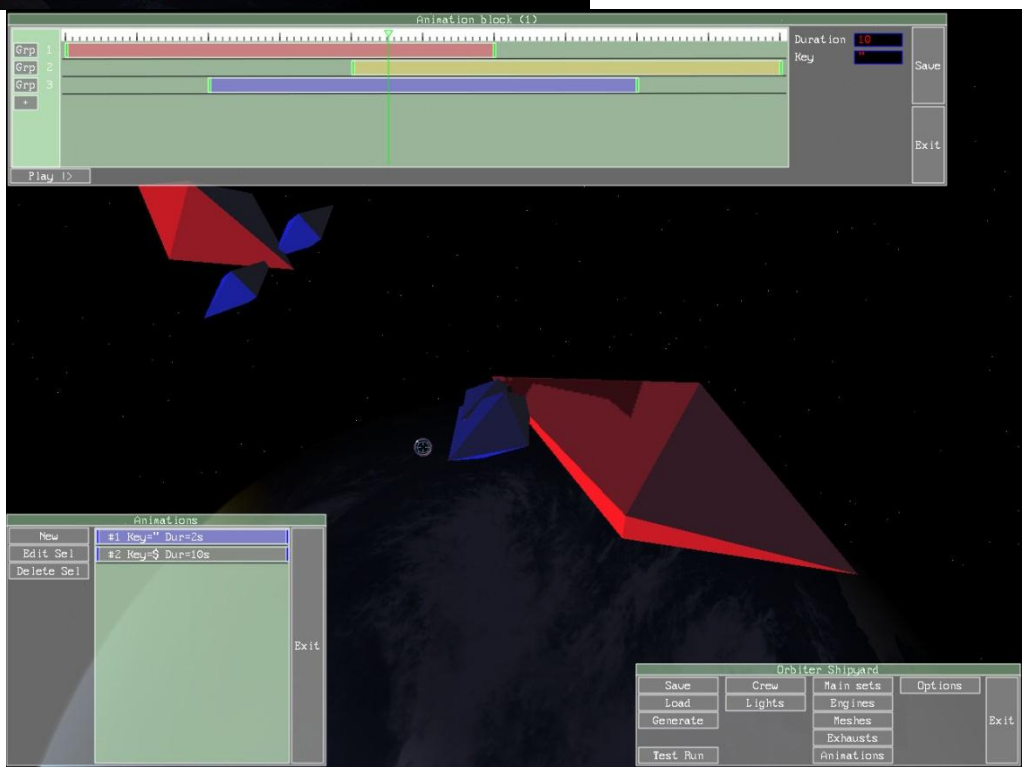
The generator will also create a config file and several scenarios if required.

The key to this program will be a successful user interface. This is probably the most difficult part in designing. Everyone has different ideas how thing should work and how they should look. Artlav has done a wonderful good in creating a functional and easy to use GUI. It includes a mesh preview on the meshes select, a vessel preview screen and the ability to interact with the vessel without resorting to Orbiter.





The input for the various parameters is simple and efficient. It allows modification of the numbers to adjust the performance of the vessel. The most difficult part of the GUI is the animations. Here Artlav has decided to use a flash like system. This uses time bars to represent the time period of the animation. The various meshes can be selected and viewed real time using the vessel preview. Artlav has mentioned that he would like to match spacecraft 3 in animation options and this system allows the greatest flexibility.



Orbiter Shipyard project will change the way people create add-ons for Orbiter. The ‘Mesh-makers’ will have greatest benefit from this program. They will be able to produce a fully function custom vessel without using spacecraft 3. This will probably not be Artlav’s last project but it might be his greatest.

So You Wanna Build a Rocketship?

by Andy44

One of the most rewarding experiences in Orbiter is flying a spacecraft that you yourself designed and built from scratch. Almost everyone who masters the basics of Orbiter feels this urge at some time. You spend the first few weeks or months learning how to reach a desired orbit, rendezvous and dock with other vessels, planning trajectories to the Moon and beyond, and landing. Along the way you learn more about spaceflight than you ever imagined you would. You download several add-ons, perhaps to recreate history or to run your own space exploration program, but a something nags at the back of your mind: *Is this how I would do it if I were in charge*? Something else may nag at you, as it did me: *I downloaded all this stuff for free; wouldn't it be nice if I could share something of my own*?

So you download Anim8or and read the mesh-building and spacecraft3.dll tutorials and you're ready to go, right? Maybe. Maybe not. It helps to have a goal in mind and a structured process for reaching that goal. In this article I will attempt to help guide you there, by discussing the process by which we build add-ons that make some sort of sense. Even science fiction spaceships or futuristic "what-if" systems often have, within the boundaries of the fictional world they live, rules to live by. We will use as an example a simple cargo ship to carry stuff between the Earth and the Moon, based on an add-on of my own. Many of the ideas and math equations and lots of other neat information about fictional spaceship design can be found on the Atomic Rocket Homepage. I'm going to avoid math for now, perhaps to save it for a future article.

Mission Objectives

Before discussing spacecraft hardware, you have to decide what you are trying to achieve. Think of the overall mission, not the individual vehicles. For instance, the entire Apollo program started with one simple sentence: "Land a man on the Moon and return him safely". Everything in the Apollo program, the CSM, the LM, the Saturn rockets, the factory tooling, the launch pads, the vehicle assembly building, the test facilities, the mission control, all started with that sentence, that string of words which drove the entire effort. If you want to explore the Moon, say so, but be specific and settle on a goal. For example, "I want to establish a small colony on the lunar surface, with options for future expansion." Let that goal drive the rest of your add-on design.

Now, some of you are thinking, "I just want to build a cool spaceship that carries cargo to and from the Moon, I don't care about all that stuff." That's fine, that's pretty much how lots of people start. But it helps to have a larger goal defined, so that when you have to make decisions about your design, you have something to guide you. For instance, how much cargo should your ship carry? Is it expected to land on the Moon or Earth or just transfer between orbits? These are the type of questions you will need to answer, and it's much easier when you know how this ship fits into the grand scheme of your space program's objectives. The result is a space vehicle that seems to feel more purposeful once you've finished it.

Break it Down

Now that you've determined what you want the main objective to be, start thinking about the system that will get you there, what we will call the "mission mode". Looking back at the Apollo program again, NASA had several different ideas to choose from. "Direct ascent" to the Moon and back to Earth again was the obvious option. One big rocket, shedding stages as it flew, would go from the launch pad all the way to the lunar surface, take off and fly all the way back to Earth, and finally shedding the last of its stages, would re-enter and parachute down. They could've done this with either a very big rocket or by using a small, two-man Gemini-style vehicle as the capsule. But they did what many of us did: they had their heart set on a roomy, three-man Apollo capsule before they figured out the rest of the mission mode, which led them to choose the "lunar orbit rendezvous" mission mode. Another possible mode was "earth orbit rendezvous", which is what Wherner Von Braun envisioned early on for really big vehicles carrying dozens of men for extended explorations of the Moon. This was too costly for the U.S. government, but money is no object inside Orbiter.

As you can see, there are multiple ways to accomplish your mission objectives, multiple mission modes. Some are cheaper but lead to future dead ends; while others are expensive but bring greater benefits in the future. NASA spent a lot of money paying people to analyse costs and engineering feasibility to decide what mode they would use in Apollo (some would say they got it wrong despite this); as an Orbiter add-on developer you have the luxury of just picking whatever you want! For our example lunar colony mission, let's decide we want to use a Heinlein-style system: cargo vehicles will transfer freight from Earth to low-earth orbit (LEO), other vehicles will carry cargo between lunar orbit and the lunar surface colony, and your cargo ship will transfer the freight between low-earth orbit and lunar orbit (LO). We can add some space stations on each orbit to use as waypoints, as well. The main cargo vehicle between Earth and LEO will be the Space Shuttle or equivalent, carrying containers or modules up to 28 metric tons.

Just like that, we have decided a few major design aspects of our cargo ship: We know it doesn't have to land or take off, so it will have no landing gear, wings, parachutes, etc. We also know that the cargo it carries will usually be carried aboard the Space Shuttle, so we know how big and how massive the cargo is. It will mass up to 28 metric tons and be the right size and shape to fit into the shuttle payload bay. 28 metric tons one-way to lunar orbit will be the minimum requirement for our cargo capacity.

The rest of our lunar space program can now be set aside as we focus on our cargo ship.

Delta-V Requirements

In space, delta-V, the amount of velocity you can change, is everything. No matter how big and heavy your space vehicle is, it will need the same delta-V to get from one orbit to another, but a more massive vessel needs more propellant to achieve the same delta-V. This is why a small space probe like the Surveyor can get to the Moon using a small rocket, while the massive Apollo spacecraft requires a Saturn V to get there. In addition, the Apollo spacecraft has to do more than just crash into the Moon, it has to manoeuvre into lunar orbit with the lander attached to it, and manoeuvre again to carry its crew back to Earth. This makes the Apollo spacecraft more massive, which in turn makes the Saturn V upper stage even more massive, which in turn makes the Saturn V booster even larger still! This is because once you've chosen a propulsion system; there are only two ways to increase available delta-V: reduce vehicle mass, or increase propellant. The amount of delta-V you require will therefore influence the design of your spacecraft, the size of the propellant tanks, whether you jettison modules, etc.

So, how much delta-V do we need? There are a few ways to calculate this. Since you know you are going from LEO to LO, it's not difficult to do a rough calculation, being purposely conservative. Leaving Earth orbit for the Moon ("trans-lunar injection" or TLI) requires a change in velocity of about 3500 m/s. When you get to the Moon, you need to change your velocity by about 800-900 m/s or so. To get back to LEO you need the same delta-V. So, 3500 + 900 + 900 + 3500 = 8800 m/s to go from LEO to LO and back to LEO, at which time we will refuel our ship. Add a healthy safety margin, say 20%, and we get 10560 m/s total delta-V. Sounds like a lot, doesn't it? That means a lot of propellant, right? Well, it does, and it's also cold reality. There's no way to get around it. But as we shall see, there are some things we can do to make it easier to deal with.

By the way, if you don't feel like doing math to figure out delta-V, you can use Orbiter! Take the Delta Glider and fly from LEO to LO along the same type of transfer orbit you expect your cargo ship to fly. Before leaving, LEO, look at the Burn Time Calculator MFD and record how much delta-V is available in your fuel tanks. After entering LO, record it again and subtract one from the other. Now you know how much delta-V it takes to do this flight, and remember, the delta-V is the same no matter how big or small the vessel is (unless you're talking about something so big is has its own gravity, like the Death Star)!

Make sure you record how much delta-V each phase of the mission requires, not just the total. This is important because when your cargo ship gets to LO it will drop off its cargo or maybe pick some up, which will change its mass. Although it will still take about 4400 m/s to get back to earth, you will be carrying a different mass of deadweight and thus will need a different amount of propellant to achieve the same delta-V. If any part of your spacecraft will have detachable modules of any sort, you will have to calculate each phase of the flight separately.

Looking again at the Apollo CSM, the vehicle used the Saturn upper stage to perform TLI, and then jettisoned it, creating a new phase. After being inserted into lunar orbit, the LM was detached and used for the landing, and then it too was jettisoned, creating yet another phase. By jettisoning modules and shedding mass as it flew its mission, the Apollo spacecraft was able to achieve all the required delta-V without looking like a flying fuel tank. Apollo also avoided the 3500 m/s requirement to get back into LEO, because it went straight into re-entry and landing upon returning from the Moon. Our cargo ship is reusable, so we don't have the option of shedding lots of modules or avoiding that last big manoeuvre.

Choose a Propulsion System

Once we've determined our mission and how much delta-V it requires, we can settle on a propulsion system. No other component of our space vessel will have as much influence on the design then the engine we use to drive it. Since Orbiter can use fictional as well as realistic propulsion schemes, we have very many to choose from. For our cargo ship example, let's limit our choices to realistic, near-future technology.

There are three many things to consider here, I'll try to name some bigger ones:

-*Specific impulse (I_{SP})*. Defined directly as the average velocity of the exhaust as it leaves the nozzle, I_{SP} can be thought of as the efficiency of a jet propulsion system. Basically, the higher the I_{SP}, the more delta-V you get for each kilogram of propellant you expend. I_{SP} in Orbiter is measured in m/s, but in many texts it is also measured in seconds, which is the I_{SP} in m/s divided by g in m/s^2 ($g = 9.80665\ m/s^2$).

-*Thrust*. Thrust is the force which the engine applies to the space vehicle, measured in Newtons (N), or in many American texts, pounds or pounds-force (lbs). In general, you want higher thrust when operating close to a gravitational body. The most extreme example is a rocket launch vehicle, which needs very high thrust to get its fuel-laden mass up off the launch pad and started to move. Thrust is more important than I_{SP} in this situation, since high I_{SP} won't get you anywhere if your thrust isn't high enough to lift your weight. Thrust is less important once you are in freefall, but it's still an issue. This is why the Space Shuttle uses low I_{SP} solid rockets to get off the pad, but uses high I_{SP} hydrogen-burning engines to get to orbit. A high-thrust rocket will deliver delta-V faster than a low-thrust rocket and changing velocity faster wastes less propellant and makes calculation easier in Orbiter. The higher your I_{SP} is, the less propellant you need to carry out your mission. The ideal engine has both high I_{SP} *and* high thrust, but as usual, reality intrudes.

-*Mass*. Simply, heavier is bad. Remember the part where we want high I_{SP} *and* high thrust? Well, there are some types of engines out there that may get us this, such as a nuclear-thermal rocket. According to Murphy's Law, there must be a drawback, right? You guessed it: these engines tend to weigh a lot. A nuclear-thermal rocket, for instance, uses a fission reactor, which can easily kill your crew and destroy your payload with radiation. To prevent this, you must add massive shielding, such as lead. Alternatively, you could cut down on shielding mass by making the ship longer so that the reactor is far away from the crew, but that adds some mass in the form of the ship's structure. You may also use the propellant tanks to help shield the crew for much of the mission, as well. There are creative ways to reduce the pain. In any case the bottom line is that the mass of not just the engine itself but all the extra parts, such as shielding, turbo pumps, plumbing, radiators, and other auxiliary equipment must be factored into the design of your ship and the choice of your engine.

If you go the science fiction route, you can ignore the mass part and just give your vessel magic engines, like the ones the Delta Glider uses. For our example lunar cargo ship, let's choose a nuclear-thermal rocket (NTR). Why? Well, we don't have to land or take off, so we don't need the high thrust of a chemical rocket, and we don't have to worry about making the launch pad radioactive. The NTR produces a moderate amount of thrust for what we need. We need lots of delta-V, which means high I_{SP}, and an NTR can deliver a theoretical 1000 s or so (real NTRs were tested in the early 1970s and only reached about 800 s, but let's live a little!). A nuclear reactor is also a handy thing to have aboard ship for things like electricity, and although the shielding adds mass, the engine is relatively small. Since all of our propellant must be carried up from the ground on expensive rocket launches, we want to get as much efficiency out of it as we can.

Let's also use an "alternative propulsion scheme" to help save propellant; we'll examine the use of aerobraking to slow us down into LEO when we return from the Moon. Although this is risky, it's worth looking at because it could give us over 3000 m/s of "free" delta-V. We need to analyse the pros and cons. A heat shield for aerobraking will

have mass, but perhaps this is less than the mass of propellant required to do the same job. Because we have already decided to use an NTR, we know the ship will probably be long and skinny, so that means a bigger, heavier heat shield. Is it still worth it? We also need to think about safety concerns. We will be flying a critical nuclear reactor through the upper atmosphere at 11 km/s! You can ignore the politics and safety issues in Orbiter, of course; it's up to you to decide how much realism you can stomach.

For your own missions, you should look at "alternative propulsion" methods as well as any trick that can make your mission easier. For instance, use slingshot trajectories whenever feasible in order to save time and delta-V. It takes a long time to get to Saturn; it's takes a lot longer and costs more fuel if you don't go via Jupiter. You can also use aero manoeuvres to save delta-V if you plan to do plane changes, but don't forget to design your ship to handle the heating and acceleration. The X-20 Dynasoar is an example of a spacecraft that was designed for this kind of abuse.

Orbiter makes it tough to use some propulsion schemes, such as solar sails and very low-thrust plasma drives, which take months to build up velocity. You probably want to avoid these, unless you have some way to get around Orbiter's time acceleration issues.

Other Equipment

Once you've chosen a payload and an engine, you can start to sketch out how the ship will look. To do this, you also need to decide what else you'll need. If the ship is manned, it will need a living space and life support equipment. All vehicles will have a frame or a body of some sort. Communications equipment requires antennae. If your ship is solar-powered, how big do the arrays need to be, and where will you put them? If you have a nuclear reactor or other heat-producing equipment, you will need radiators or some other way to shed heat.

You can research the masses and sizes of this gear in books or on the internet, so I won't get too specific, here, but if, say, you require large solar arrays, you need to know this before you design your vehicle. You need to know how much all this stuff masses, and factor it into the dry mass of your vessel, which is the mass before you add propellant.

To the dry mass, add the payload or any other detachable module masses. This is the mass you must be able to provide delta-V for. Using Tsiolkovky's Rocket Equation, you can now determine how much propellant it will take to provide this delta-V.

Alternatively, if your propellant mass is fixed (as with, say, a solid rocket), you can use the Rocket Equation in reverse to determine what your maximum dry mass is. Then you will have to start eliminating stuff to get down to the maximum allowable mass.

Avoid adding bells and whistles until after you've added up all the essential equipment and calculated how much excess delta-V you have for luxuries. Even with our example lunar cargo ship, with its fancy atomic drive, the mass will grow quickly out of control. Remember that the more stuff you place aboard the vehicle, the more propellant mass you need to carry.

Sketch it Out

At this point, it is useful to draw a sketch of what your vessel will look like. You know what gear is essential, you know what your payload will look like, and what sort of propulsion system you will use, and about how big your propellant tanks need to be.

For our example lunar cargo ship, we can start out with a few simple assumptions: the crew will be near the bow and the nuclear engine will be at the stern, with the propellant tanks between the two, to minimize radiation exposure for the crew.

We must decide where to put our aero brake heat shield; logically it should be at the bow or stern so it can protect the whole ship without being excessively large, and since the engine nozzle is in the way at the tail, we'll put it in front of the crew section.

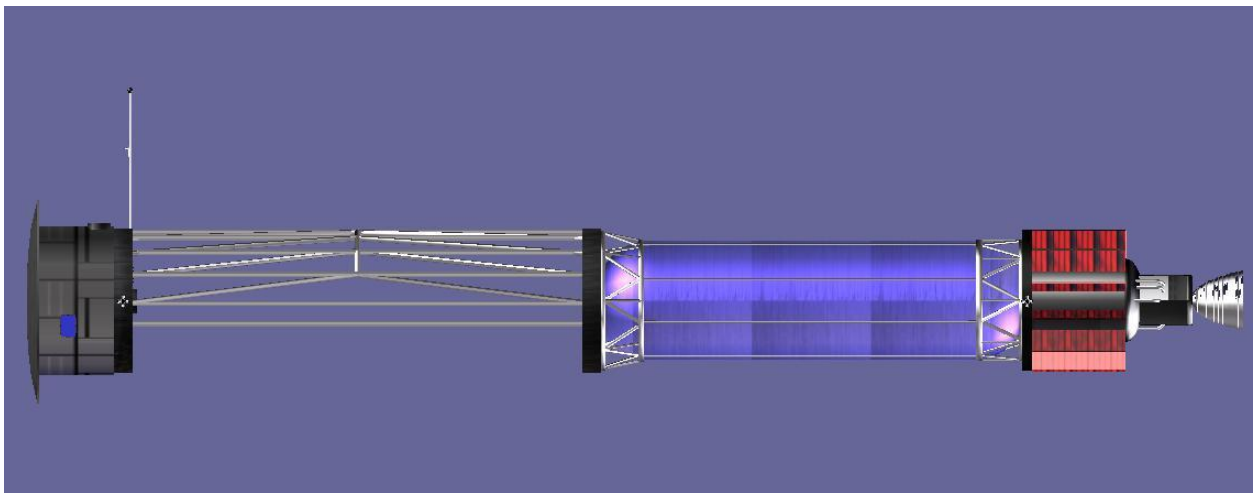
Our reactor will need radiator fins; let's mount them right next to the reactor for max efficiency. We also need a radiation shield, and we can put that right in front of the reactor, so it will protect everything forward of the propulsion section. That means we can make it as small a diameter as possible, too, and save some mass. Our ship won't need solar panels, since the reactor will provide power.

How about the payload bay? Does it need protection from the sun or other hazards? If so, you have to build that in, and perhaps have doors that swing open, as with the Space Shuttle. Our cargo ship doesn't need protection; during the aero phase our heat shield will protect the payload, so our bay can be an open truss work, placed between the crew module and the propellant tank.

We also need to think about docking ports. While we're at it, we need to think about protecting the crew of any vessels we dock with from our reactor's radiation. The ideal place for a docking port, therefore, is in the centre of the heat shield on the nose. The crew has easy access, and the ship's radiation shielding protects the space station crew, as well as keeping them as far from the reactor as possible. Only problem is that it means putting a hole through the heat shield. We may want to put a docking port on the side of the crew module instead, but that means the heat shield will get in the way during docking. Will our payload modules have passengers or otherwise be pressurized? If so, we need a docking port on the aft side of the crew section. This docking port can also serve as a means of attaching the payload to the ship in Orbiter.

Because we know our ship will be screaming through the upper atmosphere behind its heat shield, we have to make sure that anything sticking out, like antennae or other gear, is behind the shield, or is stowable. Since we can animate things in Orbiter, a retractable antenna mast is not a problem. Note that in your sketch as well. Also figure out where things like RCS jets will go.

Although my first sketch was hand-drawn, the picture below shows the first draft of the ship looked like in Anim8or:



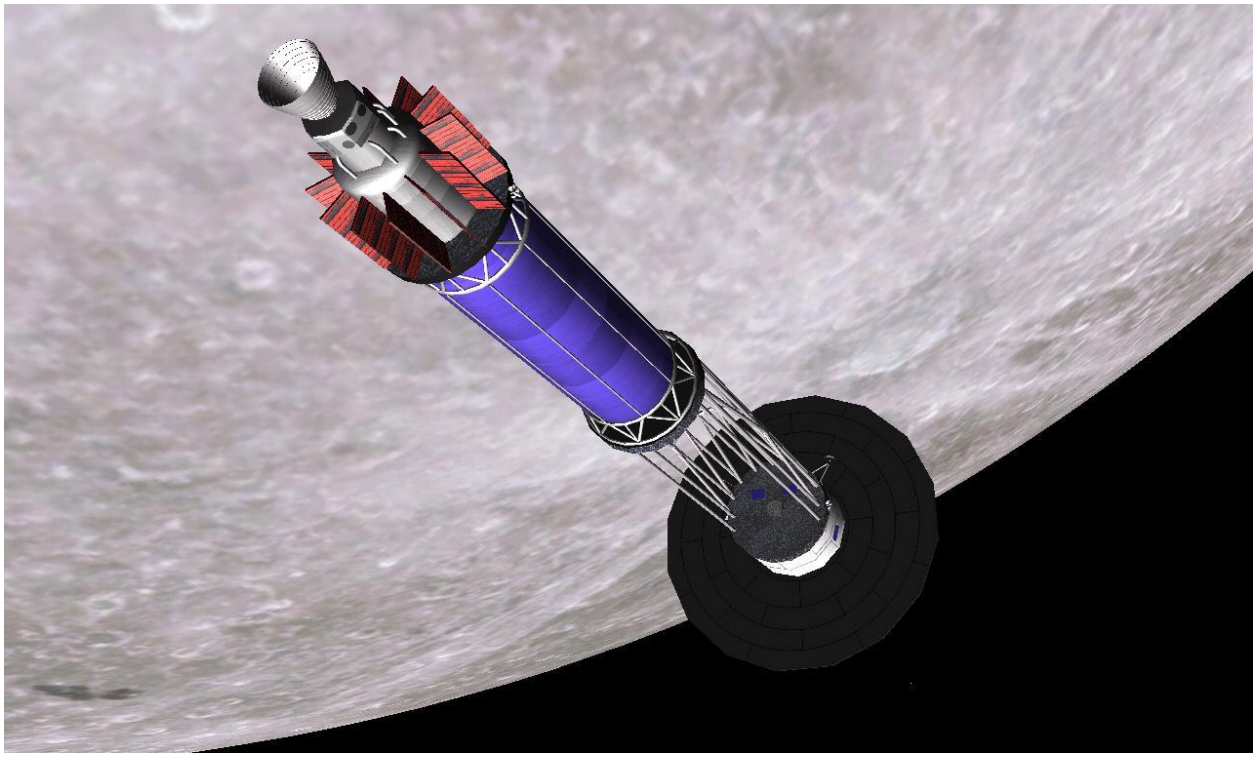
Get to Work

Now that's you've got an idea of what your add-on vessel will look like and why, it's time to start building it. The sketch will help you out with the mesh work, and the homework you've down with the delta-V and mass calculations will tell you what performance characteristics you should put in your Spacecraft3 .ini file or custom .dll code.

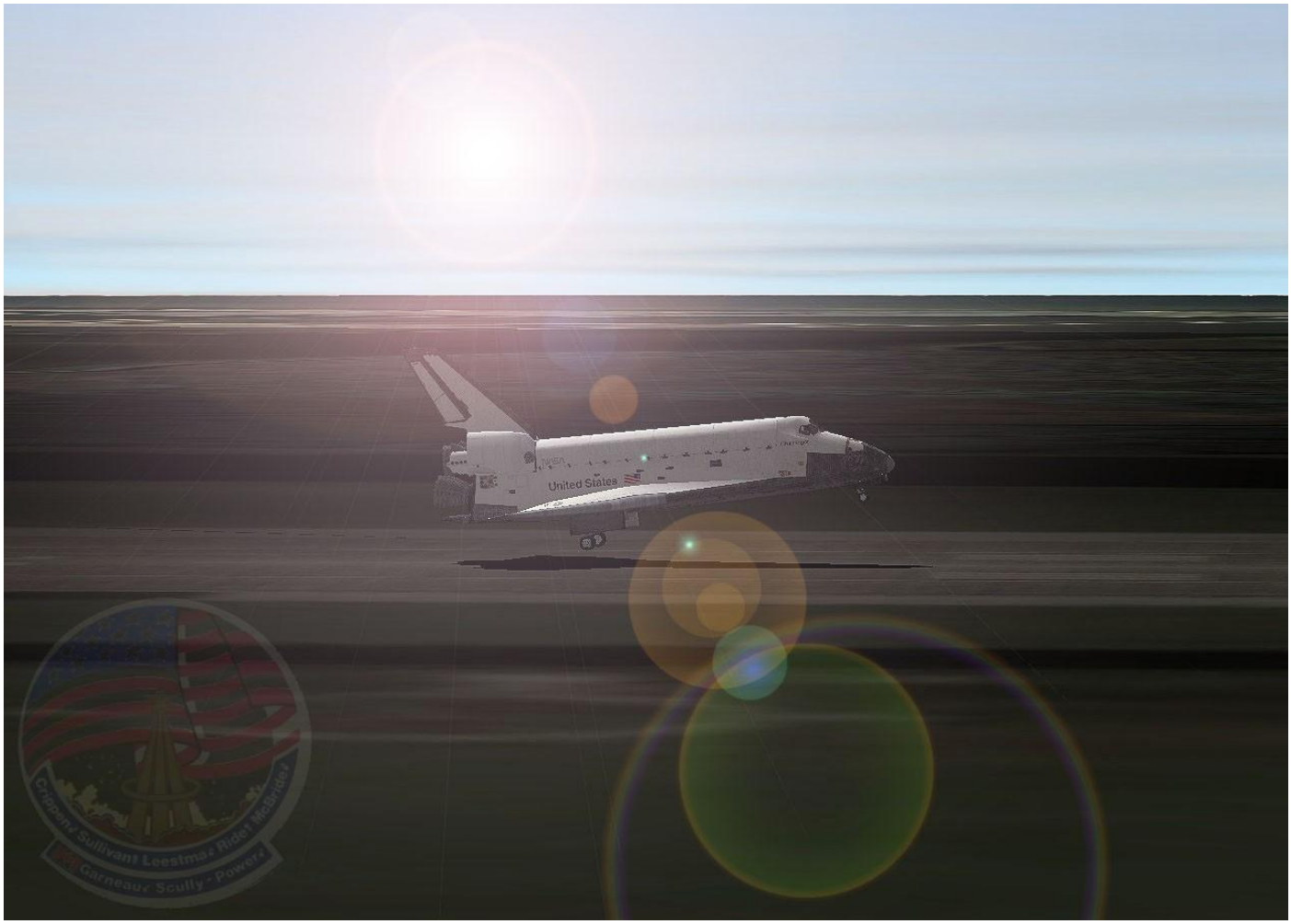
For some add-ons, such as those based on ships from science fiction movies, you can probably skip all of this. You already know what it looks like, what parts move, and depending on your source material, you know the mass and performance characteristics.

But for those of you who are building your own add-ons from scratch, I hope this will help you sort it out and get your rocket ship flying.

My first released version of the cargo ship looked like this:



Good luck!



The Future is Now

An interview with Doug Beachy, the author of the XR series

DeltaV:
Hi Doug, Thanks for coming on

Doug Beachy:
Sure thing

DV:
Some quick word associations to start off with.
Real Life?

DB:
Ah, well, real life is the same for all of us: get up, go to work, get home, work on add-ons, go to bed, repeat.....

DV:
Orbiter?

DB:
Martin Schweiger is a genius! I can't thank him enough for creating Orbiter and enhancing it all these years. It's a monumental amount of work.

DV:
XR Series

DB:
The first thing I learned is just how much time and effort it takes to develop, test, and polish a software project part-time on evenings and weekends. It really does eat up all your free time, particularly in the early stages of a project when there is a mountain of work to do. In the end, though, it is satisfying to see everything come together.

DV:
Ok finish this sentence: You're addicted to Orbiter...

DB:
I think we have an entire thread on that, actually. :)

DV:
That we do.
How did you get into Orbiter?

DB:
It was several years ago (back in early 2004, I believe). I remember Googling for "shuttle simulator" and seeing the "Orbiter - free space flight simulator" link and thinking, "Wow, what this???" After I installed it and played around with it a bit I was hooked right off the bat.

DV:
Sounds like a common problem.
What was your first add-on?

DB:
Technically that would be the "STS-114 Orbiter Sound Pack" I created in August, 2005 for OrbiterSound. It contains a bunch of sound clips from the STS-114 mission (ATC chatter) that I created from NASA TV during the mission.

However, my first software add-on was PersistentExtMFD, released in June 2006, which I wrote so Orbiter would remember the mode, location, and window size of each external MFD. When I wrote it I wasn't planning on releasing it as an add-on -- I just wrote it because I wanted it. But it turned out pretty well, and so I decided to release it as an add-on. Unfortunately it has to patch the Orbiter core in memory, so that's why it only works with the now-obsolete Orbiter 060504 version.

DV:
Nice, You are known for your excellent XR Series, how did you come to create the XR1 Deltaglider

DB:
I started working on the XR1 in August 2006 because I loved flying the DeltaGlider but I wanted more of a challenge (more pilot workload). "More to do" = "more fun!" At the default settings an XR vessel has a higher pilot workload, and so for me it is more fun to fly. Of course, each pilot has his own ideas about "what's fun and what is just too much work," so that's why support for XR preference files was added. To sum up, I developed the XR1 is because I wanted it; when I first started I wasn't thinking about releasing it publicly -- I just wanted a ship that was more fun to fly.

DV:
What is the most defining XR vessel?
Which one do you think made the most impact on the community?

DB:
That would definitely be the XR2 Ravenstar. In addition to being the most refined and polished XR vessel to-date, Steve Tyler's modelling and texturing skills are the best I've ever seen.

DV:
What is the most disappointing moment in Orbiter/ add-on development?

DB:
I can't speak for all add-on developers, but speaking personally it was right after I first released the XR1 version 1.0. I was surprised at how many negative comments were being posted – I hadn't expected that, and at first it was pretty discouraging. But after awhile I realized that most users weren't making negative comments to say, "Your work sucks," they just had different opinions about how the add-on should work or what features it should have. And that's OK. :) Orbiter has a great community, and the silent majority of users really do appreciate each add-on author's work.

DV:
By contrast what was the most exciting thing?

DB:
Ah! Believe it or not, it was when I first saw Steve Tyler's new prototype model (which later became the XR2) on M6. I PM'd Steve about it and asked him if he'd be interested in turning that into the XR2, and he replied and said yes. I was pretty thrilled about that. :)

DV:
That was a good choice

DB:
Yes, I can't complain. :)

DV:
What is the future of the XR's

DB:
I have been tremendously fortunate to work with some very talented 3D artists like Russell Hicks on the XR5 and most recently Steve Tyler on the XR2. We have kicked around some ideas for an XR0, a small two-seater craft that could fit in the XR5's bay, and for an XR7, which would be a heavy-lift vehicle like the XR5 only somewhat smaller and

sleeker. For the immediate future, however, I will be working on the XR2 Mk II to make the virtual cockpit active. Steve is also working on some mesh changes and tweaks for the XR2 Mk II: new landing gear, moving the cargo bay slightly aft to increase main cabin space, etc.

DV:
What advice would you give to up and coming add-on developers

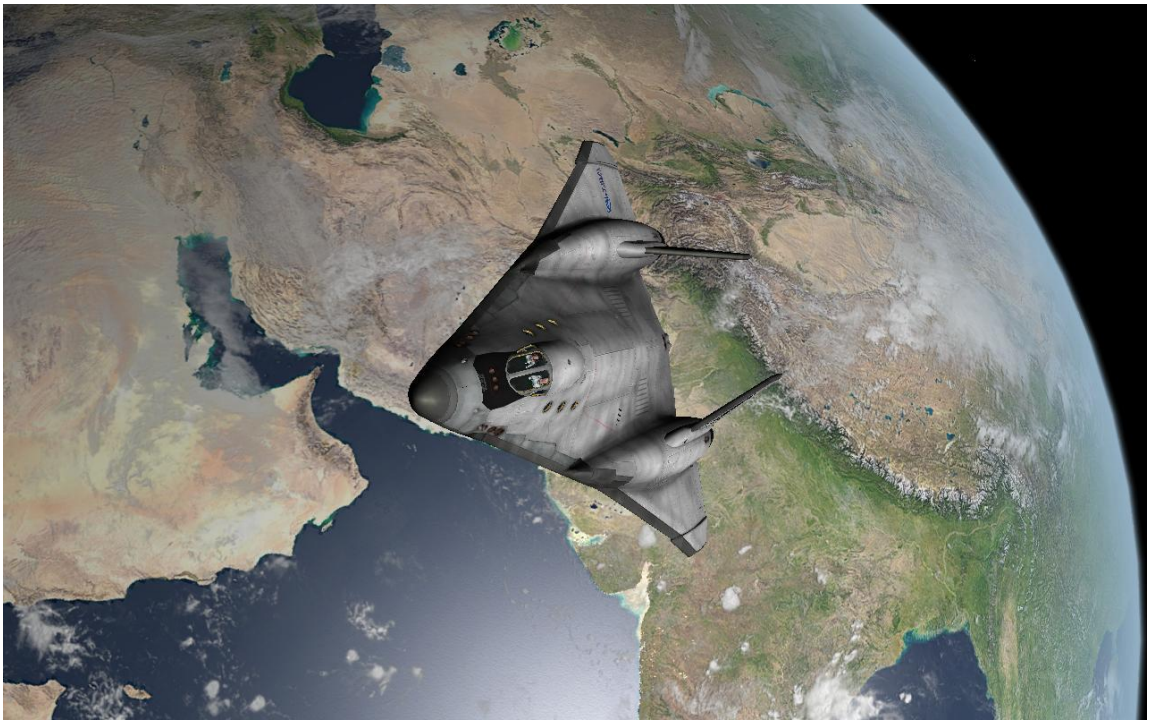
DB:
Hmm....three things come to mind:
The first thing is to be careful to not try to add too many features up front in the 1.0 release – otherwise the software will likely never be released. Sometimes it is hard to decide which features to cut or push to the next version, especially when users and/or your beta testers are clamouring for all of them, but sometimes you just have to make the tough call.
The second thing is, build up a small-to-medium-sized beta team of experienced users and have them test your add-on in a closed beta. Early-on with open beta testing I ended up spending lots and lots of time replying to posts from many different users, and it just ate up way too much time. For me at least, a small, closed beta test team of experienced users worked much more efficiently.
Third, and most important, don't get discouraged if you release your add-on and get some negative feedback. Remember that the large majority of users are happy with your add-on, and don't take it personally when you receive feedback on how to change it.

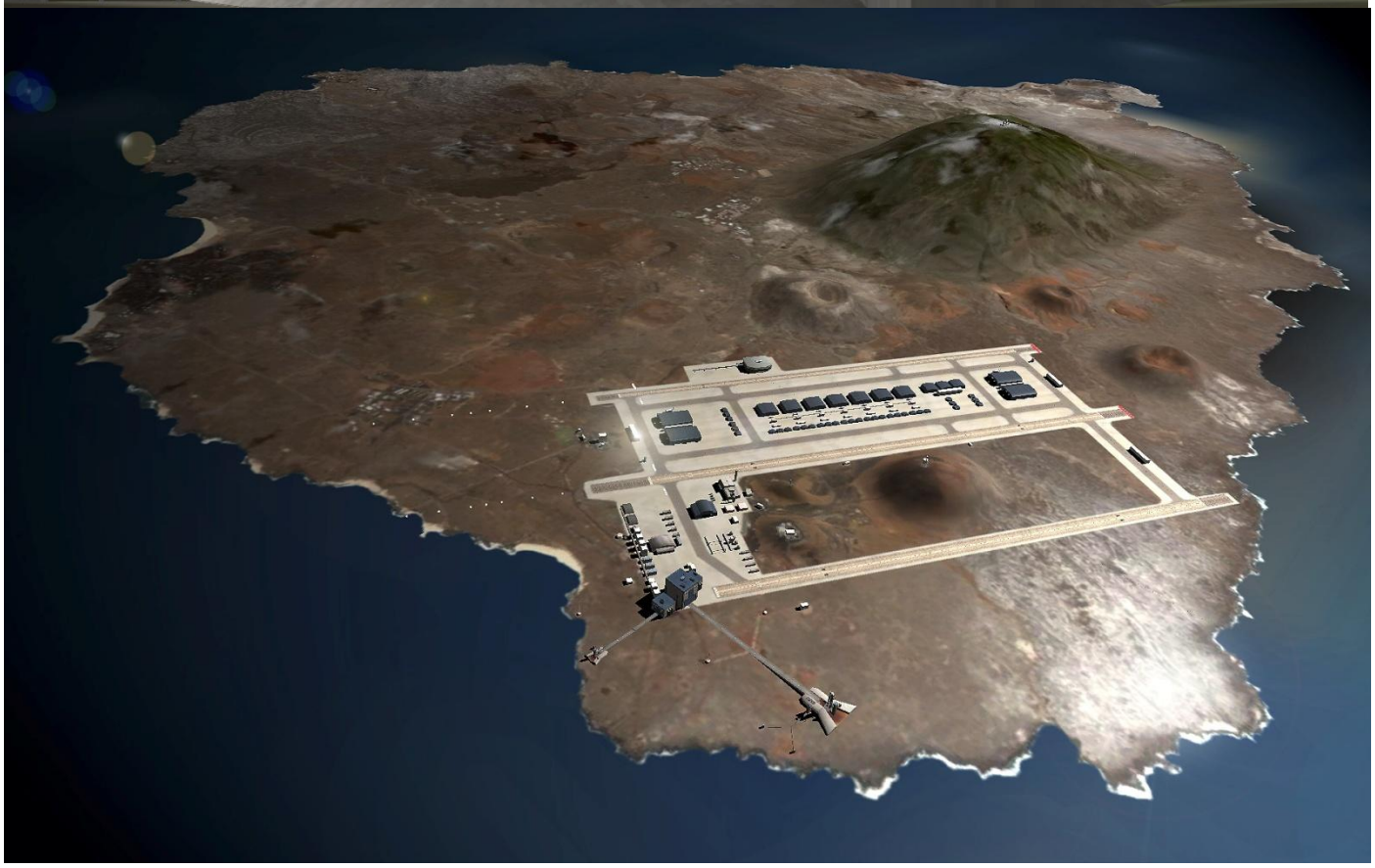
DV:
Any final words to the Masses before we strap you back to you programming chair?

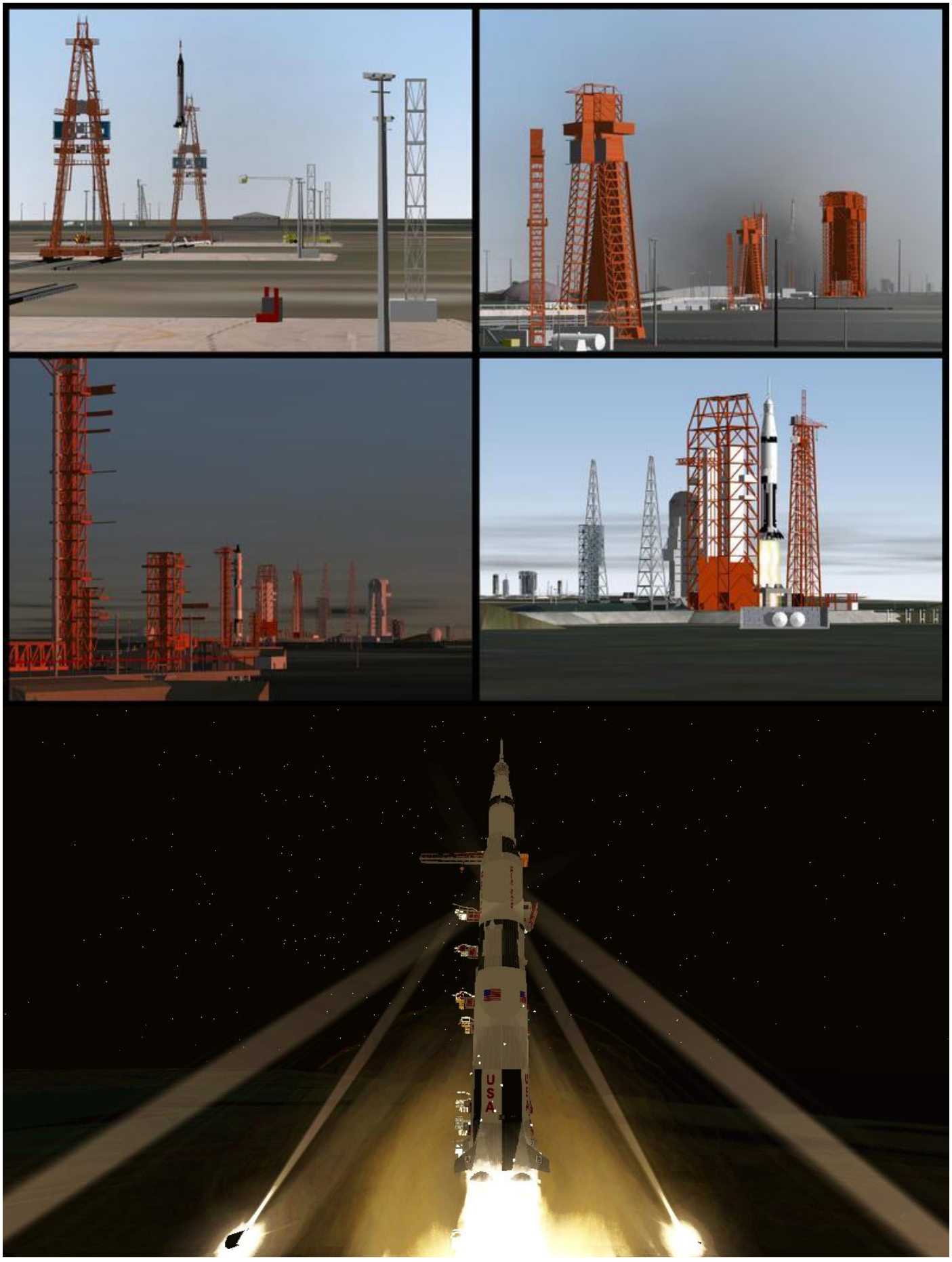
DB:
I want to give big THANK-YOU's to Dr. Martin Schweiger for creating Orbiter, to Tex for creating the new Orbiter-Forum.com which enabled us to get off M6, to DanSteph for his excellent DGIV, OrbiterSound, and UMMU add-ons, and last but not least, to all the add-on developers out there who make Orbiter even more interesting and fun. Here's to you guys! :)

DV:
Thanks for your time Doug

DB:
It was my pleasure.



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