SIMCOSMOS – Virtual Dreams

NASA VSE SC v2.0dev

(20060614 - MFL Edition)

for Orbiter v060504

ATTENTION!
- alpha doc - high probability of missing, incorrect or not final info/pictures - alpha doc -

http://simcosmos.planetaclix.pt
http://www.flickr.com/photos/simcosmos/
simcosmos@clix.pt
António Maia

0. Contents

- alpha doc - high probability of missing, incorrect or not final info/pictures - alpha doc -

1. Introduction - NASA VSE SC v2.0 (June2006DEV)

VSE = Vision for Space Exploration*
SC = simcosmos adaptation + extrapolations + creative liberties
DEV = in development

*This addon is based on NASA's ideas and goals for space exploration with some of them coming from the **E**xploration **S**ystems **A**rchitecture **S**tudy (**ESAS**): http://www.nasa.gov/mission_pages/exploration/news/ESAS_report.html

It also contains a few of my "own extra components" as well integrations with other author(s) addons.

The - still in development - files related with the current pdf are part of a mini-package distributed in the context of **Mars For Less** Project implementation for Orbiter Space Flight simulator (http://www.orbitersim.com) and also pretends to be a small demo of the ongoing updates and upgrades to my previous **NASA VSE SC (and SRB Launcher) v1.0**.

This is NOT the full NASA VSE SC v2.0 package (no release date for that one): parts of this mini-package contents (models, textures, configuration files, documentation, etc) might be in a non-finished, very rough, non-optimised, sometimes even less pretty and not fully tested state and, of course, several other components from the full package are missing in this demo… The reader can have an idea about a few of the missing things (some of them are cool and heavy ☺) by visiting my flickr photo set (please see link in first page) or if ever played with the previous versions that, in the moment I write these lines, still are available at Orbit Hangar Mods:

NASA VSE SC v1.0: http://www.orbithangar.com/searchid.php?ID=1957
SRB Launcher v1.0: http://www.orbithangar.com/searchid.php?ID=1298

Related Links:
http://www.orbitersim.com/Forum/default.aspx?g=posts&t=3978
http://forum.nasaspaceflight.com/forums/thread-view.asp?tid=2719&posts=1&start=1

Note: the two above addons have some less realistic parameters in their configurations, limited or outdated and/or less correct and/or less precise documentation and were released before Orbiter2006. NASA VSE SC v2.0 release will perhaps mean the removal of those earlier packages given that v2.0 plans to gather the best of them into a single package, for example, SRB Launcher v1.0 documentation was a lot better than the simple readme provided with NASA VSE SC v1.0… By other hand, that last one had more and better looking toys, better scenarios, etc

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Meanwhile I hope that all members and persons interested in **Mars For Less** have fun with the current demo: this zip should give a complementary and good enough medium lifter simulation that can be used for a few of that project needs, although this particular conceptual SRB launchers of mine are sometimes closer in concept with heavy lifter options (this will be more evident whenever NASA VSE SC v2.0 sees the light of the day and other SRB launcher “development paths and upgrades” are presented). For many more additional notes I **strongly** recommend an attentive reading to the rest of this document (also in a kind of alpha phase) in particular to the installation notes, performance notes and credits / conditions of use. Thanks!

MFL Related Links:
http://marsdrive.com
http://www.aovi93.dsl.pipex.com/mars_for_less.htm
http://flyingsinger.blogspot.com

2. Installation

It should be relatively easy to install these files:

Step1
Just unzip it into your main Orbiter2006 directory (keeping the folder structure).

Step2 – Overwrite Alert! (partially optional)
At least 2 files will be surely overwritten in Step1:

\Textures\Horizon.dds
\Textures\Star.dds

These are my custom textures for Earth's Horizon and for the Sun. The Horizon.dds was conceived for usage with NASA_VSE_SC_MFL scenarios and with the atmospheric parameters available inside the file:

Config\NASA_VSE_SC_MFL\System\03_Earth\00_Earth.cfg

AtmHazeColor = 0.812 1 1
AtmColor0 = 0.239 0.455 1

You have two options:

Step2.1) If liking the new Sun texture + Horizon texture and related parameters you might like to open Orbiter's default **\Config\Earth.cfg** and apply those two lines so that the atmospheric effect can also be viewed in scenarios exterior to my addon and using Orbiter's default Earth.cfg

Step2.2) If you do not like my atmospheric settings + textures:

Delete:
\Textures\Horizon.dds
\Textures\Star.dds

Find:
\Textures\Horizon_Orbiter20060504BACK.dds
\Textures\Star_Orbiter20060504BACK.dds

Copy + paste and then rename them to **Horizon.dds** and **Star.dds**. Last but not least, you might want to copy Orbiter's default Earth.cfg atm parameters to my addon's **00_Earth.CFG** (see information above)

Note: There is also a chance, for some persons, of overwriting **Modules\Stage.dll** and perhaps also **Config\Vessels\Stage.cfg** (Vinka's multistage.dll package): this is **OK**.

Step3 – Required / Included Addons

Francisdrake's ESAS CEV: http://www.orbithangar.com/searchid.php?ID=1972
- Included (thanks Franz): CEV-E in stowed configuration (just model, non-functional)
- Required: ESAS CEV addon (see link) IF wishing to release CEV-E from the SRB launcher.

Vinka's Multistage and Spacecraft.dll: http://users.swing.be/vinka/
- Included (thanks Vinka) inside my addon's directory structure. See site for full packages / docs

Dansteph's Orbiter Sound: http://orbiter.dansteph.com
- Required IF wanting to have sound.

Next is a list of all files included in NASA_VSE_SC_v2.0dev_MFL20060614:

\README_NASA_VSE_SCv2.0dev_MFL20060614.htm
Doc\NASA_VSE_SC_MFL\2.0_DEV\NASA_VSE_SCv2.0_MFL20060614.pdf

Modules\Stage.dll
Modules\NASA_VSE_SC_MFL\Vinka_genericDLL.txt
Modules\NASA_VSE_SC_MFL\multistage01.dll (+ 02.dll)
Modules\NASA_VSE_SC_MFL\spacecraft01.dll (+ 02.dll +03.dll)

Config\Vessels\Stage.cfg
Config\Spacecraft\[VSE_SC_MFL]CEV-E_001ISS.ini
Config\Spacecraft\[VSE_SC_MFL]Module1.ini

Config\NASA_VSE_SC_MFL\Launchers\CLV\!README_CODES!.txt
Config\NASA_VSE_SC_MFL\Launchers\CLV\CLV.cfg
Config\NASA_VSE_SC_MFL\Launchers\CLV\m110_CEV-E-A_001ISS.ini
Config\NASA_VSE_SC_MFL\Launchers\CLV\m110_CEV-E-A_001ISS.txt
Config\NASA_VSE_SC_MFL\Launchers\CLV\m110_CEV-E-A_EAST.txt
Config\NASA_VSE_SC_MFL\Launchers\CLV\u120_Module1_EAST.ini
Config\NASA_VSE_SC_MFL\Launchers\CLV\u120_Module1_EAST.txt

Config\NASA_VSE_SC_MFL\Spacecraft\spacecraft01.cfg (+ 02cfg + 03cfg)
Config\NASA_VSE_SC_MFL\Spacecraft\CEV_Franz\spacecraft01.cfg

Config\NASA_VSE_SC_MFL\Spacecraft\System\Sol.cfg
Config\NASA_VSE_SC_MFL\Spacecraft\System\03_Earth\00_Earth.cfg
Config\NASA_VSE_SC_MFL\Spacecraft\System\03_Earth\Base\Canaveral_SC2015.cfg,
(*rest of bases are equal to Orbiter's default ones… for now)*
Config\NASA_VSE_SC_MFL\Spacecraft\System\03_Earth\Base\Facilities\MLP-LUT.cfg
Config\NASA_VSE_SC_MFL\Spacecraft\System\03_Earth\01_Moon.cfg
Config\NASA_VSE_SC_MFL\Spacecraft\System\03_Earth\01_Moon\Base\
Copernicus.cfg, Descartes.cfg, Fra_Mauro.cfg, Hadley.cfg, Marius_Hills.cfg, Procellarum.cfg, Taurus_Littrow.cfg, Tranquillity.cfg (thanks to AMSO)

Meshes\NASA_VSE_SC_MFL\Launchers\CLV\1M_SRB5.msh
Meshes\NASA_VSE_SC_MFL\Launchers\CLV\2M-InterstageRCS.msh
Meshes\NASA_VSE_SC_MFL\Launchers\CLV\2M-J2S_DE.msh
Meshes\NASA_VSE_SC_MFL\Launchers\CLV\2M-J2S_DEcrg.msh
Meshes\NASA_VSE_SC_MFL\Launchers\CLV\3M-LES_CEV_1.msh
Meshes\NASA_VSE_SC_MFL\Launchers\CLV\Fairings\180_MFL_1.msh
Meshes\NASA_VSE_SC_MFL\Launchers\CLV\Fairings\180_MFL_2.msh

Meshes\NASA_VSE_SC_MFL\Spacecraft\CEV_Franz\CEV-E-launch.msh

Meshes\NASA_VSE_SC_MFL\Bases\03_Earth\00_Home\KSC\LC39_SC.msh
Meshes\NASA_VSE_SC_MFL\Bases\03_Earth\00_Home\KSC\MLP_LUT_SC.msh

Meshes\NASA_VSE_SC_MFL\Zahadum\zahadum.msh
Meshes\NASA_VSE_SC_MFL\Zahadum\zahadum_1.msh

Textures\Star.dds
Textures\Star_Orbiter20060504BACK.dds
Textures\Horizon.dds
Textures\Horizon_Orbiter20060504BACK.dds

Textures\NASA_VSE_SC_MFL\exhaust2_noalpha.dds
Textures\NASA_VSE_SC_MFL\exhaust_crcs.dds
Textures\NASA_VSE_SC_MFL\gen_silver.dds
Textures\NASA_VSE_SC_MFL\gen_solpan.dds

Textures\NASA_VSE_SC_MFL\Launchers\J-2S.dds
Textures\NASA_VSE_SC_MFL\Launchers\CLV\1ststage_SRB5seg.dds
Textures\NASA_VSE_SC_MFL\Launchers\CLV\1ststage_SRBbottom.dds
Textures\NASA_VSE_SC_MFL\Launchers\CLV\1ststage_SRBrec.dds
Textures\NASA_VSE_SC_MFL\Launchers\CLV\1ststage_SRBsmoke.dds
Textures\NASA_VSE_SC_MFL\Launchers\CLV\2ndstage_foam.dds
Textures\NASA_VSE_SC_MFL\Launchers\CLV\LOGO_NASA.dds
Textures\NASA_VSE_SC_MFL\Launchers\CLV\Misc1.dds
Textures\NASA_VSE_SC_MFL\Launchers\CLV\Fairings\180_MFL_L.dds
Textures\NASA_VSE_SC_MFL\Launchers\CLV\Fairings\180_MFL_Rdds

Textures\NASA_VSE_SC_MFL\CEV_Franz\cev-decals.dds
Textures\NASA_VSE_SC_MFL\CEV_Franz\cev-hatch.dds
Textures\NASA_VSE_SC_MFL\CEV_Franz\cev-rad.dds
Textures\NASA_VSE_SC_MFL\CEV_Franz\cev-silver.dds
Textures\NASA_VSE_SC_MFL\CEV_Franz\cev-solar.dds

Textures\NASA_VSE_SC_MFL\Bases\03_Earth\00_Home\KSC\N-LUT_Ares.dds
Textures\NASA_VSE_SC_MFL\Bases\03_Earth\00_Home\KSC\N-MLP_01.dds
Textures\NASA_VSE_SC_MFL\Bases\03_Earth\00_Home\KSC\N-Pad39_Ramp.dds

Sound\NASA_VSE_SC_MFL\NASA_VSE_SC_MFLsounds.txt
Sound\NASA_VSE_SC_MFL\SRB_124s.wav
Sound\NASA_VSE_SC_MFL\SRB_fairings.wav
Sound\NASA_VSE_SC_MFL\SRB_sep.wav

Scenarios\NASA_VSE_SC_MFL\Description.txt
Scenarios\NASA_VSE_SC_MFL\(2.0 – CLV (DEV20060614)\Description.txt
Scenarios\NASA_VSE_SC_MFL\(2.0 – CLV (DEV20060614)\m110_CEV-E-A_001ISS.scn
Scenarios\NASA_VSE_SC_MFL\(2.0 – CLV (DEV20060614)\u120_Module1_EAST.scn

3. Uninstalling

It should also be relatively easy to remove the files:

Step1
Just delete all folders called **NASA_VSE_SC_MFL** and that are placed under:

\Doc, \Config, \Modules, \Meshes, \Textures, \Sound, \Scenarios

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Step2 – Remember the **Overwrite Alert!** (partially optional)

Delete:
\Textures\Horizon.dds
\Textures\Star.dds

Find:
\Textures\Horizon_Orbiter20060504BACK.dds
\Textures\Star_Orbiter20060504BACK.dds

Copy + paste and then rename them to **Horizon.dds** and **Star.dds**.

Last but not least, change Orbiter's default Earth.cfg atm parameters to the defaults, in case you changed them to my suggestions.

Note: Regarding **Modules\Stage.dll** and perhaps also **Config\Vessels\Stage.cfg** (Vinka's multistage.dll package): if you are not a developer, perhaps the best is to leave them there or you can remove both if you are sure that will not need them on those positions for generic based dll addons (from other authors)…

Step3 – Required / Included Addons

Francisdrake's ESAS CEV: http://www.orbithangar.com/searchid.php?ID=1972
- The included CEV-E in stowed configuration (just model, non-functional) **is removed if deleting all NASA_VSE_SC_MFL folders**
- For the removal of ESAS CEV addon, **please refer to the documentation or folder structure of that zip**

Vinka's Multistage and Spacecraft.dll: http://users.swing.be/vinka/
- The files Included (thanks Vinka) inside my addon's directory structure **are removed if deleting all NASA_VSE_SC_MFL folders and reading Step2 above**. If you installed the full packages / docs, **please refer to that addon support site / docs / zip**

Dansteph's Orbiter Sound: http://orbiter.dansteph.com
- Required IF wanting to have sound. Are you sure you want to remove this!?
Please refer to that addon support site / docs / zip.

Step4
Delete \README_NASA_VSE_SCv2.0dev_MFL20060614.htm

4. The SRB Launcher – v2.0 (June2006DEV)

The SRB launcher concept is apparently simple: one solid booster acting as first stage and a liquid powered second stage. Due to a number of reasons, real life's SRB launcher will probably be a more restricted design than this virtual implementation: until word in contrary, it will be used only for ISS related missions (cargo / crew) and for crew transfer duties regarding exploration missions, in both cases, delivering a **C**rew(ed) **E**xploration **V**ehicle (**CEV**) into a sub-orbital trajectory. For all the rest, NASA will use the also in the plans heavy lifter, EELV (Delta / Atlas) or any other rocket. This is why the SRB Launcher is also widely known as **CLV** (**C**rew **L**aunch **V**ehicle)

However, in virtual world, we are not limited by political, economical, technical and other constraints: *our* SRB launcher, although based on real life plans, will not only act as a **CLV** but also as a cargo launcher for a number of different payloads and missions, with all the consequences that this brings to its design and implementation in virtual world.

On the following pages I will try to give a first overview of my options for conceptual SRB launchers or, if you prefer a more beautiful name, for Ares I (as it seems that will be the "name" of the launcher).

- alpha doc - high probability of missing, incorrect or not final info/pictures - alpha doc -

4.1) 5 segment SRB

4.1.1) Description

The 5 segment SRB keeps some heritage from the 4 segment boosters used on STS but also introduces new things and, because of that, it is in fact a new element. The most noticeable visual difference is probably the increase in length (extra segment) to accommodate more solid fuel. The internal grain geometry also changed (more about it later).

Other differences regarding the 4 segment SRB are (from bottom to top):

- new motor nozzle (wider, to handle greater thrust output)
- some kind of control element that might or might not be needed, on certain very specific conditions, for the first seconds of flight and pitch profile, while in the lower and denser layers of the atmosphere and if the thrust vector control (TVC) of the solid motor is not enough: in this specific case, those extra control elements are represented by 4 fins but this is just a visual representation (other option could be some kind of RCS in the SRB's bottom)… Anyway, real life SRB launcher might not need these additional control elements… In fact I'm including these fins mostly because they look cool, hehehe

- separation system (from interstage / second stage): from some real life news, the separation engines might be located on the interstage and that structure might go away with the SRB; however, in this simulation, the separation is done in a different way (more like Apollo) and that is why there are separation engines also in the bottom of the SRB, arranged in a symmetrical way

- new avionics and recovery system (addition of a bigger drogue and main parachutes for recovery from higher altitude than the ones experienced for the 4 segment SRB used on STS)

- conical adapter (linking with the interstage; separates after staging event)

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4.1.2) Thrust Curve

The SRB's thrust duration, variation and intensity is adjusted by playing with the fuel grain quantity, composition and geometry. This allows, among other things, to adjust the thrust accordingly with key moments of the ascent profile such as, for example:

- lift-off
- maximum dynamic pressure (max Q)
- 2nd part of the ascent, where the throttle must decrease in order to keep a comfortable environment for astronauts and cargo
- staging event

The 5 segment thrust curve that I'm using (thrust level vs time) is +/-based on real data. (ATK/NASA 1998 - alpha doc: more info about this to be included on final documentation)

The 5 seg. SRB data (~27 points) was extracted from a picture that was part of that study and will hopefully represent all the main variations. Those extracted points were later edited (for v2.0dev) mainly because my SRB launcher has a few configuration variants (only two of them are available in this zip) and I had to adjust it accordingly with a common factor for various types of missions.

alpha doc: on a later occasion this data will probably be reviewed but, for now, it seems that the performance is in concordance with expected values, despite the current simulation limitations. As a side note, less detailed data (less points) were also extracted to simulate a 4 segment SRB but, after some consideration, the 4 seg. version was abandoned (first in the virtual and then in the real world ☺).

Back to the thrust curve: the variation in grain geometry is not as *versatile* (in the lack of better expression) as the thrust variation in liquid boosters but it provides some (pre-defined) control and can also be considered as something elegant. For the moment (Vinka's generic dlls), I think that the best way of implementing the CLV's thrust curve is via a guidance file.

ATTENTION! The last paragraph means that a guidance file must be used for each SRB launcher mission and that the first part of the guidance file (until ~140s) must be equal, with exception for the roll program heading... All this to have a better 5 segment SRB simulation.

After interstage/second stage separation (~132s), the simulation of the 5 seg. SRB's full burnout (thrust quickly decaying to "zero value", which happens at ~138s or ~140s) is not currently simulated. The separation moment is defined by performance losses considering ~220t (alternative launcher variants) as maximum mass on the top of the SRB and also by a ~100t dead mass if the 5 seg. SRB remained attached much beyond those ~132s

Please remember once more that the current SRB implementation is not perfect: burnout masses (and also fuel mass) still needs to be adjusted as well the ISP, thrust curve, etc…

If the full burnout is implemented (with a custom dll, for example) it would affect the maximum SRB apogee by a few extra Km.

To sum up a long story, the first part of the ascent is smoother now…

G control: less than 3g

MaxQ: less than 39KPa
(depending of payload mass, roll program, etc)

… At least, regarding the 5 segment SRB performance, things are a little better than what happened on previous versions of the addon, and part of this was thanks to the thrust curve implementation, although in a clumsy way and not counting with the simulation of extra stuff like, just to give an example, thrust variations accordingly with the temperature of the day ☺

Note: later versions of NASA VSE SC might include 1st stage alternatives, for example:

- H2O2/Kero with 2 x RD-18X but keeping the same SRB core dimensions / shape
- H2O2/Kero stage acting as core for 2 x 5 seg. SRB or 2 other H2O2/ kero stages with respective upper stage adaptations…

Related links:
http://www.sworld.com.au/steven/pub/lrb.pdf
http://forum.nasaspaceflight.com/forums/thread-view.asp?tid=2694&start=1
Related images here:
http://forum.nasaspaceflight.com/forums/thread-view.asp?tid=2694&start=43
http://www.flickr.com/photos/simcosmos/160787412/
http://www.flickr.com/photos/simcosmos/161689267/

4.2) Interstage

This ~4.3t element makes the bridge between the SRB and the second stage. It is a structural ring with RCS (for SRB assistance / roll control) and 8 very efficient separation engines that, together with the separation engines available on the SRB, are a major player in the staging moment and also contribute for the first start of the dual J-2S derived engines.

4.3) Second Stage

The second stage is a mix between STS heritage (ET core) and Apollo heritage (engines).

Real life's second stage plans started by playing around with the concept of a modified and expendable SSME variant. However, the modifications to make such engine capable of being air started (without launch pad support) caused a shift to a J-2S derived engine (J-2X), which by its turn caused the move to the 5 segment SRB.

In virtual reality, I never used the SSME and went to J-2S derived engines from the start mainly because of their built-in air start / restart capability. The virtual second stage also evolved into a twin-engine configuration due to:

- Redundancy: engine out capability
- Performance: equivalent to SSME

The J-2S derived engines are using **J-2S80** thrust and ISP numbers:

Thrust = **2424280.780N** (2 x 1212140.39N); ISP (vac) = **448.3s**

note: alpha doc - alpha doc - alpha doc - alpha doc - alpha doc - alpha doc - alpha doc: the final documentation will probably contain a J-2S derived engines comparison table with thrust, ISP, engine dimensions, more info about the second stage, etc…

Until recently I was using ESAS J-2S+ numbers (2442073.666N, 451.5s ISP) but, in the end, decided for the J-2S80… I do not know what the J-2S80 dimensions are … I just modelled the engines having the J-2S dimensions as reference and they seem to fit ok in a 5.5m diameter stage although it would not be a comfortable fit. Their gimballing capability, inside the interstage, would be reduced to a safe value of just 2 or 3 degrees in the yaw plane (+/- 6 deg. for pitch plane) in order to avoid contact with the interstage walls while conducting the pre-launch tests. If necessary, the twin RCS pods, on the sides of the stage, provide additional attitude control for the second part of the ascent. The J-2S80 should also have a low thrust mode, for precise orbital tweaks.

This conceptual stage has been prepared (main propellant tanks size, RCS, etc) for full orbital insertion and for multiple restarts (something that will probably not happen with real life's CLV). Such multiple restart capability (from 3 up to 5 times) is represented by all those small elements located on the stage's bottom: as what happens with other 3D / textures details, these are just a visual representation that "something" is there with "some" function but it does not pretend to be a 100% correct representation.. Final notes: there are two basic 2nd stg variants: one for upper stages or payloads having a 5.5m diameter, the other - with a special adapter – more oriented for other diameters / cargo flights. I also have plans to use second stage modifications to serve as space tugs and as small temporary space stations.

4.4) Performance Data

1st Stage	
Configuration	5 segment SRB
Dimensions	53.4m /~3.7m diam.
Propellant Mass	646735Kg
Dry Mass	106735Kg
Total Mass	753470Kg
Max. Thrust	15480358N
ISP	265.8s
Burn time (@100% thrust / vac.)	~108.5s
Burn time (operational)	~132.0s
2nd Stage	
Configuration	2 x J-2S80
Dimensions	28.2m / 5.5m diam.
Propellant Mass (with RCS)	140000Kg
Dry Mass	bas: 15444Kg crg: 16000Kg
Total Mass	bas: 155444Kg crg: 156000Kg
Max. Thrust	2424281N
ISP	448.3s
Burn time (@100% thrust / vac.)	~254.0s
Vehicle Performance	
Max Q	<~39KPa 11Km alt., Mach~1.5, MET=055.00s
SRB separation	63.5 to 67Km alt., Mach~5.8, MET=131.56s apogee ~95Km to 100Km alt. splashdown range (from KSC) ~420Km
2nd stage ignition (interstage sep.)	66 to 70Km alt., Mach~6.0, MET=137s
MECO	mission / payload dependent, MET=417s, 435s, etc
Max Gs	3.0g
Payload 28.5 deg	28t, 200Km alt. 30t to lower orbit or sub-orbital injection
Payload 51.6 deg	26t, 400Km alt.

Extra performance data and sources are available inside: \Config\NASA_VSE_SC_MFL\Launchers\CLV (see INI)

- alpha doc - high probability of missing, incorrect or not final info/pictures - alpha doc -

Global Comments:
The included guidance autos are not optimised yet. Performance numbers not final too.

By keeping the 5seg.SRB + 155t class 2nd stage and adding a 3rd stage, the vehicle should be capable of comfortably and directlely deliver ~6t (preliminary minimum number) to a geostationary orbit with all the implications this brings to cargo delivery regarding other planetary bodies such as the Moon, Mars, etc and to other performance numbers...

The planned upper stages are based on Centaurs used on Atlas V (~22t, RL-10-A4) or Delta IV (~30t, RL-10-B2) rockets, possibly even a multi RL-10 eng. variant, another one based on J-2S derived tech (the last one perhaps requiring a 1st stage modification)... The delivered payload for interplanetary missions might double / increase by using a dual / multiple launch strategy and orbital assembly: this should allow for interesting mission profiles until I implement the heavy lifter. Even after the heavy lifter makes its appearence, the upgraded SRB launcher should be a very nice complement for smaller payloads (in the 10t up to 40t? range)

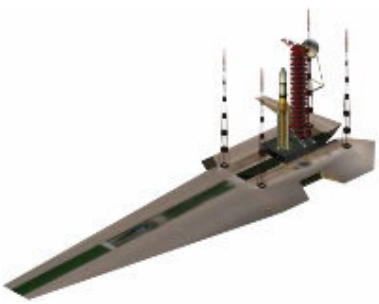
5. Cape Canaveral, Earth's atmosphere and the Sun

Cape Canaveral will require quite a few changes to support the planned new launch vehicles. Those modifications will happen on the VAB, launch pads and other support hardware / facilities. These changes will be something similar to what happened during the Apollo to STS era transition.

Focusing only on the launch pads…

A while ago I was playing with the following concept:

- the current STS fixed service tower would be maintained, perhaps even simplified on some aspects and suffer an height increase; it would be used for access to the launcher and perhaps also for propellant transfer
- everything else from STS era would be "deleted"
- a new universal mobile launch platform (MLP) would be made and a minor umbilical tower would be present there; such tower would provide electrical interfaces and, if the main tower design was really simplified, it would also be used for propellant transfer duties



However, after thinking a little more about the issue, I decided to do something more like the original Apollo intentions:

- **clean pad approach**
- universal MLP with a bigger tower that will serve for all needed access to the launcher (astronauts, engineers, electrical, propellants)
- 4 lightning protection towers

Only the future will tell what is going to happen in real life. Back to the already mentioned above **Universal MLP**: the virtual version is probably quite different than a future real life variant… This happens because my virtual toys are based in an alternative reality… Among other things, we should have one heavy lifter variant powered by 4 SRB!

So, the idea here is to make something extremely modular: the same type of launch pad and MLP should be capable of supporting:

- Basic SRB launcher variants and also their heavy variants
- Basic Heavy Lifter and respective evolution path

On a future occasion I will also probably add one or two extra smaller pads just for the basic versions of the SRB launcher in order to allow for a more effective launcher management when the launch rate starts increasing in the virtual reality. Those new pads will also probably have a mobile service tower like in LC40 (Atlas) or LC37 (Delta)...

The new conceptual launch pads assume much more standardized launcher and payload preparation and integration procedures than what happens with STS.

The current concept for Pad39 A and B is not final yet: changes might happen with the progress of the development work. The same can be written regarding visual upgrades such as the addition of animated arms to the MLP tower, etc.

Note1: The included pad39A and 39B have 2 observer cameras (press **CTRL+F1 + Ground** to select, use **target lock** having as target the launcher in one of the pads).

Note2: There are "4" pad definitions that can be used in the scenario files. Next are their designations and objectives:

PAD 11 = 39A = HLV or 3 x core SRB launcher
PAD 12 = 39B = HLV or 3 x core SRB launcher

PAD13 = 39A = SRB Launcher
PAD14 = 39B = SRB Launcher

Note3: The MLP+LUT are currently implemented in the scenario files as a non-selectable "vessel": this allows for an easy visual preparation of launch scenarios (addition / removal of MLP+LUT from pads), please compare the provided scenarios to see what I mean.

NASA VSE SC v2.0dev: Earth's Atmosphere and the Sun

To end this chapter, as you saw on the install notes, this zip comes with my own versions for:

- Earth's horizon (texture and colour)
- Sun (texture)

These are also work in progress. The starting point for the tweaks, in particular for the atmospheric tweak, was not a 100% realistic concern but, instead, to have something more visually appealing both when flying at lower altitudes and in low earth orbit (when comparing with Orbiter's default settings)

The lower altitudes "requirement" appears because, in some future moment, I would like to implement a lifting body CEV concept and also because there are many cool airplanes available for Orbiter… This to not talk about other possible low altitude requirements (SRB recovery boats? hummm) and a future integration with Sputnik's HL-20 and Francisdrake's Biconic CEV (like in v1.0 of NASA VSE SC).

6. Legal Stuff, Credits and Thanks

6.1) First, about my work and legal stuff

Except for the cases that will be referenced in the next page (6.2) **I'm the author of all contents included inside the zip.**

Making a few generic comments and sometimes being more specific about the 3D models (SRB launcher and Launch Pad Components - original files are in .an8 format (anim8or)): they are not a masterpiece of art but I would like to write some "terms of usage"

- People do not need to contact or give me credit when uploading screenshots of these models to public web spaces or forums unless those images are intensively used for a presentation, multimedia production or any other project. On such cases please let me know first about that project and give at least the following credit:

  António Maia (http://simcosmos.planetaclix.pt)

- The contents of this package must remain together. Unless for private use or other special occasions (where I should be informed and agree about) people are not allowed to change and / or extract parts of this package and redistribute that derived work without my previous permission.

- To be explicit: it's OK to redistribute this zip package (in compressed state) as long as the original zip name, folder structure and contents are kept exactly the same as I made them. However, have in mind that I only commit myself to quickly support the non-dev marked package versions (the current one is a dev marked zip btw) of the specific Orbiter version they were made for (read: current Orbiter version) and that, except for special occasions, only support the packages that I personally uploaded to public distribution places.

In all cases, do not claim to be the author and please give the proper credits. If having any doubt regarding these issues, just contact me! (email on first page)

Other very important notes:

About all files: do not make money with them!

And, the usual:

Use all these files at your own risk!
I'm not liable for any bad stuff that happens!
(ex: CTD, data loss, health problems, etc)

6.2) Collaborators / Credits

Next is where I will try to sum up the credits for all the included components that were not fully made by me. If seeing any incorrect information or if you feel there is a missing credit please email so that I can solve the issue as soon as possible (from the moment I read the email). Thanks!

Components	Author and/or Origin and/or + Info
Modules\Stage.dll Modules\NASA_VSE_SC_MFL\multistage01.dll (+ 02.dll) Modules\NASA_VSE_SC_MFL\spacecraft01.dll (+ 02.dll +03.dll)	**Vinka**'s generic DLL http://users.swing.be/vinka/
Particle settings tip for SRB launcher's smoke: http://www.orbitersim.com/Forum/default.aspx?g=posts&t=3978 (20050802)	**Randolph Vallee** (aka **Lambo**)
CEV-E in launch configuration + exhaust texture Meshes\NASA_VSE_SC_MFL\Spacecraft\CEV_Franz\ CEV-E-launch.msh Textures\NASA_VSE_SC_MFL\CEV_Franz\cev-decals.dds Textures\NASA_VSE_SC_MFL\CEV_Franz\cev-hatch.dds Textures\NASA_VSE_SC_MFL\CEV_Franz\cev-rad.dds Textures\NASA_VSE_SC_MFL\CEV_Franz\cev-silver.dds Textures\NASA_VSE_SC_MFL\CEV_Franz\cev-solar.dds Textures\NASA_VSE_SC_MFL\exhaust_crcs.dds	**Franz Berner** (aka **francisdrake**) ESAS CEV addon: http://www.orbithangar.com/searchid.php?ID=1972
Apollo landing locations for: Config\NASA_VSE_SC_MFL\Spacecraft\System\03_Earth\01_Moon.cfg	**Alain Capt** (aka **ACSoft**) http://www.acsoft.ch/AMSO/amso.html
\Config\NASA_VSE_SC_MFL\System\03_Earth\Base*.*cfg	- Except for Canaveral_SC2015.cfg all other base cfg are an exact copy of Orbiter's Earth bases
Textures\Star.dds ---------- Textures\Star_Orbiter20060504BACK.dds ---------- Textures\Horizon.dds ---------- Textures\Horizon_Orbiter20060504BACK.dds ---------- Textures\NASA_VSE_SC_MFL\exhaust2_noalpha.dds ----------	- Star based on NASA pic; Orbiter default alpha - Original file from Orbiter 20060504 (backup) - Horizon based on Mig-25 pic; Orbiter def. alpha - Original file from Orbiter 20060504 (backup) - Orbiter's default exhaust2.dss but with no alpha
Textures\NASA_VSE_SC_MFL\Launchers\CLV\1ststage_SRBsmoke.dds Textures\NASA_VSE_SC_MFL\Launchers\CLV\1ststage_SRB5seg.dds Textures\NASA_VSE_SC_MFL\Bases\03_Earth\00_Home\KSC\ N-MLP_01.dds ---------- Textures\NASA_VSE_SC_MFL\Bases\03_Earth\00_Home\KSC\ N-Pad39_Ramp.dds ----------	- Smoke based on NASA's STS launch photo - Based on 4 seg. SRB pic from: http://www.safesimplesoon.com - Based on NASA's Apollo or STS MLP images - Based on NASA's STS aerial photo of pad39A
Textures\NASA_VSE_SC_MFL\Launchers\CLV\Fairings\180_MFL_L.dds Textures\NASA_VSE_SC_MFL\Launchers\CLV\Fairings\180_MFL_Rdds	**http://www.marsdrive.com**

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final doc will perhaps also have a few pdf / forums links for data sources

6.3) Extra Credits and Final Thanks

Beyond all mentions made in the previous page I would also like to thank:

Dr. Martin Schweiger (and all collaborators)
Orbiter, Orbiter, Orbiter, Orbiter, Orbiter, Orbiter, Orbiter ;-D
Orbiter, Orbiter, Orbiter, Orbiter, Orbiter, Orbiter, Orbiter ;-D
http://www.medphys.ucl.ac.uk/~martins/orbit/orbit.html

Dansteph for Orbiter Sound
http://orbiter.dansteph.com

Mike Majeski aka gladiator1332
For the inspiration, with your earlier addon about the SRB launcher:
that was the start of NASA VSE SC!

Bruce Irving aka FlyingSinger
http://flyingsinger.blogspot.com
For the emails regarding **MFL** Project + logo(s)

Chris Bergin from http://nasaspaceflight.com for such interesting site / forum contents as well to all participating there. In particular, thanks to Ross aka **Kraisee** for the tip regarding the 5 segment thrust curve data.

R. Steven Glanville
anim8or - not the heaviest 3D editor around
and that is why I love it
http://www.anim8or.com

Martin Wright
DXTBmp, cool to convert dds
http://www.mnwright.btinternet.co.uk

All persons with whom I "addon-cooperated" in the past / team now (things like this zip distract me from a few lonely and cooperative projects… arghhhh, so little time, so many things to do…Thanks for the patience!).

Thanks also to the **Orbiter Community** in general and, in particular, to those having positive attitudes, free time, blablablabla, etc to contribute and participate, in any way, to help us all enjoy even more this fantastic program!

And to end… If you liked this addon and want to thank me, here goes one of many special ways: try to do an addon, even if it is something simple, even if you do not release it. If you want to make something public, try to follow a few basic guidelines (search the forum, Orbiter pdf + SDK, community sites for info; start with something simple if not familiar with general addons dev, etc) and prepare a good zip.

Once you start and if you enjoy the experience, I'm afraid that there might be no way back, muhahahahaha!

- Boring Appendix: Payload Guide and Customisation Tips -

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Dear reader, if you are new to Orbiter space simulator or if it's the first time you wish to add your own payloads I highly recommend a good, calm and very attentive reading at Vinka's great generic dll documentation available here: http://users.swing.be/vinka/

The process of adding a payload might be greatly simplified on later of my addon versions… I'm trying to organize all for eventual interested coders to do what they know best ;-)

But this still might take quite a while to prepare, mostly due to my fault (other ongoing real and virtual life projects…). Meanwhile here go a few tips!

There are 3 types of "vessels" for Orbiter simulator, powered by different "technologies"

- **CFG** vessels
- **Spacecraft generic DLL** based vessels
- **custom DLL** vessels

CFG vessels have all their physical parameters (3D model reference, empty and fuel masses, thrust, cross sections, principal moments of inertia, etc) defined in a simple text file having **.cfg** as extension and located under \Config or \Config\Vessels (or other places). This is the simplest method of having something in Orbiter but it has limitations such as: not possible to define more advanced physical parameters, animations…

Custom DLL vessels use, as the name implies, a **dll** with all their properties inside (dll called by a very simple cfg). On these cases, the limits of what can be implemented on a given vessel are only imposed by the Orbiter version capabilities and the imagination of the author but… this requires programming skills (c++)… If you do not know what is a compiler or what sdk means then please advance to…

Last but not least, the better of the two worlds: the **spacecraft generic dlls**! These are dll that can be used for a lot of different vessel implementations and that interpret the physical properties from simple text files, this time with an **.ini** extension. People do not need to code c++ but can easily add advanced features to their vessels (such as virtual cockpits, animations, particle effects, custom exhaust textures, advanced physical properties, remote arms, etc) as long as they are supported by the gen. dll.

If by now this is sounding confusing, the only thing I can recommend to the reader is a good view at Orbiter documentation and at Vinka's site: take your time to learn about these things.

Now, an **IMPORTANT** note:

Unless I made something wrong, simple CFG vessels or spacecraft.dll (v040110) seem to have a small problem with multistage2.dll (v050721) launchers (the version I'm using to implement the current SRB launcher). When these type of payloads are released they loose all the fuel.

So, I strongly recommend that you only try to implement, as payload for this SRB launcher, vessels based on spacecraft2.dll (v050721) or spacecraft3.dll (v060302) or custom dll vessels (the last ones require a workaround).

A) Creating a launcher configuration with the custom payload

- Go to **\Config\NASA_VSE_SC_MFL\launchers\CLV**

Two ini (launcher configurations) are available there:
m110_CEV-E-A_001ISS.ini
u120_Module1_EAST.ini

The one you will want to use as template will depend of your intended payload: if the payload has a service module similar to the one of Francisdrake's CEV-E then you should use **m110_CEV-E-A_001ISS.ini**: if needed, you can also copy + paste the fairing definitions from the other INI, etc.

If your payload is more like a big satellite or space tug with a maximum diameter of 5m, etc, then **u120_Module1_EAST.ini** should be the best template. Assuming that it is the case (**spacetug for an ISS mission and powered by spacecraft3.dll**)…

- Copy + paste **u120_Module1_EAST.ini** and rename it to:
u120_<payload's name>_<mission, launch heading or orbital inc., etc>.ini

ex: **u120_SpaceTugXP3O_ISS.ini**

- Open **u120_ SpaceTugXP3O_ISS.ini**
Modify the header with the relevant info, if you wish:

```
;==========================
;NASA_VSE_SC
;SRB Launcher SC INI
;António Maia aka simcosmos
;http://simcosmos.planetaclix.pt
;v2.0dev (20060611)
;(5 segment SRB + 2nd stg: 2 x J-2S80)
;==========================
;Payload:
;UnManned – SpaceTugXP3O_ISS by <your name>
;http://<your-site-url-here.com>
;http://
;==========================
```

A.1) About Custom Fairings

- Scroll all the way down to the fairing definition: **leave things as they are if not wishing to have the extra customisation work (move to the next page)**

or…

[FAIRING]
N=2
;Write the full path to the fairing main designation, for example if:
;\Meshes\NASA_VSE_SC_MFL\Launchers\CLV\Fairings\180_SpaceTugXP3O_1.msh
;\Meshes\NASA_VSE_SC_MFL\Launchers\CLV\Fairings\180_SpaceTugXP3O_2.msh

Then:

MeshName="NASA_VSE_SC_MFL\Launchers\CLV\Fairings\180_SpaceTugXP30"
Diameter=5.6
Height=18
angle=0
off=(1.401,0,64.32)
EmptyMass=3572

rot_speed=0.52

IMPORTANT!
You need to have two fairing meshes with the exact same name as the one used in the [FAIRING] definition except that one must end in **_1** and the other in **_2**.

In the example above:
180_SpaceTugXP3O_1.msh and **180_SpaceTugXP3O_2.msh** are simple copies of the original 18m length / 5.5m diameter fairings called:
180_MFL_1.msh and **180_MFL_2.msh**.

Once you make the copy + paste + renaming, use notepad to open:
180_SpaceTugXP3O_1.msh and **180_SpaceTugXP3O_2.msh**

Search the texture definition in the end of each file and respectively change to:
NASA_VSE_SC_MFL\Launchers\CLV\Fairings\180_SpaceTugXP3O_R.dds
NASA_VSE_SC_MFL\Launchers\CLV\Fairings\180_SpaceTugXP3O_L.dds

Then go to:
\Textures\NASA_VSE_SC_MFL\Launchers\CLV\Fairings

And use the original files as templates to create the new custom textures for your specific payload.

A.2) Custom Payloads

- Now for the payload(s) definition (**generic dll payloads**)...

Search the payload definition on…
\Config\NASA_VSE_SC_MFL\launchers\CLV\u120_SpaceTugXP3O_ISS.ini

Note: I might include a few extra payload adapters on a next version…

```
[PAYLOAD_1]

;Write the full path to the mesh in stowed / launch configuration
;example (adapt as needed), for:
;\Meshes\SpaceTugXP3O\SpaceTugXP3O_stowed.msh
MeshName="SpaceTugXP3O\SpaceTugXP3O_stowed"

;Adjust the position of the 3D model
;(X=left/right, Y=up/down, Z=altitude)
off=(0,0,59.8)

;Height, diameter (m) and mass (Kg) should be self explanatory
Height=10
Diameter=5

Mass=28000
```

```
;You can use Vinka's cfg >> dll on my custom directory structure:
Module="NASA_VSE_SC_MFL\Spacecraft\spacecraft03"

;Or… point to their original location, IF you have installed Vinka's packages or
addons that use these files in their default location…
Module="Spacecraft\spacecraft3"

;Exact name of the spacecraft.dll INI located under \Config\Spacecraft\
;To keep files organized I recommend using some kind of naming
;convention, for example, I started the files related with this packaged with
;[VSE_SC_MFL]; use something like that or feel free to other convention
Name="[VSE_SC_MFL]SpaceTugXP3O"

SPEED=(0,0,2)
ROT_SPEED=(0,0,0)

Render=1
```

Now go to **\Config\Spacecraft** and copy +past + rename:
[VSE_SC_MFL]Module1.ini to **[VSE_SC_MFL]SpaceTugXP3O**

Please go to vinka's site and download the full zips to learn how to implement features on generic.dll ini files.

- For custom **dll payloads** the only way I found to have a functional vessel is a kind of ugly workaround and it is basically like this:

1. The payload definition on the multistage2.dll launcher ini should have the payload mass and point to a spacecraft.dll based ini

2. That spacecraft.dll ini is just a bridge between the multistage2.dll ini upper stage and the custom dll payload: it has no physical properties of note and has an invisible msh.

3. The payload definition of that spacecraft.dll ini contains the true payload references…

To add to the confusion, this only seems to work with the a given choice of focus parameters on the multistage launcher and dummy spacecraft INIs and with the older spacecraft.dll acting as the "payload generator"…

If your head is hurting by now maybe it is best to stop here, hehe
Else you might want to pass the eyes by how I integrated francisdrake's CEV-E

ATTENTION!

Not all custom dlls allow this creation method! Some addons require settings on the scenario files: if they are not there and if the addon is not programmed to start with default settings then you might have a nice crash to desktop.

Also: you need to have access to the mesh in stowed / launch configuration

B) Guidance File

Copy + Paste + Rename:
Scenarios\NASA_VSE_SC_MFL\(2.0 – CLV(DEV20060614)\u120_Module1_EAST.scn

To:
Scenarios\NASA_VSE_SC_MFL\(2.0 – CLV (DEV20060614)\u120_SpaceTugXP3O_ISS.scn

Now, open that file and change the target launch heading (roll program) from **90** to **42** (for this example we are assuming that SpaceTugXP3O is going to ISS)

```
|=====   ROLL   =====]
4.85=engine(100,98.88,3.24)
6=roll(3,89,42,78,1)
```

You can next either keep the rest of the guidance file like the original and will end up with a result that will be different accordingly with the payload mass or… You can tweak the guidance to meet specific mission goals (please see Vinka's multistage full package for documentation). If choosing to tweak the guidance do **NOT** change anything until the 132s mark! Remember that the 5 segment SRB thrust curve is currently being simulated with the guidance files! So, start changing the pitch after the 132s in order to reach your desired orbital parameters… Ho, do not forget that fairings should go away at an altitude of 130Km or 135Km.

C) Last Step: the launch scenario!

Copy + Paste + Rename:
Scenarios\NASA_VSE_SC_MFL\(2.0 – CLV (DEV20060614)\u120_Module1_EAST.scn

To:
Scenarios\NASA_VSE_SC_MFL\(2.0 – CLV (DEV20060614)\u120_SpaceTugXP3O_ISS.scn

Open the file and change its description, as you like.

You just then need to replace…
U-Module1 references by **U-SpaceTugXP3O**
And…
u120_Module1_EAST by **u120_ SpaceTugXP3O_ISS**

```
BEGIN_FOCUS
  Ship U-SpaceTugXP3O
END_FOCUS

BEGIN_CAMERA
  TARGET U-SpaceTugXP3O
  MODE Extern
```

And…

```
U-SpaceTugXP3O:NASA_VSE_SC_MFL\Launchers\CLV\CLV
  STATUS Landed Earth
  BASE Cape Canaveral:14
  ;BASE Cape Canaveral:11
  HEADING 90.00
  FUEL 1.000
  CONFIG_FILE
Config\NASA_VSE_SC_MFL\Launchers\CLV\u120_SpaceTugXP3O_ISS.ini
  GUIDANCE_FILE Config\NASA_VSE_SC_MFL\Launchers\CLV\u120_SpaceTugXP3O_ISS.txt
  CONFIGURATION 0
  CURRENT_STAGE 1
  CURRENT_PAYLOAD 1
  FAIRING 1
END
```

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All what is written in this appendix is just an example!

Use what works best for you… On my case I just decided to create a custom directory structure… However this is not the most common approach.

Once again, if you are new to this, please read Vinka's documentation and try to understand what you are doing. Like wrote above, perhaps one day my launchers will be more friendly to configure but, meanwhile, this is the current state of the work: you can try to implement custom payloads or wait for a next version where I will add more of my toys, integrate a few extra addons (by providing all the required files) or wait even longer(!) (for an eventual custom dll implementation of the SRB launcher).
Have fun!