

VRX 10-2.2

THE DEPARTMENT OF SPACE DEPARTMENTS

S.H.E.R.P.A. Mk 404
“RED ROVER”

OPERATIONS MANUAL

DO NOT FOLD

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GETTING STARTED

1. Find Red Rover on Steam
2. Click Install
3. On first run, Red Rover will launch into a tutorial level that will familiarize you with the controls.
4. Enjoy! Don't do anything I wouldn't do.

WHY RED ROVER?

When I was a kid, there was an unspoken assumption that when I grew up we would be living in space, working on the moon, and exploring Mars.

Well, I grew up. Worked on some pretty cool feature film and game projects, but the space exploration part never quite took off.. so I figured it was time to create my own 'space program'..

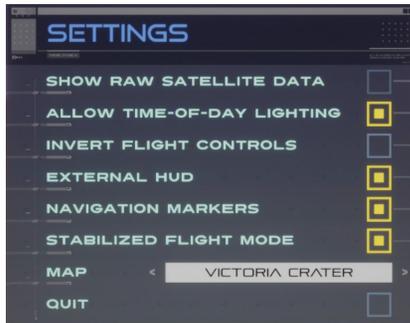
Red Rover takes satellite and terrain data from NASA'S HiRISE Mars orbiter and incorporates it into a driving simulator. I'm taking my decades of movie magic experience and putting it towards making something that lets me virtually experience the real planet Mars (subject to current technological VR limitations, of course)

Red Rover started as a personal research project a few years back - because I've always wanted to explore Mars. With the growth of VR technology and available data from NASA, I've taken the opportunity to make this happen, and I'm now making this available on Steam so that like-minded explorers can get to explore Mars as well! No missions to do, no highscores to beat, just nine large curated Mars datasets for you to explore!



SETTINGS

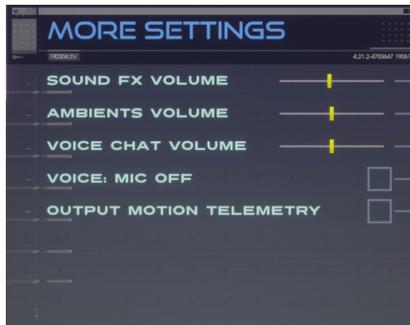
Toggle the Settings panel with **ESC** or **Numeric Keypad 0**, or the **menu button on your gamepad**



- 1. SHOW RAW SATELLITE DATA**
For Red Rover we've augmented the satellite texture with tiled sand, rock and gravel texture maps to give the ground a better sense of scale. To explore the original raw satellite data, turn this option on. (Note: this also disables Time-of-Day Lighting)
- 2. ALLOW TIME-OF-DAY LIGHTING**
This option allows you to control the position of the sun. Using the d-pad or numeric keypad, you can position the sun to show the Martian terrain at different times of the day. Note that in the interest of giving you godlike powers, it is possible to actually position the sun where it would never be IRL - ie, shining from the north pole.
- 3. INVERT FLIGHT CONTROLS**
Forward & Backwards thrust Vectoring controls are reversed for people who don't fly space rovers the same way I do.. (I'm lookin' at you Enrique)
- 4. EXTERNAL HUD**
Turns off the external hud so you can simply *drive*. We recommend putting on Bowie or a selection of your favorite space driving music on your music app to accompany you on the trek across Martian terrain.
- 5. NAVIGATION MARKERS**
We've left a few 'artifacts' on Mars to mark some of the great vistas we've discovered. The maps are huge, so it's probably safe to say that we ourselves have not managed to explore everything in its entirety. (each map is 5km by 5km, except for Noctis Labyrinthus, which is 5km by 10km)
- 6. STABILIZED FLIGHT MODE**
The jumpjet vector thrust system is the bee's knees, but can cause VR discomfort if not flown correctly, especially if you are prone to motion sickness. For a more civilized experience, the Stabilized Flight Mode makes jumpjet flying as babysoft as Tesla autopilot (but you still have to keep your hands on the gamepad)
- 7. MAP**
Pick a map to explore! Left/Right on the dpad, or 4/6 on the numeric keypad. Enter selects.
- 8. QUIT**
Return to Earth.. :(

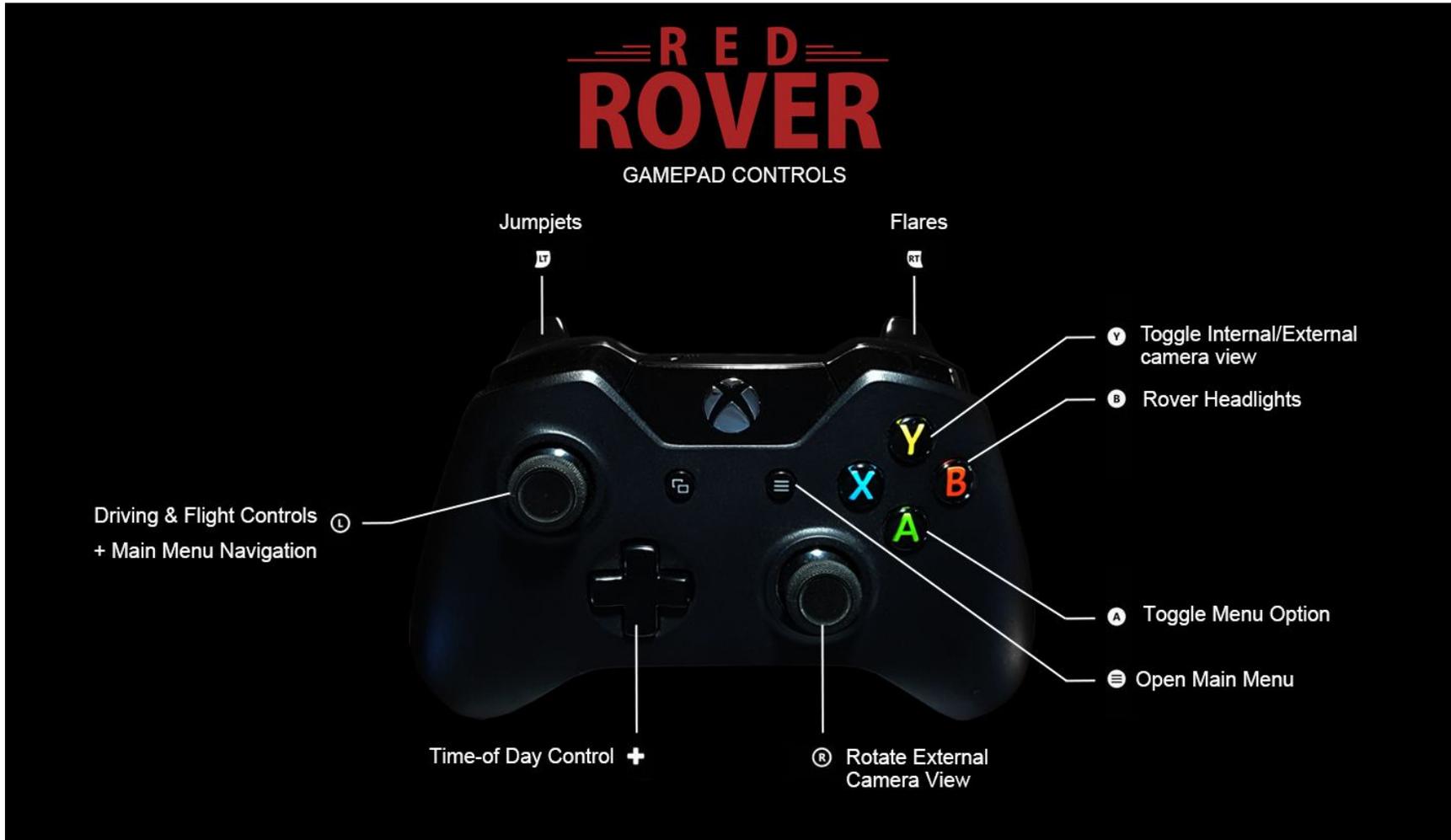
MORE SETTINGS

The More Settings panel is accessible from the main menu by using [and], or left and right shoulder buttons on your gamepad

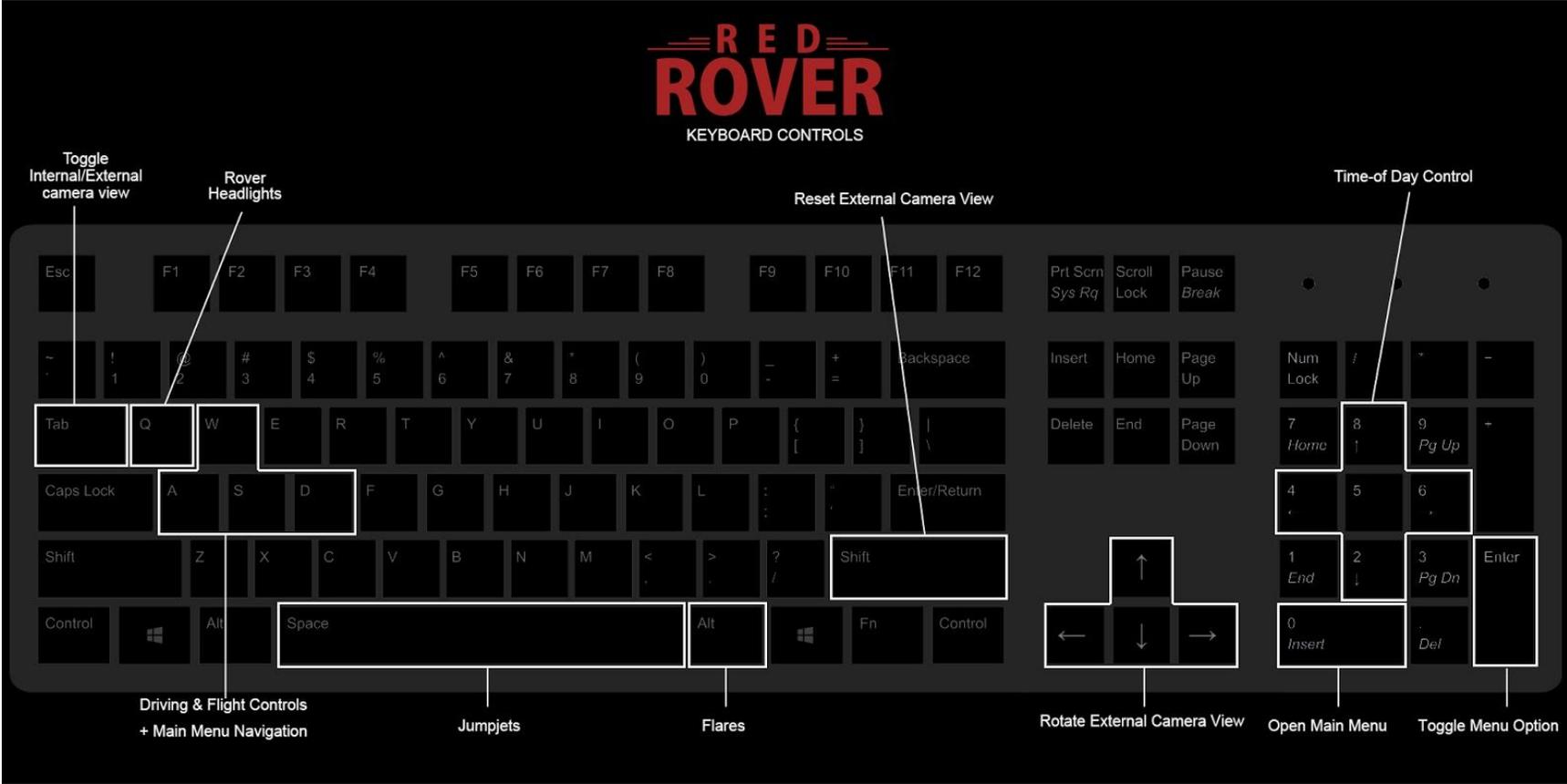


9. **SOUND FX VOLUME**
Controls relative intensity of effects sounds such as thrusters, engine and projectile flares.
10. **AMBIENT SOUNDS VOLUME**
Controls relative intensity of ambients wind sounds.
11. **VOICE CHAT VOLUME**
Controls relative intensity of -- oh wait, this is future stuff. Ignore this, thanks!
12. **VOICE CHAT MIC MODE**
Ignore this as well!
13. **OUTPUT MOTION TELEMTRY**
Toggles motion telemetry output for motion platforms. For more details see page 12.

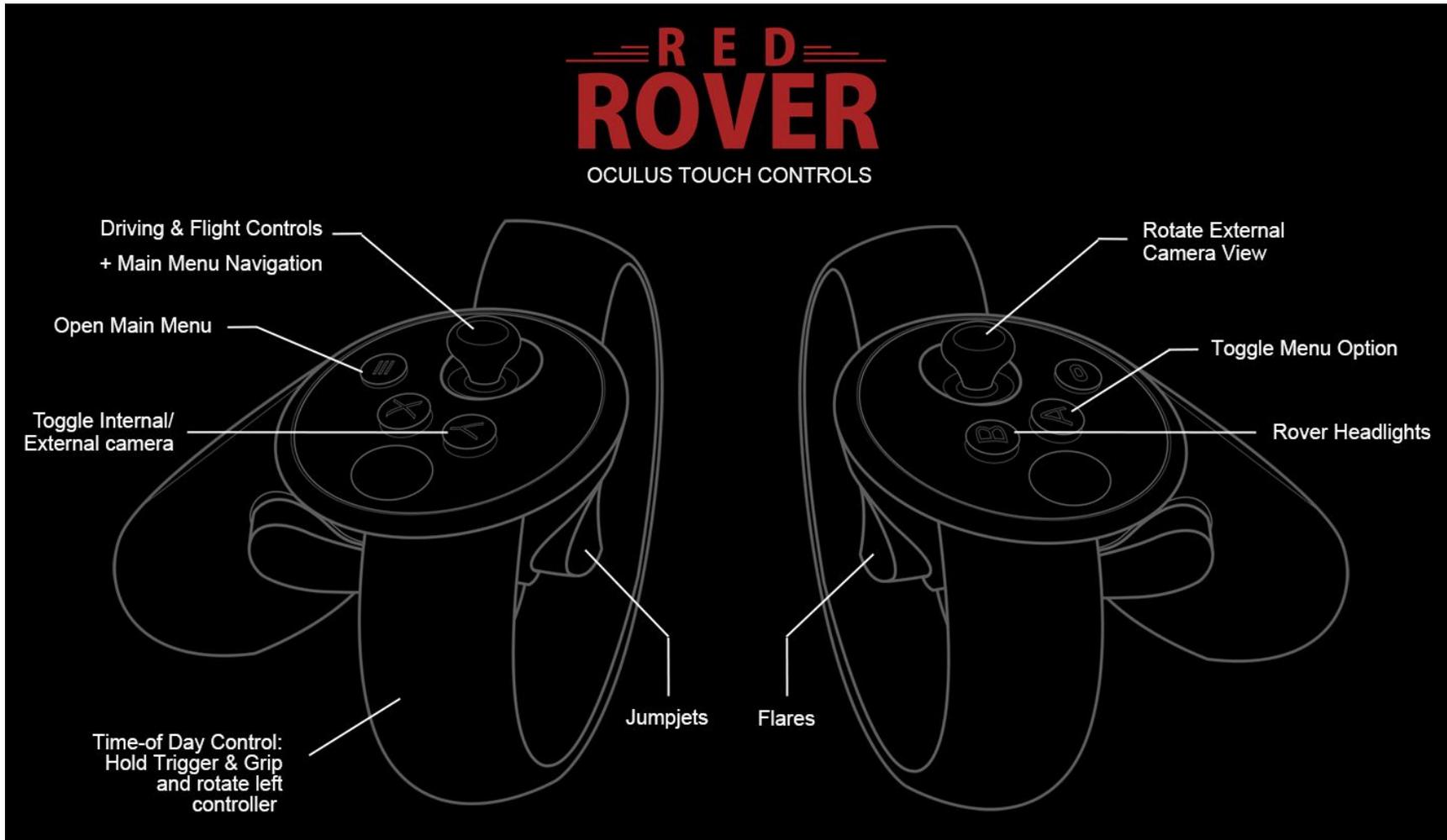
GAMEPAD CONTROLS



KEYBOARD CONTROLS



TOUCH CONTROLS



HOTKEYS

- \ - Toggle Opportunity traverse path highlight on/off (Victoria Crater map only)
- F** - Switch over to driving Opportunity when in range
- < >** - External camera zoom (Opportunity only)

TECHNOLOGY

The [HiRISE camera](#) is one of six instruments on board the Mars Reconnaissance Orbiter, which has been orbiting Mars since 2006 and producing some of the highest resolution imagery of Martian terrain to date. Using stereo pairs of satellite images, the wizards at JPL & the University of Arizona are able to extrapolate height and generate a Digital Terrain Map (DTM). More info on this detailed process is here - <https://www.uahirise.org/dtm/about.php>

On our end, we use the DTM and the corresponding aligned projected satellite image and process it into a set of image data that can be ingested into Unreal Engine. The DTMs are huge and contain way more information that can comfortably be shoved into the current slate of game engines, so we have to crop the typically elongated map scans (a result of satellite trajectory) and scale down the dataset into something that can run in real time on a PC. This typically involves a lot of time spent in Photoshop working to preserve the scale and detail of the satellite data as much as possible, and to ensure that we can transfer the data into Unreal in real world scale.

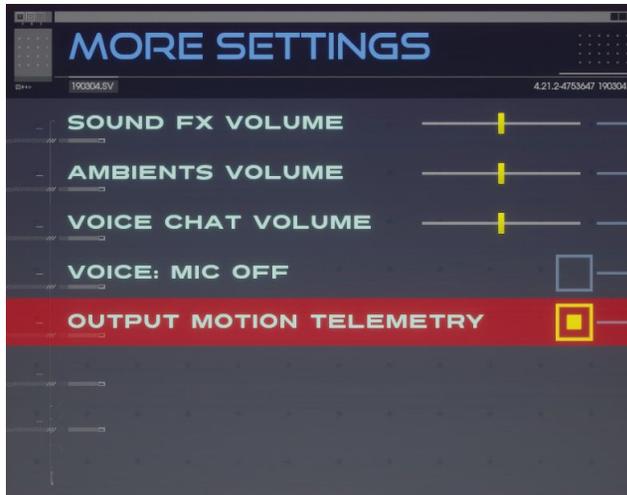
Because of the nature of generating 3d data from stereo pairs, and the resulting methods of getting the data into a game engine format, you may find some levels containing artifacts of this process. Steep slopes will sometimes contain stairstepping artifacts, for example. In the interest of preserving the dataset, we decided to keep these artifacts as they are in the levels instead of cleaning them up.

Since the satellite data is (at its highest resolution) only about one pixel per half meter, we end up having to approximate the look of the terrain closest to the rover/camera by overlaying ground texture maps in the near field. This means that the detail that you see on the ground is a 'best guess' use Earth-equivalent ground textures, and therefore NOT ENTIRELY ACCURATE. To see what it actually looks like, try the 'Use Raw Satellite Data' option from the menu panel (hint: it's realllly blurry)

MAP LINKS

Map	HiRISE	Areobrowser
Aeolis Streams	https://www.uahirise.org/PSP_002424_1765	http://areobrowser.com/dtm/PSP_002424_1765
Avalanche Slopes ^{NEW}	https://www.uahirise.org/ESP_032979_2070	http://areobrowser.com/dtm/ESP_032979_2070
Becquerel Crater	https://www.uahirise.org/ESP_034419_2015	http://areobrowser.com/dtm/ESP_034419_2015
Candor Chasma	https://www.uahirise.org/PSP_001918_1735	http://areobrowser.com/dtm/PSP_001918_1735
Coprates Chasma ^{NEW}	https://www.uahirise.org/ESP_018347_1660	http://areobrowser.com/dtm/ESP_018347_1660
Hale Crater ^{NEW}	https://www.uahirise.org/PSP_002932_1445	http://areobrowser.com/dtm/PSP_002932_1445
Harmakhis Vallis ^{NEW}	https://www.uahirise.org/ESP_012579_1420	http://areobrowser.com/dtm/ESP_012579_1420
Hibes Montes	https://www.uahirise.org/PSP_010361_1955	http://areobrowser.com/dtm/PSP_010361_1955
Jezero Crater	https://www.uahirise.org/PSP_002387_1985	http://areobrowser.com/dtm/PSP_002387_1985
Noctis Labyrinthus	https://www.uahirise.org/ESP_027526_1685	http://areobrowser.com/dtm/ESP_027526_1685
Orson Welles Crater ^{NEW}	https://www.uahirise.org/PSP_008391_1790	http://areobrowser.com/dtm/PSP_008391_1790
Parana Basin ^{NEW}	https://www.uahirise.org/PSP_002786_1580	http://areobrowser.com/dtm/PSP_002786_1580
Protonilus Mensae ^{NEW}	https://www.uahirise.org/ESP_019358_2225	http://areobrowser.com/dtm/ESP_019358_2225
Shalbatana Vallis ^{NEW}	https://www.uahirise.org/PSP_007455_1785	http://areobrowser.com/dtm/PSP_007455_1785
South Olympus	https://www.uahirise.org/ESP_012429_1910	http://areobrowser.com/dtm/ESP_012429_1910
Terra Sirenum ^{NEW}	https://www.uahirise.org/ESP_041282_1520	http://areobrowser.com/dtm/ESP_041282_1520
Victoria Crater	https://www.uahirise.org/TRA_000873_1780	http://areobrowser.com/dtm/ESP_021747_1780
Western Cerberus	https://www.uahirise.org/ESP_026040_1880	http://areobrowser.com/dtm/ESP_026040_1880

MOTION PLATFORM TELEMETRY



Red Rover now supports telemetry output for motion simulator platforms. To activate telemetry output, open the main menu with the gamepad menu button (or Num 0 on the keyboard) and then the gamepad left & right shoulder button (or [&] on the keyboard) to navigate between the main menu and the secondary settings menu. From the More Settings menu, activate *Output Motion Telemetry*,

Because there is a vast difference in hardware that collectively makes up the motion platform industry, you will most likely need to customize your setup to accept this motion telemetry. For assistance in setting up your motion platform, I recommend visiting the xsimulator.net forums, since there is a dedicated and active community group there. Community member Icy7CE has written a motion platform plugin for Red Rover that can be accessed here:

<https://www.xsimulator.net/community/marketplace/red-rover-plugin.221/>

TELEMETRY OUTPUT FORMAT

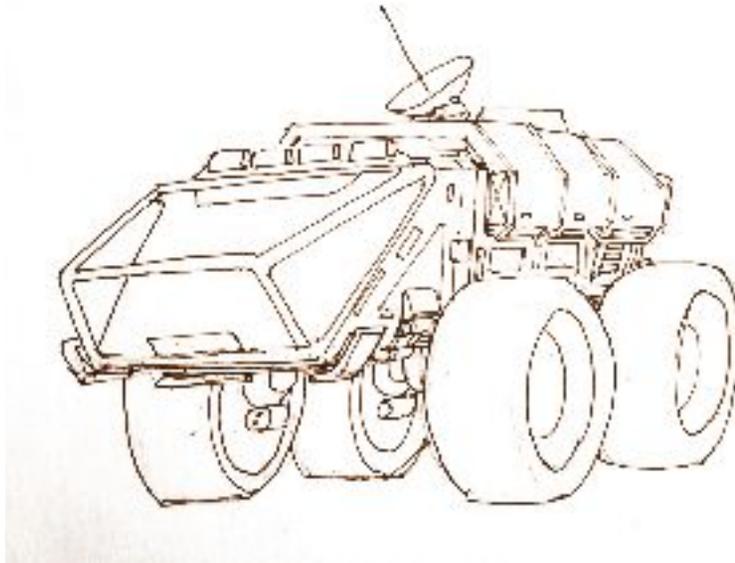
For those of you who will be rolling your own motion platform code, Red Rover will broadcast on UDP port 3001 (once the motion telemetry option is activated) with the following string data:

**S~Roll:3.992432 Pitch:0.877153 Yaw:0.211427 VeloX:-0.006728 VeloY=-0.018088 VeloZ=-0.001492 RPM:630 Gear:1 Alti:0
Jets:0~E**

- S~ and ~E marks the beginning and end of telemetry data, space delineates between datasets.
- Roll, Pitch & Yaw are in degrees
- VeloX/Y/Z is world space linear acceleration for computing sway/heave/surge (this is in cm/sec, so these will be some fairly large numbers at speed)
- RPM & Gear are self explanatory. Note that Gear is a string, as it can be N or R
- Alti is altitude when in flight
- Jets is 0 or 1 when jumpjets are triggered.

ACKNOWLEDGMENTS

- to Eric Geusz, designer of our little Martian Rover, for inspiring me with superawesome Mars artwork
- to Sam Warner at [Welltold Games](#), for telling me to stop keeping this R&D project to myself
- to NASA/JPL/University of Arizona for HiRISE satellite data and the continued pushes on the boundaries of space exploration
- to Christian Lopez @ Caltech/Jet Propulsion Laboratory for the awesome Mars Exploration Rover 3d model and textures



Red Rover concept sketch by Eric Geusz