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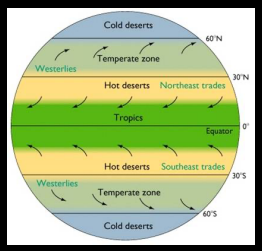
Mars Lander

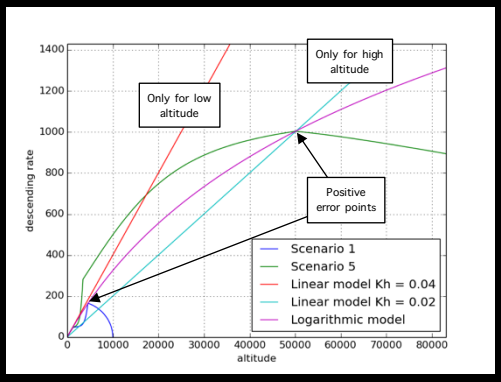
New Features

1. New scenarios including an aero-stationary orbit and 2001 Mars Odyssey orbit
2. Auto landing using parachute allowing safe landing after orbital re-entry in all scenarios including automatically coming down from an orbit by backfiring
3. Supports manual attitude control rotating the craft in the plane of the orbit
4. Supports auto orbital injection into a circular orbit of desired altitude
5. Supports auto orbital injection into an elliptical orbit of desired apogee and perigee from setting window
6. Able to deal with moderate levels of engine lag and delay
7. The mechanics, calculation of ground speed and initial velocities of scenarios take account of rotation of Mars
8. Simulates steady atmospheric wind flow with randomized wind speed and direction
9. Simulates additional random gusts that lasts 3~20 seconds
10. Wind direction takes account of a simple model of wind pattern in Mars

Because of rotation of Mars, easterly winds are featured near the equator[1]



11. Minimal fuel usage and minimal descent time achieved by targeting a logarithmic relationship between descending speed and altitude



The graph shows descending rate over altitude for auto landing using logarithmic model in scenario 1 and 5. Linear model with Kh = 0.04 allows for the fastest landing from low altitudes (scenario 1), however when landing from high altitudes (scenario 5), lander crashes because the point where the error term becomes positive is too late. Linear model with Kh = 0.02 ensures safe landing from high altitudes, however such relationship is unnecessary in low altitudes and increases the descent time. Logarithmic model with a gradient near 0.04 at low altitude allows for both safe landing from high altitude and the fastest descending.

12. Enables toggle between parachute landing and engine-only landing when auto landing
13. Supports setting window that allows user to manually set fuel rate, average wind speed, apogee and perigee for orbital injection, engine lag and engine delay
14. Supports right-click on instrument window for popup menus

New User Interface

During auto landing press **p** to toggle between auto parachute deployment and engine-only landing

Auto parachute deployment

Parachute deployment disabled

Press **a** for auto landing and **o** for auto orbital injection into desired orbit

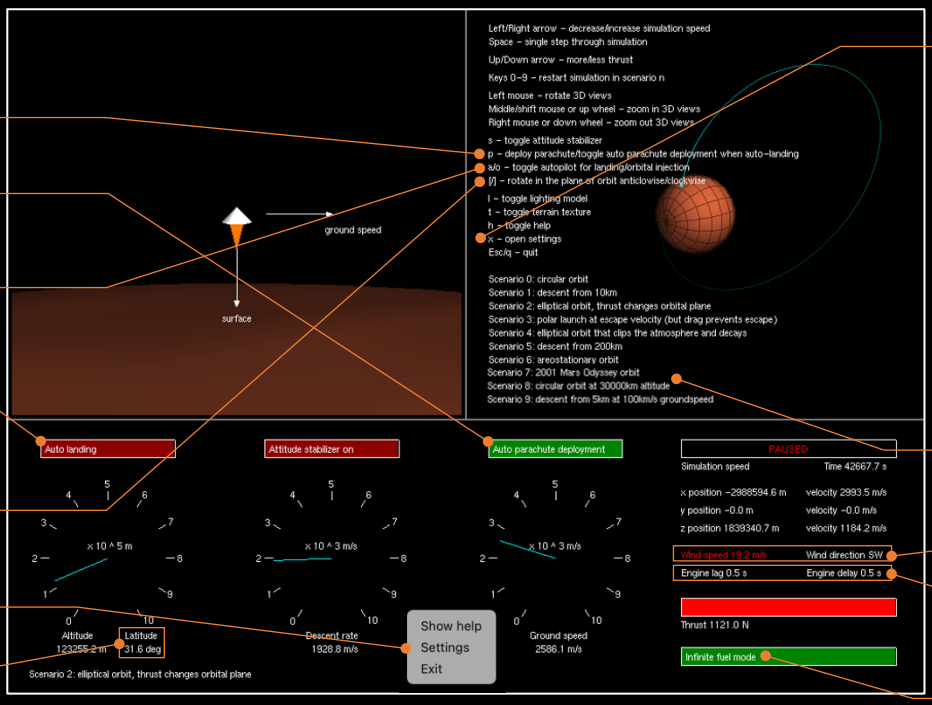
Auto landing

Auto orbital injection

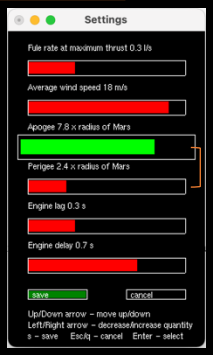
Press **[** for anti-clockwise rotation and **]** for clockwise rotation when attitude stabilizer is on

Right-click on instrument window for popup menus

Displays latitude in degrees



Press **x** to open settings, use arrow keys to change settings, **s** to save and **Esc** or **q** to cancel the changes



Apogee and Perigee for auto injection orbit (Set them equal for circular orbit injection)

New scenarios

Displays wind speed and direction, red font color indicates a wind gust

Displays engine lag and delay

Indicates infinite fuel mode when the user sets the fuel rate to zero

[1]D.umn.edu. 2009. Lab 12: Aeolian Features on Earth & Mars. [online] Available at: <https://www.d.umn.edu/~kgran/geol3210/fall09/Lab12_Aeolian_Mars.htm> [Accessed 19 September 2021].