Orbital Mechanics Simulator

Design Document

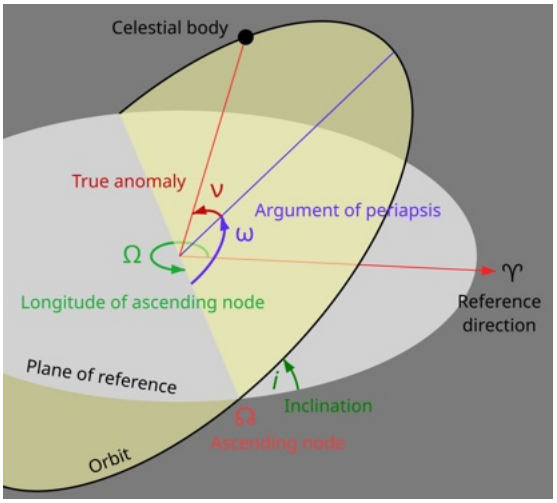
Overview

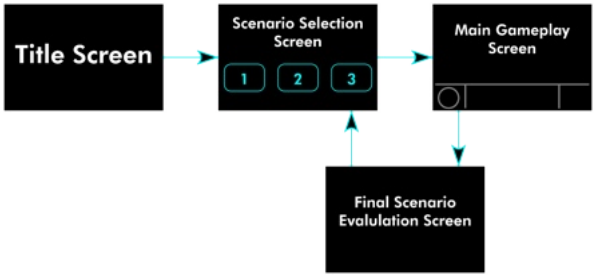
Project Purpose
This 3D spaceflight simulator will be part of a web page where users will learn about the orbital mechanics topic within the topic of spaceflight. It will allow students and people without a background in physics to understand the physics required to go from an Earth orbit to a Moon orbit. It allows users to plan out and execute a series of velocity change maneuvers to go from an Earth orbit to a Moon orbit based on an approximation of realistic orbits of celestial bodies called patched conics, which uses multiple spheres of influence to represent discrete gravity wells for each body. It will also present some historical context in the form of the Apollo Moon missions, the Voyager missions, and more recent robotic missions to the Moon.

Target Audience
This experience is targeted at users who enjoy:

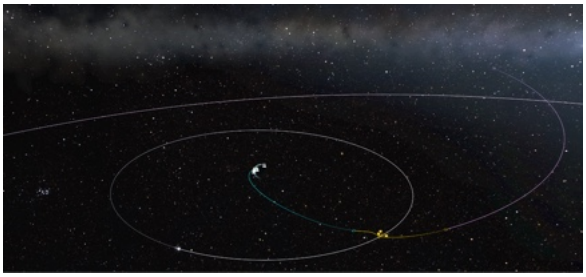
- Playing spaceflight simulators such as Kerbal Space Program
- Learning about intro-level physics and astronomy, such as college students
- Watching documentaries about space missions to the Moon and beyond, such as those about Apollo or Voyager missions

Concept art

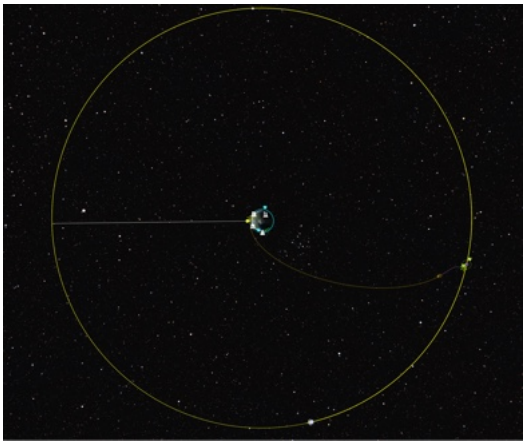




Reference examples



Kerbal Space Program 1



Kerbal Space Program 1

Project Requirements

Shaders / Materials	- Realistic materials and shaders for rendering the Sun, the planets, and the Moon
Lighting	- The Sun should be the main source of light, possibly faked by using a directional light that is turned to where the Sun should be in the sky when close to a planet - Scattering effects are optional for atmospheric effects or for planetary rings - Spaceship lighting will probably not be needed
Animation	- Planets and moons should move along their orbits and rotate realistically - Time made to elapse at a multiple of real-time, which will make planetary motions more obvious - Video clips of Apollo and Voyager missions
VFX	- Focus on realistic VFX, if needed
Cameras	- Technical limitations of 32-bit float may require the use of multiple cameras at different scales to composite the final view, with a camera for solar system scale, another camera which shows the spacecraft and possibly the nearby celestial body when within range, and a third camera to show UI elements such as a nav ball - Possibly have a separate map view from the main view
Post-processing	- Bloom on the sun and brightly lit celestial bodies - Convey a sense of the vastness of space and the extreme contrast between sunlight and shadow
Audio	- The vacuum of outer space is silent - But have sounds to represent various switches and rocket engines, including RCS thrusters - Maybe have space-appropriate music in sections where there would otherwise have no audio

UI	- Trying to avoid having a UI where you have to memorize the keyboard controls, which is what KSP is like - Controls for setting up and adjusting maneuver nodes, and seeing the effects of it by showing the projected orbits - Cutscenes or separate screens for explaining orbital mechanics and for showing video clips