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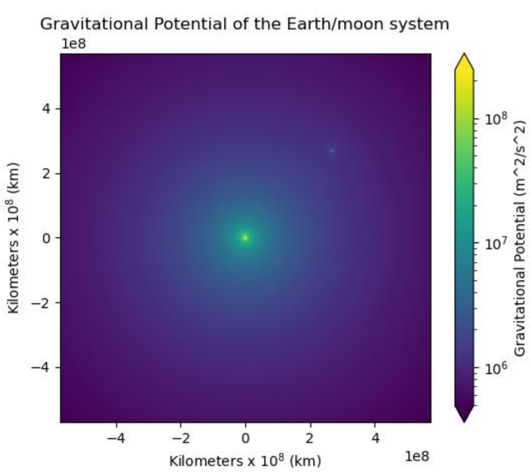
I: INTRODUCTION

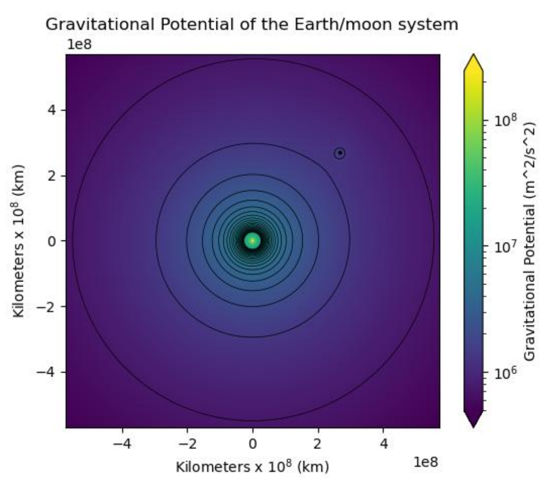
Upon reception of preliminary launch data of the United States Saturn V launch vehicle undergoing its successful initial test phases, the scope of mankind's journey to the moon is brought into sharp focus. Riding a vehicle, its scale unlike any witnessed hitherto by humans, three brave souls will depart this planet, traverse the expansive emptiness of space, land on the surface of the moon, and return safely. The task is daunting, but within reach of this administration and the personnel of NASA.

II: GRAVITATIONAL POTENTIAL OF EARTH-MOON SYSTEM

Any heavenly body possesses an element of gravitational potential related to that body measured in physical work: the transfer of energy between any object near the body. This potential is directly proportional to the body's mass and inversely proportional to the distance from the body. As an object closes the distance between itself and a given body, the influence of the body on the object increases at an exponential rate. The Earth is large with enormous gravitational potential near its surface, and a vehicle meant to depart that body must be powerful, and thus massive. Furthermore, the distance to the moon is vast, and the launch vehicle must concurrently carry ample power to leave the gravitational bounds of the Earth and traverse that distance. The moon, however, is small: approximately one-sixth Earth's mass, allowing a spacecraft to depart the moon with far less power requirements.

Maps of gravitational potential are obtained by plotting a gradient map via the equations of gravitational potential for Earth and moon respectively by converting cartesian coordinates to polar coordinates. Z-dimensional components are then introduced to serve as color gradient and contours, scaled logarithmically to accommodate the astronomical distances and respective potentials between bodies in the system.

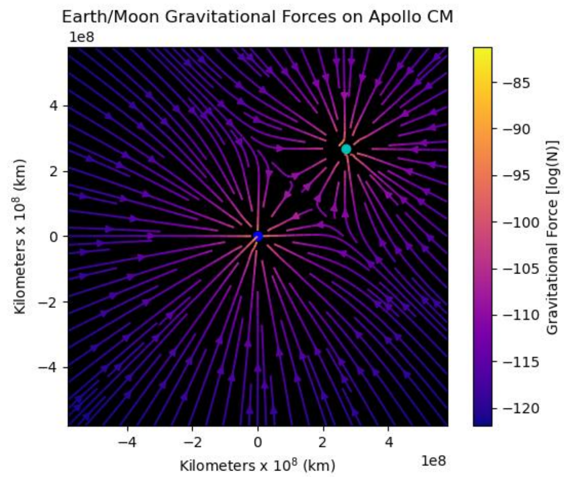




III: GRAVITATIONAL FORCE OF EARTH-MOON SYSTEM

Just as any heavenly body possesses gravitational potential, it possesses gravitational force in similar fashion, measured in Newtons. This force is proportional to the mass of the body times the mass of a secondary object, and inversely proportional to the distance between them. Much like potential, gravitational force increases as an object closes the distance between a given body. As such, a launch vehicle must both triumph over gravitational potential and force, and use these natural phenomena to its advantage to successfully bring humans to the moon and safely return.

In much the same manner as plots for gravitational potential, gravitational force is depicted in two-dimensional space via Newton's gravitational force equations with respect to two masses and the distance between them. Force is calculated between both the Earth and moon respectively and the Apollo command module (CM). A vector sum of both equations is taken for both x and y force components and plotted as a two-dimensional field of acting gravitational force between both bodies on the spacecraft.



IV: PROJECTED PERFORMANCE OF SATURN V STAGE I BOOSTER

Undergoing recent launch trials using systems intended for the lunar voyage, the Saturn V stage I booster displays an operating duration of 160 seconds reaching an altitude of 70km. Booster performance calculations are derived from elementary arithmetic and calculus operations, in order:

- Determine burn time by taking the difference in booster mass fueled and exhausted, divided by burn rate
- Determine the expected change in velocity using Tsiolkovsky's rocket equation
- Estimating the altitude upon fuel exhaustion of the first stage by integrating the change in velocity over the total burn time

Estimated values for endurance of stage I and altitude are 157.7 seconds and 74.09 kilometers respectively. As with all performance calculations in aviation and aerospace, vehicle performance depends on many more factors including temperature, humidity, atmospheric pressure, abnormalities of fuel burn, and the difference between usable and non-usable fuel quantities. Any deviation from nonstandard atmospheric conditions results in performance variation before reaching higher altitudes where atmospheric interference becomes negligible. However, this successful test shows the viability of the Saturn V stage I as a vehicle to ultimately slip the surly bonds of the Earth's lower, thicker atmospheric layers prior to low orbit insertion.

V: DISCUSSION AND FUTURE

With the success of the Apollo launch vehicle's stage I booster, the agency can now focus on latter launch stages of the overall program. While the Saturn V stage I takes the astronauts through the stratosphere, stage II and stage III will establish stable low Earth orbit where stage III is shut down before exhaustion. Once established, astronauts will use gravitational force to its advantage, engaging stage III once again at a strategic point in its low Earth orbit as to perform a "gravitational slingshot" maneuver to establish trans-lunar insertion. Upon exhaustion of stage III, the voyage to the moon will be underway. Owing to the moon's comparatively low gravitational force and potential, the thrust available to the Apollo command and service modules and lunar excursion module will be ample to escape the moon and achieve trans-Earth insertion via the same method. Preliminary test data indicates that phase one of this momentous undertaking is successful, and the agency is confident that further steps in the program are safe to begin.

VI: SUPPLEMENTAL CHARTS