Lab 2 Report

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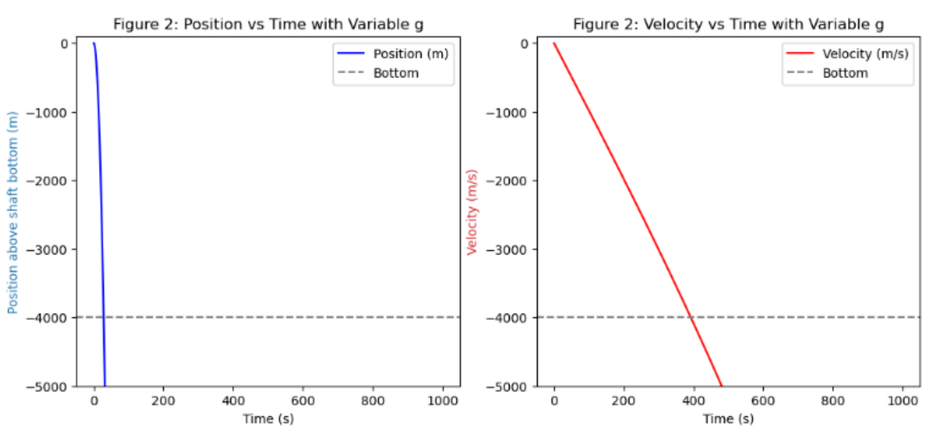
I. Introduction

The purpose of the project was to simulate a 1 kg mass dropping down the mine shaft and measuring the time to hit the bottom, to measure the vertical depth of the shaft. My code has simulated the motion of this mass in various cases, taking into account several physical factors. Factors such as drag, which is the resistance on an object by air particles, the coriolis effect, which affects moving objects traveling long distances around or in Earth, as well as creating a model of Earth that becomes more dense as we go farther into it, which is more realistic than a uniform density model. I have also measured the gravitational effects of an object if we were able to dig a hole straight through the earth and drop the object in. I hope the findings in this report will be of use.

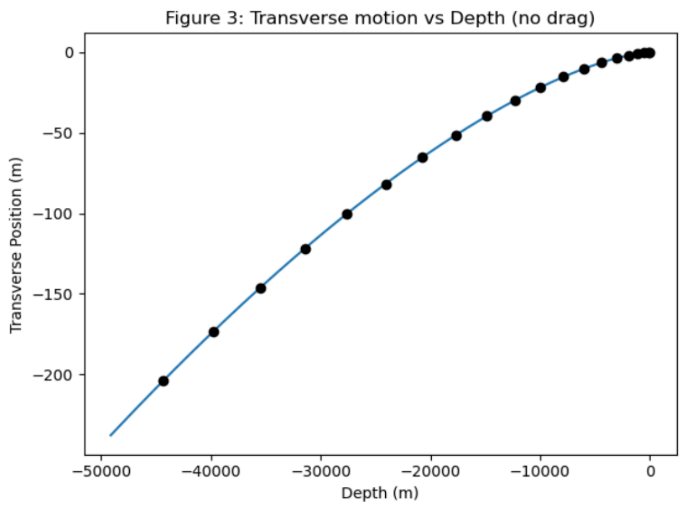
II. Calculation of Fall Time (including drag and variable g)

The fall time calculated without including drag or a variable gravitational force was 28.6 seconds. With no drag and variable gravity, it was 28.5 seconds. With drag as well as variable gravity, the time was roughly 48 seconds. With enough depth, variable gravity will have a noticeable effect on the motion of the object, however since 4 km is quite small relative to the size of the earth, its effects here are negligible. However, drag plays a large role in the fall time of the object.



III. Feasibility of depth measurement approach (Including Coriolis forces).

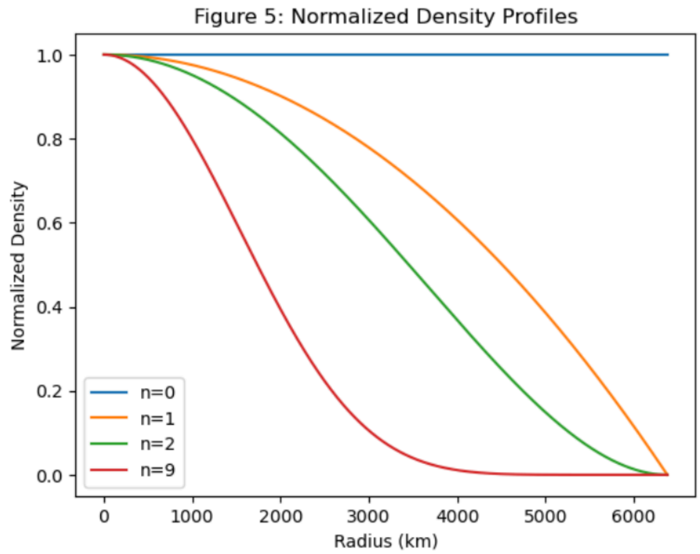
Due to Coriolis forces, the object will also hit the walls of the shaft, at a depth of 237.9 m, at 21.8 seconds in, assuming the shaft is a uniform 5 meters wide down the entire length.



This interferes greatly with the depth measurement approach originally planned. We can't get an accurate reading of the depth if the object is going to collide with the sides of the shaft, instead of having fully free motion. With these findings, I greatly recommend using a different technique for measuring the depth of the mineshaft.

IV. Calculation of crossing times for homogeneous and nonhomogeneous earth.

I modeled a few different levels of density concentrations, to help discover what these free-fall experiments would look like on another body, such as the moon. In the extreme low end (n=0 in the calculation), it would take 3801.2 seconds to cross the diameter of the earth. In the extreme high density case (n=9), it would take 6000.0. Density effects the fall time because density is the amount of mass in a certain volume, and mass creates a gravitational force. So the more density, generally the greater the gravitational force. My finding was that Earth is approximately 1.6 times more dense than the moon. That fact coupled with the moon being smaller than the earth means that there is less gravitational force on the moon, and therefore will take longer for an object of the same mass to fall the same distance on the moon.



V. Discussion and Future Work

In summary, my study shows that while simple free-fall calculations may indicate that this depth measurement plan will be feasible and accurate, the addition of more realistic factors shows a few pitfalls to this method. In a practical setting, drag and the Coriolis effect would create significant inaccuracies if we used the proposed method. However, in the future, we could get even more accurate data by introducing more variables, such as assuming a not perfectly spherical Earth, and taking into account atmospheric pressure, which varies with altitude and would affect drag.