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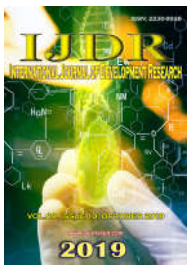

RESEARCH ARTICLE OPEN ACCESS

# SIMULATION OF PHYSICS EXPERIMENTS USING THE OCTAVE PROGRAM CASE STUDY: CALCULATION OF GRAVITY ACCELERATION

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**ABSTRACT**

**Objective:** The calculation of some physical constants requires different lab equipment and tools and time to conduct practical experiments and repeat them in accordance with the student's manual skills in dealing with different devices and tools. These experiments are financially expensive and presented with physical risks in addition to the time taken. Therefore, we can take advantage of the computer in dispensing with devices and tools and reduce the time taken to conduct experiments. There are many programs used in automated testing, most notably Matlab. But it is expensive and no ordinary person can afford it. Therefore, we will use an open-source, open-source Matlab alternative, the Octave program. In this paper we will make a comparison between the manual procedures in finding some physical constants and their mechanical counterparts using the open source program on the computer. The aim of this paper is to reduce the risk and shorten the time of physical experiments and enlightenment with the open-source Octave program and to highlight its positive aspects in how to use it in the field of physics. In this paper we will focus on the calculation of gravity acceleration as a case study and compare the results of the real procedures with the default simulation results on Octave.



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## INTRODUCTION

Physics is primarily experimental science, that is, a science based on observation and conducting laboratory experiments under controllable conditions. The basic physical phenomena are then described accurately through mathematical relationships called physical laws. These laws are used to analyze and understand the physical issues we are exposed to in different Aspects of our lives, in terms of basic phenomena.
The main objectives of the study of practical physics are the student's understanding of the importance of practical experience in the study of physics, explaining the physical concepts that the student is exposed to in his theoretical study, increasing the student's ability to observe carefully, and allowing him to acquire laboratory skills and training in the use of laboratory equipment and techniques efficiently. The purpose of any experiment is to verify the validity of a rule or theory or a physical law and to find the relationship between two or more variables and to determine the values of the physical constants [1-4].In order to achieve the objectives of the laboratory experiments, physicists, like others, took advantage of the modern technologies provided by computer programs. We created what is known as computational physics, the study of phenomena or solving physical problems using certain computer programs. Computational physics is a branch that mediates theoretical physics with experimental physics. It is a study of phenomena or solving physical problems using certain computer programs. Computational physics is a branch that mediates theoretical physics with experimental physics. Increasing interest has begun in the physics of physics, which has become a major focus of modern research in the various fields of physics and is used in the simulation of certain physical phenomena and the development of perceptions and fantasies of scientific hypotheses and contribute to the analysis of data numerically. Computational physics includes the design of specific programs and devices to solve other problems [5].We do not deny the role and importance of conducting experiments in traditional ways, but the use of software has its advantages in terms of reducing waste in equipment and tools and reducing the time used to conduct experiments in traditional ways. In order to cover the two sides, the use of the development of manual skills and the

use of modern technology can be carried out manually and manually experiments and advanced computer using various open source programs, such as Octave, for example, which we use in this paper as a case study to calculate the acceleration of gravity using simple pendulum with the clarification of privileges and defects for each procedure In both manual and computer cases.

## PRACTICAL PROCEDURES

**Simple Pendulum:** To calculate gravitational acceleration (g) using a simple pendulum device and a stopwatch and a ruler, the experiment was done in Physics Lab No.1 in the Department of Physics, Faculty of Sciences and Arts, Al-Baha University. The simple pendulum consists of a block suspended in a length of L and anchored at the pivot point of P. When the pendulum is shifted at an initial (small) angle and released, the pendulum swings back and forth in a periodic motion Fig.1 [1-4,6].

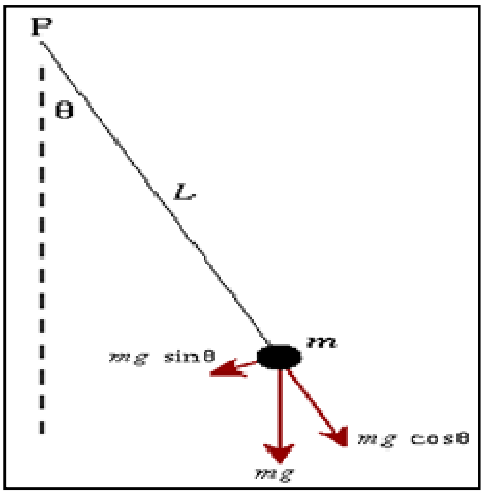


**Fig. 1. Illustrates the components of simple pendulum**

Through the application of Newton's law on the rotation system, it can be concluded that the periodic time T (sec) of the simple pendulum does not depend on the initial mass or displacement (Pendulum displacement angle), but only depends on the length of the pendulum L (m) and the value of the gravity field intensity g (m / $sec^2$), according to the equation:

$$T = 2\pi\sqrt{L/g} \quad \ldots\ldots\ldots \quad g = 4\pi^2 L/T^2 \qquad (1)$$

20-pulse time when the length of the pendulum string (L) is 0.2 m was taken. Repeat this step by increasing the length of the string 0.1 m each time until reaching 1.0 m. The one pulse time (periodic time T) is calculated and the square of periodic time is calculated ($T^2$), then the results were graphically treated by plotting the length of the thread L (m) on the horizontal axis and the square of periodic time $T^2$ ($sec^2$) on the vertical axis as shown in Fig. 2, origin lab 8 was used to plot $T^2$ ($sec^2$) vs L (m).

**Octave program:** The open-source Octave version 3.6.2 was used to simulate the experiment of calculation the gravity acceleration, after writing the program as in Fig. 3 and the results of this program are shown in Fig. 4 [7-8].

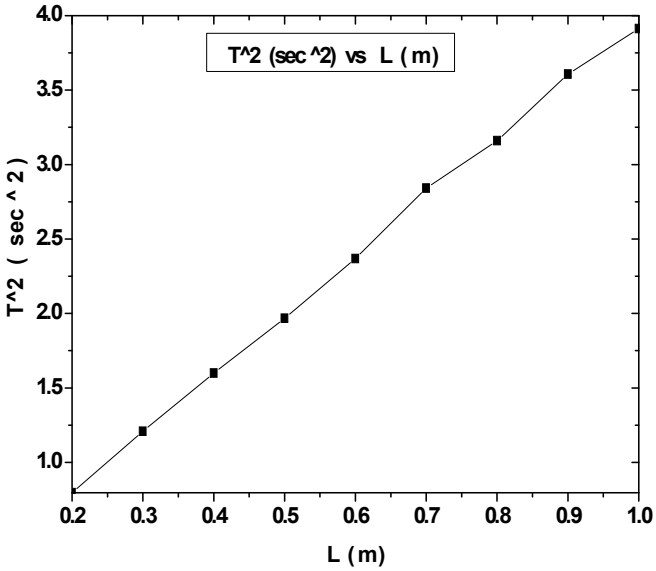


**Fig. 2.$T^2$ ($sec^2$) vs L (m)**

```
octave:2> 'g=4*pi^2*L/T^2';
octave:3> 'T^2=4*pi^2*L/g';
octave:4> g=9.8;
octave:5> L=0:0.1:1.0;
octave:6> T=2*pi*sqrt(L/g);
octave:8> xlabel('L  m' );
octave:9> ylabel('T^2  sec^2');
octave:10> title('T^2 (sec^2) vs L (m)');
octave:11> slope=mean(T.^2)/mean(L);
octave:12> g=4*pi^2/slope
g =  9.8000
octave:13>
```

**Fig. 3.TheOctave program**

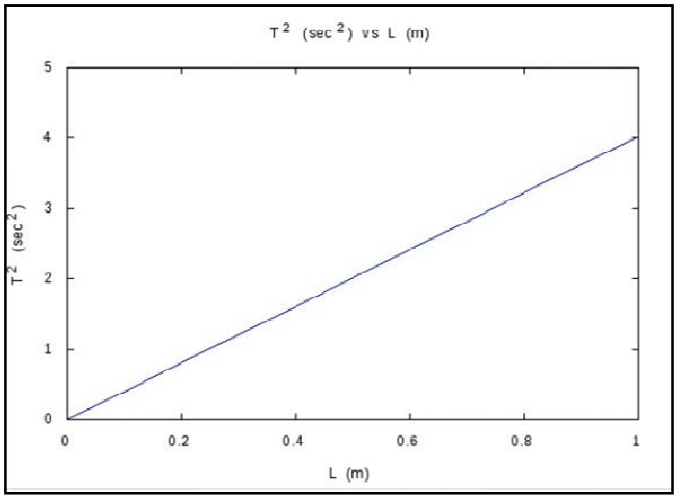


**Fig. 4. The plot from the Octave program**

## RESULTS AND DISCUSSION

**Simple Pendulum:** By using the equation 1 and Fig. 2 we find that L / $T^2$ is inverted of the slope of the straight line. By substitute the values in the equation 1 above we find that:

$$g = 4\pi^2 \left({}^{1}/_{slope}\right)$$

$g = 4 * (3.14)^2 * (1 / 3.896) = 10.123$ m / sec$^2$

This result is excellent for calculating the gravitational acceleration value compared to the fixed value (g = 9.8 m / sec$^2$) where the error in the calculated value does not exceed 10% of the fixed value.

**Use the Octave program:** The result was found to be consistent with the constant value of gravitational acceleration, when we used the Octave program to simulate the experiment of calculate the gravity constant. We find that the experiment inside the laboratory has several privileges, including training on the violating devices and acquisition of manual skills in dealing with them and training in the processing of data in different ways, either manually or using the computer. One of the disadvantages associated with this procedure is to take a long time to do the experiment and treat its results as well as exposure to errors resulting from the devices and the user and the surrounding environment, which affects the impact of the final result. And that the length of the trial time is accompanied by consumption of resources (electricity, furniture and laboratory equipment).While on the other hand we find that simulating the experience using open source computer programs such as Octave, for example, gives excellent results in a short period of time compared to manual procedures of the experiment, which reduces the waste of various resources, as well as training on the new use of various computer programs in the field Physics to keep abreast of the developments in the world of technology where we find that the use of computer programs in the most recent research.

## CONCLUSION

The importance of carrying out physical experiments cannot be ignored because it acquires the skills and experience in dealing with the real devices, drawing conclusions from them, and the ability to predict, discuss, analyze and get used to working as a research team. Also, it is necessary to train on various computer programs in the simulation of physical experiments to keep up with the progress in this field and to take advantage of the enormous potential of the computer in physics and its various researches. In order to link manual and simulation procedures, there is good training on the manual side in the initial years of study and the application of simulations and computer use in the higher years of the study, especially since research equipment in physics is expensive.

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