

Lab Report: Length, Velocity and Acceleration

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A study on different methods for determining the length, velocity and acceleration of different objects, and the errors involved in these methods.

I. INTRODUCTION

II. THEORY

A. Pendulum

$$T \approx 2\pi\sqrt{\frac{L}{g}} \quad (1)$$

Where T denotes the period of a pendulum, L its length and g the gravitational acceleration. The small angle approximation (Eqn. 1) is valid for angles $\theta \ll 1$ rad with an error $\approx \pm 15$ s per day [1].

B. Errors

$$\sigma \approx \left(\frac{\sum x_i^2 - \frac{1}{n}(\sum x_i)^2}{n-1} \right)^{\frac{1}{2}} \quad (2)$$

$$\sigma_m \approx \left(\frac{\sum x_i^2 - \frac{1}{n}(\sum x_i)^2}{n(n-1)} \right)^{\frac{1}{2}} \quad (3)$$

Where σ, σ_m denotes the standard deviation, and the standard deviation of the mean respectively of a set of n values x_i . [2].

Any errors stated in a derived number will be calculated using the equations for combinations of errors found on page 29 in Squires [2]. Lastly, when using a linear fit on a set of linearly correlated data i used the expressions found on page 39 in Squires [2] to calculate the regression line, as well as its error.

TABLE I. Length of rods

Ruler, a [cm]	Ruler, b [cm]	Laser, a [cm]	Laser, b [cm]
119.50	119.60	120.50	120.60
119.50	119.70	119.60	119.80
119.45	119.60	119.50	119.70
119.40	119.50	119.40	119.60
119.43	119.55	119.40	119.60
119.40	119.60	119.68	119.72
119.40	119.50	119.90	119.70
119.45	119.65	130.60	130.20
119.40	119.60	119.40	119.50
119.43	119.55		

TABLE II. Uncertainty in Length measurement

	x	δx
l_a	119.5cm	1.4mm $0.5\sqrt{5}mm$ 1.4mm $\sim 10^{-6}$
l_b	119.6cm	
dl_s		
$\sqrt{n} \cdot dl_i$		
dl_m		
$\alpha l_a(T - 25C)$	-0.156cm	
	$\sum x$	$\sum \sigma x_i^2$
$\sum l_a$	119.48cm	2.27
$\sum l_b$	119.58cm	2.27

III. EXPERIMENTAL PROCEDURE

IV. MEASURING THE LENGHT OF A ROD

V. MEASURING THE PERIOD AND HEIGHT OF THE FOUCAULT'S PENDULUM

VI. MEASURING THE VELOCITY OF THE LEGO-CAR

VII. MEASURING THE VELOCITY OF THE RC-CAR

VIII. RESULTS

IX. DISCUSSION

X. CONCLUSION

TABLE III. Period of pendulum

T [s]
7.30
7.72
7.57
7.43
7.73
7.27
7.68
7.60
7.34
7.75
7.06
7.32
7.55
7.29
7.08
7.82
7.78
7.44
7.68
7.46

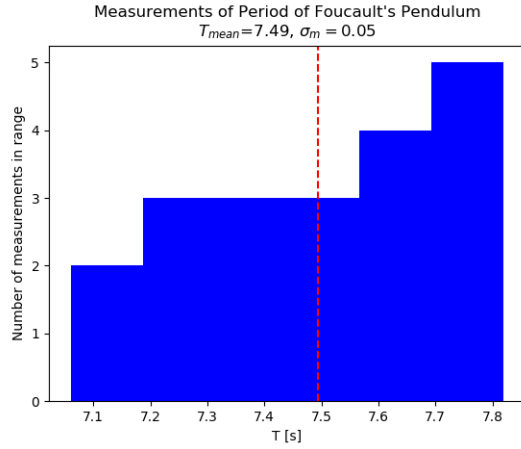


FIG. 1. Measurements of the Period of the Foucault's Pendulum in the entrance hall at the Institute of Physics, UiO.

[1] <https://en.wikipedia.org/wiki/Pendulum>.[2] G. L. Squires. *Practical Physics 4th Edition*. Cambridge

University Press, 2001.