STUDY OF DAMPED OSCILLATORY MOTION OF SPRING-MASS SYSTEM USING VIDEO ANALYSIS TECHNIQUE

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Abstract

•Study demonstrates understanding of damped oscillatory motion in an interactive approach using tracker video analysis tool.

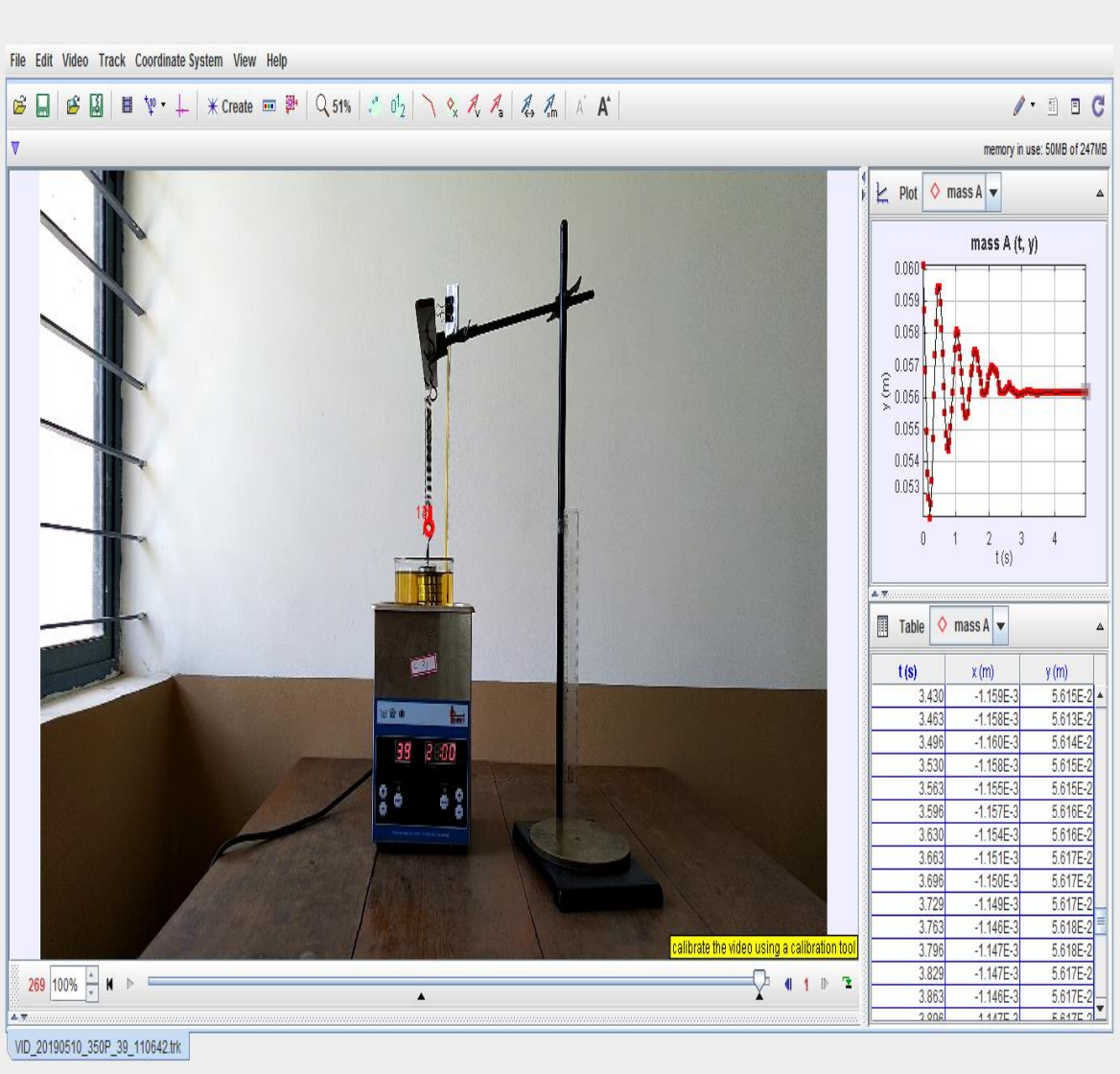
• It is employed to obtain the quantitative results of damping coefficient and quality factor for damped oscillations in different damping medium.

Results are graphically presented and the excellent curve fit observed for damped oscillations in water and castor oil medium.

•The significant results of decrease in damping coefficient and increase in quality factor values with increase in mass, which confirms that more energy dissipation in castor oil medium.

•The obtained results substantiate that the nature of oscillation of spring mass system is under damped and heavily damped motion in water and castor oil medium respectively.

EXPERIMENTAL METHODOLOGY



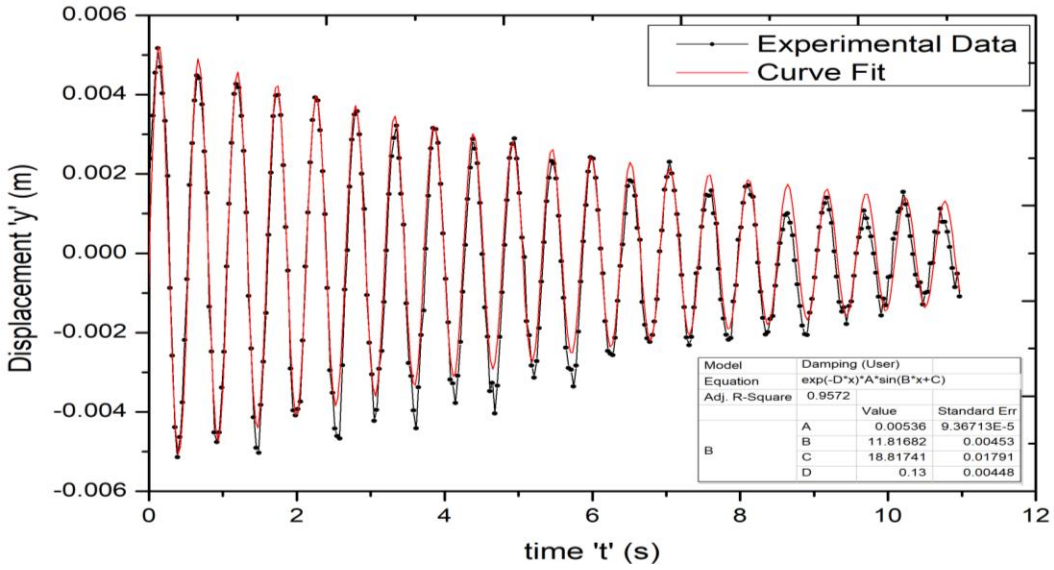
The experimental study conducted in water and castor oil medium to study the behavior of damped oscillation of spring mass system

The video of the motion of spring- mass system experiment are recorded using mobile phone camera and imported the video and analyzed using the tracker video analyser software.

This helps to extract Physical parameters such as amplitude, angular damped frequency, phase angle and damping coefficient from the graphical representation of oscillatory motion.

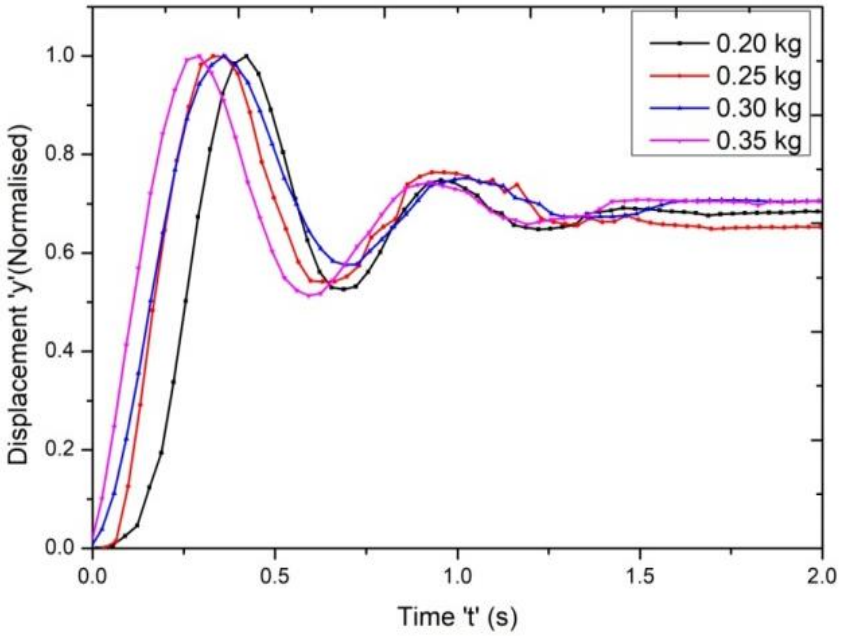
Findings in Water Medium

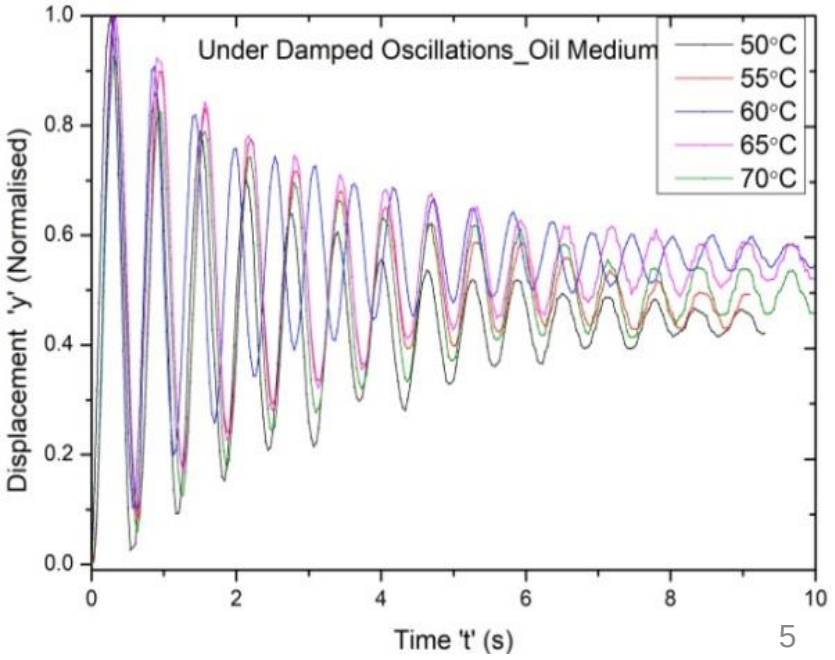
Mass (kg)	Amplitude (m)	Time Period (s)	Damping Coefficient (b) s^{-1} (Water Medium)	Damping Coefficient (b) s^{-1} (Air Medium)	τ(s)	Damped angular frequency (ω_d)rads^{-1}	Quality Factor (Q)
0.200	5.935 x 10^{-3}	0.511	0.1563	8.47 x10^{-3}	3.198	12.28	39.28
0.250	5.334 x 10^{-3}	0.511	0.1768	3.82 x 10^{-3}	2.828	12.28	34.73
0.300	7.748 x 10^{-3}	0.617	0.0946	3.22 x 10^{-3}	5.285	10.18	53.79
0.350	9.736 x 10^{-3}	0.663	0.1087	2.88 x 10^{-3}	4.599	9.46	43.49



Findings in Castor Oil Medium

Mass (kg)	Amplitude (m)	Time Period(s)	Damping Coefficient (b) s^{-1}	τ(s)	Damped angular frequency (ω_d) $rads^{-1}$	Quality Factor(Q)
0.200	2.411×10^{-2}	0.567	2.474	0.202	11.07	2.237
0.250	1.162×10^{-2}	0.611	2.587	0.193	10.28	1.987
0.300	2.138×10^{1}	0.690	2.458	0.203	9.095	1.846
0.350	1.587×10^{-2}	0.633	2.243	0.223	9.927	2.213





CONCLUSION

The present work used high-speed video analysis technique to study the behavior of a spring-mass system for viscous medium such as water and castor oil.

The graphical representation of harmonic function assists to understand the characteristics of oscillations.

The significant results of decrease in damping coefficient and increase in quality factor values with increase in mass, which confirms that more energy dissipation in castor oil medium.

Video analysis tool enables a richer pedagogical experience and helps to visualize the real path of the damped oscillatory motion which benefits to understand and facilitate to gain the complete knowledge of oscillatory motion.

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