Using the high-speed video to analyze damped harmonic motions

J. Poonyawatpornkul\textsuperscript{a,b}, P. Wattanakasiwich\textsuperscript{a,c}

\textsuperscript{a} Department of Physics and Materials Science, Chiang Mai University, Chiang Mai, Thailand

\textsuperscript{b} Department of Physics, Rajabhat Chiang Mai University, Chiang Mai, Thailand

\textsuperscript{c} Thailand Center of Excellence in Physics (ThEP), Commission on Higher Education, Bangkok 10400, Thailand

jiraporn.poon@gmail.com

We studied three cases of harmonic oscillator using high-speed video analysis technique. We used high-speed video at a rate of frame 120 frames per second and Tracker video analysis software to study oscillation of a mass-spring in glycerin at different temperatures. We were able to compare real motion paths of underdamping, critical damping and overdamping with theoretical models, and they were in good agreement. Using Tracker to fit motion paths, we obtained values angular frequency (\(\omega_d\)) and damping constant (\(b\)). Then we plotted a graph between \(\omega_d^2\) and \(b^2\) and found an undamped angular frequency (\(\omega_0\)) and mass (\(m\)). These values were compared with real values, and we found deviation about 9.25\% and 11.83\% for the undamped angular frequency and the mass, respectively. Finally, we determined quality factors (\(Q\)) of the oscillator in glycerin at temperature 15±0.5\(^\circ\)C and 25±0.5\(^\circ\)C to be 1.57 and 2.70, respectively. These \(Q\) values indicated that an oscillator in glycerin at higher temperature decays slower.