Oscillatory motion

Oscillatory motion can be termed as the repeated motion in which an object repeats the same movement over and over. In the absence of friction, the oscillatory motion would continue forever; but in the real world, the system eventually settles into equilibrium. Oscillatory motion can be found throughout the physical world in different cases from the uranium nucleus oscillation before it fissions to the carbon dioxide molecules oscillating in the universe, absorbing and contributing to global warming. Building and bridges undergoes oscillatory motion, sometimes with disastrous results. Even stars oscillates. Waves- from sound to ocean waves to seismic waves in the solid earth- ultimately involve oscillatory motion.

Here in fig 1.1 we can see two quantities that describes the oscillatory motion; Amplitude is the maximum displacement from equilibrium, and period is the time it takes for the motion to repeat itself. The other way to express the time aspects is frequency, or number of oscillation cycles per unit time. Frequency f and period T are complementary ways of conveying the same information, and mathematically they're inverse:

\[ f = \frac{1}{T} \]
Frequency is measured in hertz (Hz), and one hertz is equal to one oscillation cycle per second.

**Simple Harmonic Motion (SHM)**

When we are talking about wave, we have Simple harmonic motion. Simple harmonic motion is a type of oscillatory motion. A simple harmonic motion has three things, it basically does: Motion always goes back to equilibrium, follows the same path and oscillates around the equilibrium. SHM results when the force or torque that tends to restore equilibrium is directly proportional to the displacement from the equilibrium is directly proportional to the displacement from equilibrium. In fig 1.2, a mass m on a spring of spring constant k has angular frequency:

\[ \omega = \frac{k}{m}, \]

where \( k \) = spring constant

\( m \) = mass of an object
mass attached to a spring undergoes SHM

We can find the use of oscillatory motion and SHM in different fields from a simple pendulum to seismo-scope, bungee cords to rubber bands, for damping and many other fields. Oscillatory motion and SHM both are inter-related and are important topics in waves and oscillation.

References:

Reference 1: Essential University Physics by Richard Wolfson