Driven harmonic oscillator

A harmonic oscillator is a system in which an object vibrates with a certain amplitude and frequency. In a simple harmonic oscillator the are no extarnal forces, such as friction or driving forces working on the object. Therefore the aplitude and frequency always stay the same.

In a damped harmonic oscillation there are forces (friction) working on the object, they cause the amplitude to decrease until it stops. In real life the ideal situation of a simple harmonic oscillator does not exist. This means that to keep an oscillation going a driving force has to be put in.

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The restoring force is the force that works on the object towards the equilibrium, and it's directly proportional to the distance from the equilibrium.

$F = -kx$, where

F = restoring force, k = spring constant, x = distance from equilibrium

The friction force works in the opposite direction as the movement of the object. To make an object oscillate with a constant amplitude and frequency, the driven force must be as big as the friction force, pointed in the opposite direction.

Examples

First a mass hanging on a spring, going up and down. When the object is moving upwards, the driving force is also pointed upwards, and the other way around. The object is making a sinusoidal movement and therefore the driving force is mostly a sinusoidal force.

Another example is an electrical oscillator. For example a subwoofer. If a subwoofer is making a sound with a constant frequency, the membrane is making a harmonic oscillation. In this case the driving force is a magnetic field caused by a coil. Electric current is going back and forwards inside the coil with an adjustable frequency. The membrane of the subwoofer is pulled towards that coil and pushed away from the coil with the same frequency as the electric current.

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Bibliography

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