Biomechanics Of The Musculoskeletal System Nigg Pdf

When we are hopping and we land on our foot we don't loose all our energy, but rather it is absorbed as potential energy ready to be reused as kinetic energy. Efficient movement requires the optimisation between potential and kinetic energy. The concept of a spring damping and recoil mechanism can be seen in the form of Hooke's Law.

The most commonly encountered form of Hooke's law is probably the **spring equation**, which relates the force exerted by a spring to the distance it is stretched by a **spring constant**, k, measured in force per length.

$$F = -kx$$

The negative sign indicates that the force exerted by the spring is in direct opposition to the direction of displacement. It is called a "restoring force", as it tends to restore the system to equilibrium. The potential energy stored in a spring is given by

$$U = \frac{1}{2}kx^2$$

which comes from adding up the energy it takes to incrementally compress the spring. That is, the integral of force over distance. (Note that potential energy of a spring is always positive.)

This potential can be visualized as a parabola on the U-x plane. As the spring is stretched in the positive x-direction, the potential energy increases (the same thing happens as the spring is compressed). The corresponding point on the potential energy curve is higher than that corresponding to the equilibrium position ($x = 0$). The tendency for the spring is to therefore decrease its potential energy by returning to its equilibrium (unstretched) position, just as a ball rolls downhill to decrease its gravitational potential energy.

If a mass m is attached to the end of such a spring, the system becomes a harmonic oscillator. It will oscillate with a **natural frequency** given as either:

$$\omega = \sqrt{\frac{k}{m}} \text{ radians per second (angular frequency)}$$

or

$$\nu = \frac{1}{2\pi}\sqrt{\frac{k}{m}} \text{ hertz (cycles per second)}$$

where ν is frequency (the symbol is the Greek character nu and not the letter v) since $\omega = 2\pi\nu$.


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