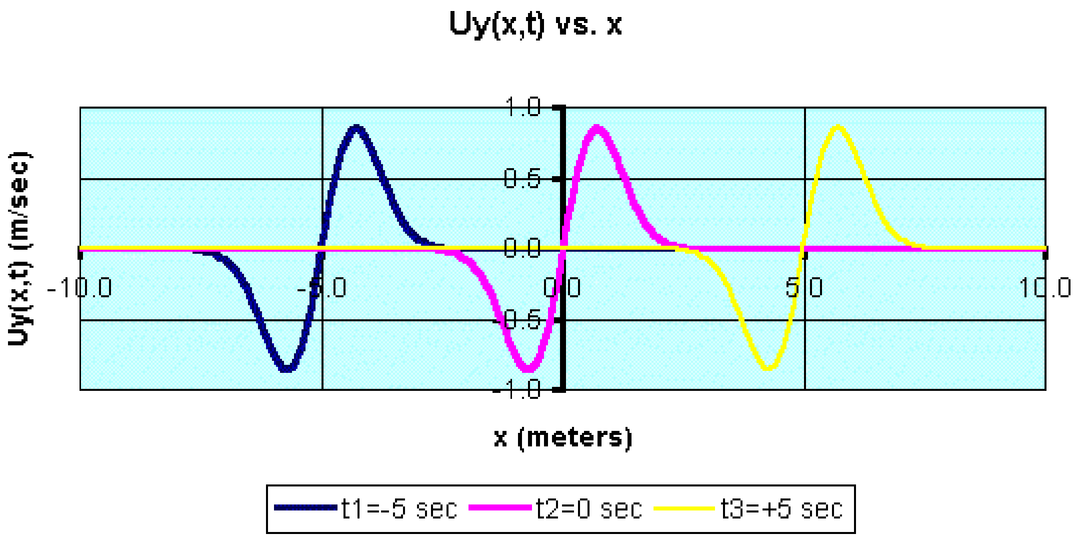
For the right-moving gaussian transverse wave, $y(x, t) = y_o \exp\{-(x - v_x t)^2\}$, with amplitude, $y_o = 1.0\ m$, and *longitudinal* wave velocity, $v_x = +1.0\ m/sec$ the following plot shows the transverse velocity of this wave, $u_y(x, t) = -(\partial y(x, t)/\partial x)\, v_x$ as a function of the position, x on the string, for $t = -5$, 0 and +5 seconds. Reproducing this plot is left as an exercise for the interested reader - see exercise(s) at the end of these lecture notes.



Harmonic Traveling Waves

Having discussed the general properties of traveling waves, we now focus specifically on *harmonic* traveling waves - i.e. waves that repeat themselves periodically in space and in time. Harmonic traveling waves are sinuosoids - and can be described either by sine or cosine functions - e.g. right-moving harmonic traveling waves can be mathematically described as:

$$y(x,t) = A\sin\left[2\pi\left(\tfrac{x}{\lambda} - \tfrac{t}{\tau}\right)\right] = A\sin\left(kx - \omega t\right)$$

or:

$$y(x,t) = A\cos\left[2\pi\left(\tfrac{x}{\lambda} - \tfrac{t}{\tau}\right)\right] = A\cos\left(kx - \omega t\right)$$

where the *amplitude*, A (= transverse displacement from equilibrium position, $y = 0$) has units of length (*e*.g. *meters*), the *wavelength*, λ (in *meters*) which is the spatial repeat distance of a harmonic traveling wave; the period, τ (units of time, *e.g.* seconds) is the repeat time of the harmonic traveling wave. Related quantities are the *frequency*, $f = 1/\tau$ (units of *cycles per second*, or *Hertz*), the *angular frequency*, $\omega = 2\pi f$ (units of *radians*/*second*, often abbreviated as *rad*/*sec*), and the *wavenumber*, $k = 2\pi/\lambda$ (units of inverse length, *e.g. inverse meters* = $1/m = m^{-1}$) of the harmonic traveling wave. The longitudinal wave *speed*, $|v_x|$ (= the *magnitude* of the longitudinal velocity, v_x) is related to the frequency and wavelength of the harmonic traveling wave by the relation $|v_x| = f\lambda$. Since $\omega = 2\pi f$ and $k = 2\pi/\lambda$, we also have $|v_x| = (2\pi f)*(\lambda/2\pi) = \omega/k$.