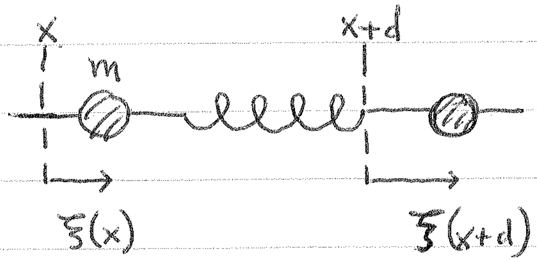
(18.09.06) Impuls transportert med bølge



$\Rightarrow$ vi har masse m på lengden $d + \underbrace{\xi(x+d)}_{\approx \xi(x) + d \frac{\partial \xi}{\partial x}} - \xi(x) \approx d\left(1 + \frac{\partial \xi}{\partial x}\right)$

(med hastighet $\frac{\partial \xi}{\partial t}$)

massebevarelse

$$\Rightarrow (\mu + \Delta\mu)\left(1 + \frac{\partial \xi}{\partial x}\right) d = \underbrace{\mu d}_{\text{ved likevekt}}$$

$\Delta\mu$: avvik fra massetetthet μ ved likevekt

$$\Rightarrow \Delta\mu = -\mu \frac{\partial \xi / \partial x}{1 + \partial \xi / \partial x} \overset{\left|\frac{\partial \xi}{\partial x}\right| \ll 1}{\approx} -\mu \frac{\partial \xi}{\partial x}$$

$\Rightarrow$ impuls (p) pr lengdeenhet ("impulstetthet") $= \pi(x,t) =$

$$(\mu + \Delta\mu)\frac{\partial \xi}{\partial t} = \left(\mu - \mu \frac{\partial \xi}{\partial x}\right)\frac{\partial \xi}{\partial t} = \mu \frac{\partial \xi}{\partial t}\left(1 - \frac{\partial \xi}{\partial x}\right)$$

(Eks:) Midlere impulstetthet for sinusbølge $\xi(x,t) = \xi_0 \sin(kx - \omega t)$ =?

$$\langle \pi \rangle = \langle -\mu \omega \xi_0 \cos(kx-\omega t) + \mu \omega \xi_0 k \xi_0 \cos^2(kx - \omega t)\rangle$$

$$= -\mu\omega\xi_0 \underbrace{\langle \cos(kx-\omega t)\rangle}_{=0} + \mu\omega^2 \underbrace{\frac{k}{\omega}}_{1/v} \xi_0^2 \underbrace{\langle \cos^2(kx-\omega t)\rangle}_{1/2} = \frac{\frac{1}{2}\mu\omega^2\xi_0^2}{v}$$

$$= \frac{\langle \varepsilon \rangle}{v}$$

Dvs: **Midlere impulstetthet = $\dfrac{\text{Midlere energitetthet}}{\text{Bølgehastigheten}}$**

Viser seg å holde generelt, også for e.m. bølger!