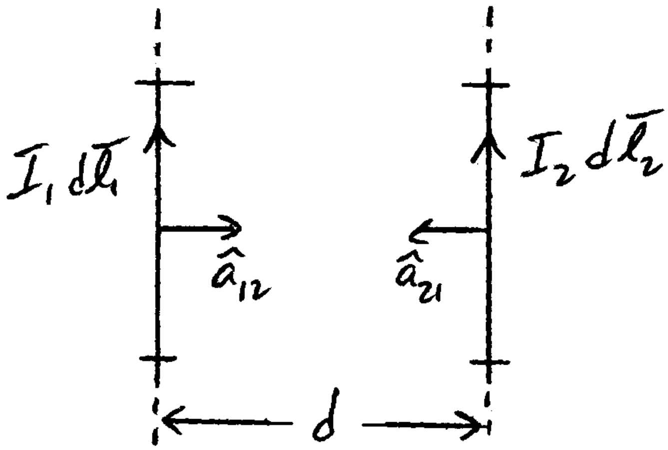
ex. Find the force between parallel wire segments. (Note: This is where research work on magnetic forces and currents started.)



$$d\bar{F}_{21} = \frac{\mu_0 I_1 d\bar{l}_1 \times (I_2 d\bar{l}_2 \times \hat{a}_{21})}{4\pi R_{21}^2}$$

$R_{21} = d$, $d\bar{l}_2 \times \hat{a}_{21}$ yields a vector pointing up, (out of the paper)

the cross product of $d\bar{l}_1$ with a vector pointing up out of the page, yields a vector in the $\hat{a}_{12}$ direction

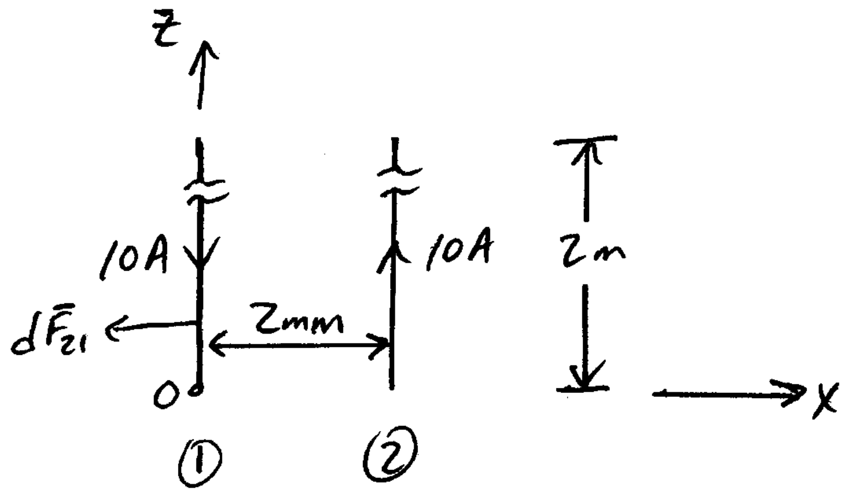
$$\underline{\underline{d\bar{F}_{21} = \hat{a}_{12} \frac{\mu_0 I_1 I_2 \, dl_1 \, dl_2}{4\pi d^2} = -d\bar{F}_{12}}}$$

$\Rightarrow$ If I_1 and I_2 both flow in the same direction, the wire segments are attracted to one another (Keeps multi-filament stranded wires intact)

$\Rightarrow$ If I_1 and I_2 flow in opposite directions, the wire segments repel one another.

ex. cont.

Why don't household power cords blow apart then?



$$d\bar{F}_{21} = \hat{a}_{12} \frac{\mu_0 I_1 I_2 \, dl_1 \, dl_2}{4\pi d^2}$$

$$= \hat{a}_x \frac{(4\pi \times 10^{-7})(-10)(10)(2)(2)}{4\pi (2 \times 10^{-3})^2}$$

$$\underline{\underline{d\bar{F}_{21} = -\hat{a}_x \, 10 \text{ N} \simeq -\hat{a}_x \, 2.25 \text{ lbs}}}$$

↳ The PVC or vinyl insulation enclosing the wires can easily handle this force distributed over the 2 m (~6 ft) length of the cord.