Kerapatan Fluks Listrik dan Hukum Gauss

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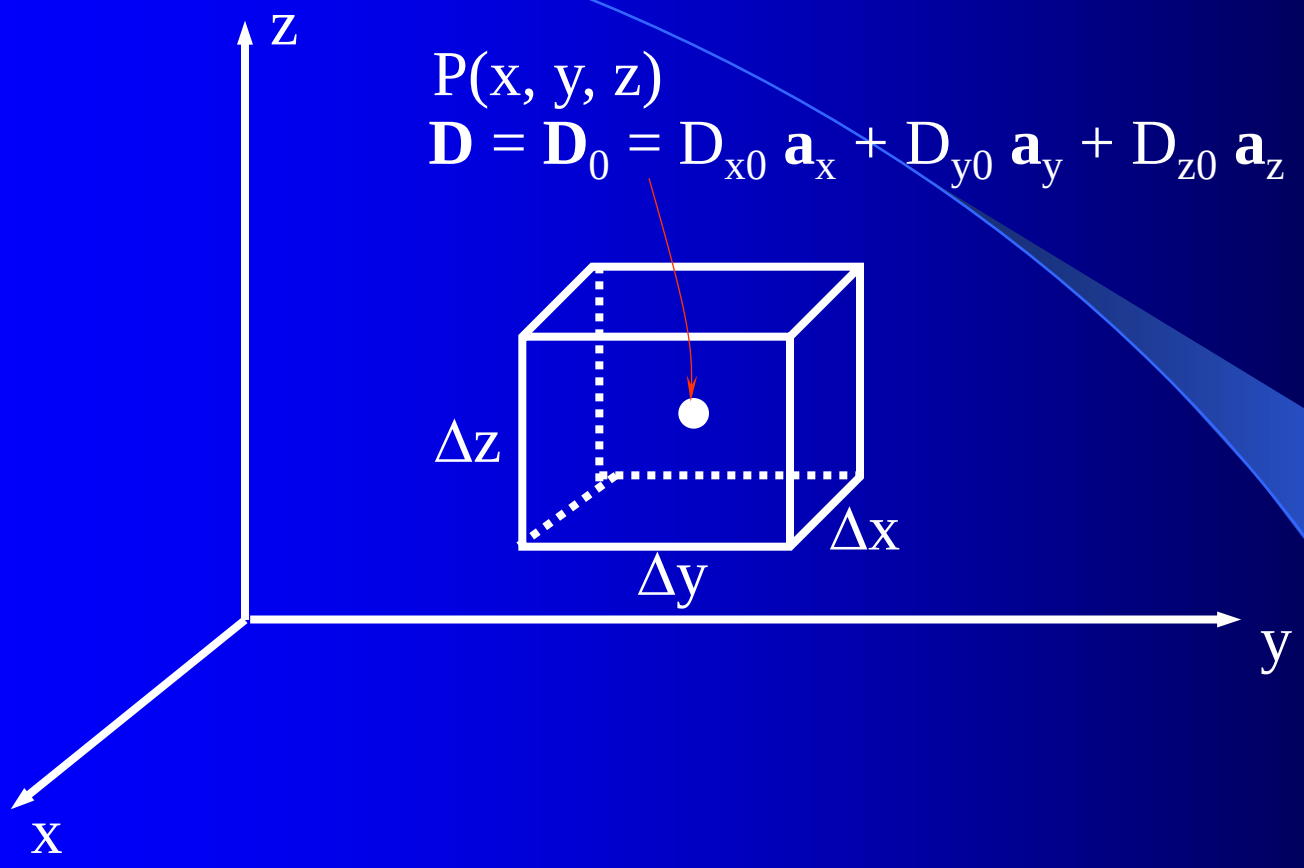
ELEMEN VOLUME DIFFERENSIAL

*Nilai **D** pada titik **P** dapat dinyatakan dalam komponen Kartesian*

$$\boldsymbol{D_0 = D_{x0}\, a_x + D_{y0}\, a_y + D_{z0}\, a_z}$$



Suatu permukaan Gaussian ukuran diferensial pada titik P

$$\oint_S \mathbf{D}.d\mathbf{S} = \int_{front} + \int_{back} + \int_{left} + \int_{right} + \int_{top} + \int_{bottom}$$

Karena elemen permukaan sangat kecil, maka ***D*** *menjadi konstanta*

$$\int_{depan} = \mathbf{D}_{front}.\Delta\mathbf{S}_{front}$$

$$= \mathbf{D}_{front}.\Delta y\,\Delta z\,\mathbf{a}_x$$

$$= D_{x,\,front}\;\Delta y\,\Delta z$$

$$\int_{back} = \mathbf{D}_{back} \cdot \Delta \mathbf{S}_{back}$$

$$= \mathbf{D}_{back} \cdot (-\Delta y \, \Delta z \, \mathbf{a}_x)$$

$$= -\boldsymbol{D}_{\boldsymbol{x},\boldsymbol{back}} \, \Delta \boldsymbol{y} \, \Delta \boldsymbol{z}$$

dan $D_{X,back} = D_{X0} - \frac{\Delta x}{2} \frac{\partial D_X}{\partial x}$ memberikan

$$\int_{back} = \left(-D_{X0} + \frac{\Delta x}{2} \frac{\partial D_X}{\partial x} \right) \Delta y \, \Delta z$$

$$\oint_S \mathbf{D} \cdot d\mathbf{S} = \left(\frac{\partial D_X}{\partial x} + \frac{\partial D_Y}{\partial y} + \frac{\partial D_Z}{\partial z} \right) \Delta x \, \Delta y \, \Delta z$$

dan,

$$\oint_S \mathbf{D} \cdot d\mathbf{S} = Q = \left(\frac{\partial D_X}{\partial x} + \frac{\partial D_Y}{\partial y} + \frac{\partial D_Z}{\partial z} \right) \Delta v$$

DIVERGENSI

- Kita misalkan vektor **A** untuk mendapatkan integral permukaan tertutup yang kecil, maka

$$\frac{\partial A_X}{\partial x} + \frac{\partial A_Y}{\partial y} + \frac{\partial A_Z}{\partial z} = \lim_{\Delta v \to 0} \frac{\oint_S \mathbf{A} \,.\, d\mathbf{S}}{\Delta v}$$

- Operasi ini sering kali muncul dalam penelitian fisis, sehingga diberi nama khusus yaitu *divergensi*.
- Divergensi **A** didefinisikan sebagai berikut:

Divergensi **A** = div **A** = $$\lim_{\Delta v \to 0} \frac{\oint_S \mathbf{A} \cdot d\mathbf{S}}{\Delta v}$$

Ungkapan divergensi

$$div\,\mathbf{D} = \frac{\partial D_X}{\partial x} + \frac{\partial D_Y}{\partial y} + \frac{\partial D_Z}{\partial z}$$ (kartesian)

$$div\,\mathbf{D} = \frac{1}{\rho}\frac{\partial}{\partial \rho}(\rho D_\rho) + \frac{1}{\rho}\frac{\partial D_\phi}{\partial \phi} + \frac{\partial D_Z}{\partial z}$$ (tabung)

$$div\,\mathbf{D} = \frac{1}{r^2}\frac{\partial}{\partial r}(r^2 D_r) + \frac{1}{r\sin\theta}\frac{\partial}{\partial \theta}(\sin\theta\, D_\theta) + \frac{1}{r\sin\theta}\frac{\partial D_\phi}{\partial \phi}$$

(bola)

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