Unit 85.1
Fieldtheoretical finger exercises
to train creative thinking and
to promote imaginative engineering

See also
** Deb 94.1, Deb 132
** Unit 15, part 55.1, pp 8-11
Start
The visual comparison of
** the 3D differential operator **curl/rotation**
of a vector field, in Cartesian coordinates
$\mathbf{F} = \mathbf{i}F_x + \mathbf{j}F_y + \mathbf{k}F_z$ (1)
in determinant representation

$$\text{rot}\,\mathbf{F} = \nabla \times \mathbf{F} = \begin{vmatrix} \mathbf{i} & \mathbf{j} & \mathbf{k} \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ F_x & F_y & F_z \end{vmatrix} \quad [1,2] \quad (2)$$

where
i, **j**, and **k** are the unit vectors for the x-, y-, and z-axes, respectively and

$$\nabla = \frac{\partial}{\partial x}\mathbf{i} + \frac{\partial}{\partial y}\mathbf{j} + \frac{\partial}{\partial z}\mathbf{k} \qquad (3)$$

and

** the **area** of a planar triangle $\Delta P_1P_2P_3$ in a 2D Cartesian coordinate system with $P_i = (x_i,y_i)$ (see Unit19) (4)

$$\text{area } \Delta P_1P_2P_3 = \begin{vmatrix} 1 & 1 & 1 \\ x_1 & x_2 & x_3 \\ y_1 & y_2 & y_3 \end{vmatrix} \qquad (5)$$

suggest the obvious thought to convert any **other** (esp. shortened) determinant structures from computational geometry (Unit 19) into **3D differential operators**, f.i.

$$\begin{vmatrix} x_1 & x_1 & x_2 & x_2 & x_3 & x_3 \\ x_1 & x_1 & x_2 & x_2 & x_3 & x_3 \\ y_1 & y_1 & y_2 & y_2 & y_3 & y_3 \end{vmatrix} \rightarrow$$

$$\begin{vmatrix} \mathbf{i} & \mathbf{i} & \mathbf{j} & \mathbf{j} & \mathbf{k} & \mathbf{k} \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} & \frac{\partial}{\partial z} \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} & \frac{\partial}{\partial z} \\ F_x & F_x & F_y & F_y & F_z & F_z \end{vmatrix} \qquad (6)$$

and more.

Test

"universes" described by field equations containing these 3D differential equations for **physical** feasibility and compatibility. And if ok, think about possible **engineering** applications.

"Putting the cart before the horse" – strategy.

References

[1] https://de.wikipedia.org/wiki/Rotation_eines_Vektorfeldes
[2] https://en.wikipedia.org/wiki/Curl_(mathematics)
[3] ACDG Unit 19
[4] Sun Tzu. The Art of War.
ISBN 978-1599869773

29.11.2017 EPSnoct