MATHEMATISCHES INSTITUT

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Introduction to Computational Fluid Dynamics – 1. Übungsblatt

Aufgabe 1: Show that the identity

$$\mathbf{u} \wedge (\nabla \wedge \mathbf{u}) = \nabla \left(\tfrac{1}{2}\mathbf{u}^2\right) - (\mathbf{u}\cdot\nabla)\mathbf{u}.$$

is valid when $\mathbf{u} = y\mathbf{i} - 2z\mathbf{j} + x\mathbf{k}$.

Aufgabe 2: A water tank consists of a cube occupying the region

$$0 \leq x \leq 1, \qquad 0 \leq y \leq 1, \qquad 0 \leq z \leq 1,$$

and the pressure of the water inside the tank is given by $p = 1 - z$. Calculate the force on each face of the cube.

Aufgabe 3: A diver is a distance h below the surface of water, which has constant density, $\varrho = 1000\text{kg m}^{-3}$. At the water surface the air pressure is $p_a = 10^5\text{N m}^{-2}$. Calculate the pressure experienced by a diver 10m below the surface. At what depth is the pressure three times atmospheric pressure?

Aufgabe 4: In an isothermal atmosphere, the equation of state can be written

$$p = \frac{p_0 \varrho}{\varrho_0}, \qquad p_0, \varrho_0 \quad \text{are pressure and density at sea level.}$$

If $\varrho_0 = 1.3\text{kg m}^{-3}$ and $p_0 = 100,000\text{N m}^{-2}$, calculate the pressure at 10,000m above sea-level.

Abgabe am 16. April 2018 am Beginn der Vorlesung.

Besprechung in der Übung am 23. April 2018.