Fluïdummechanica

Controlevolumes

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Inhoud

1 Inleiding

2 Controle massa's

3 Controlevolumes

4 Stationair controlevolume met één in- en uitstroming

Voorbeeld

Bron: http://www.nasa.gov/

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Mechanica en Thermodynamica

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$$\frac{\mathrm{d}E}{\mathrm{d}t} = \dot{Q} - \dot{W} \tag{3}$$

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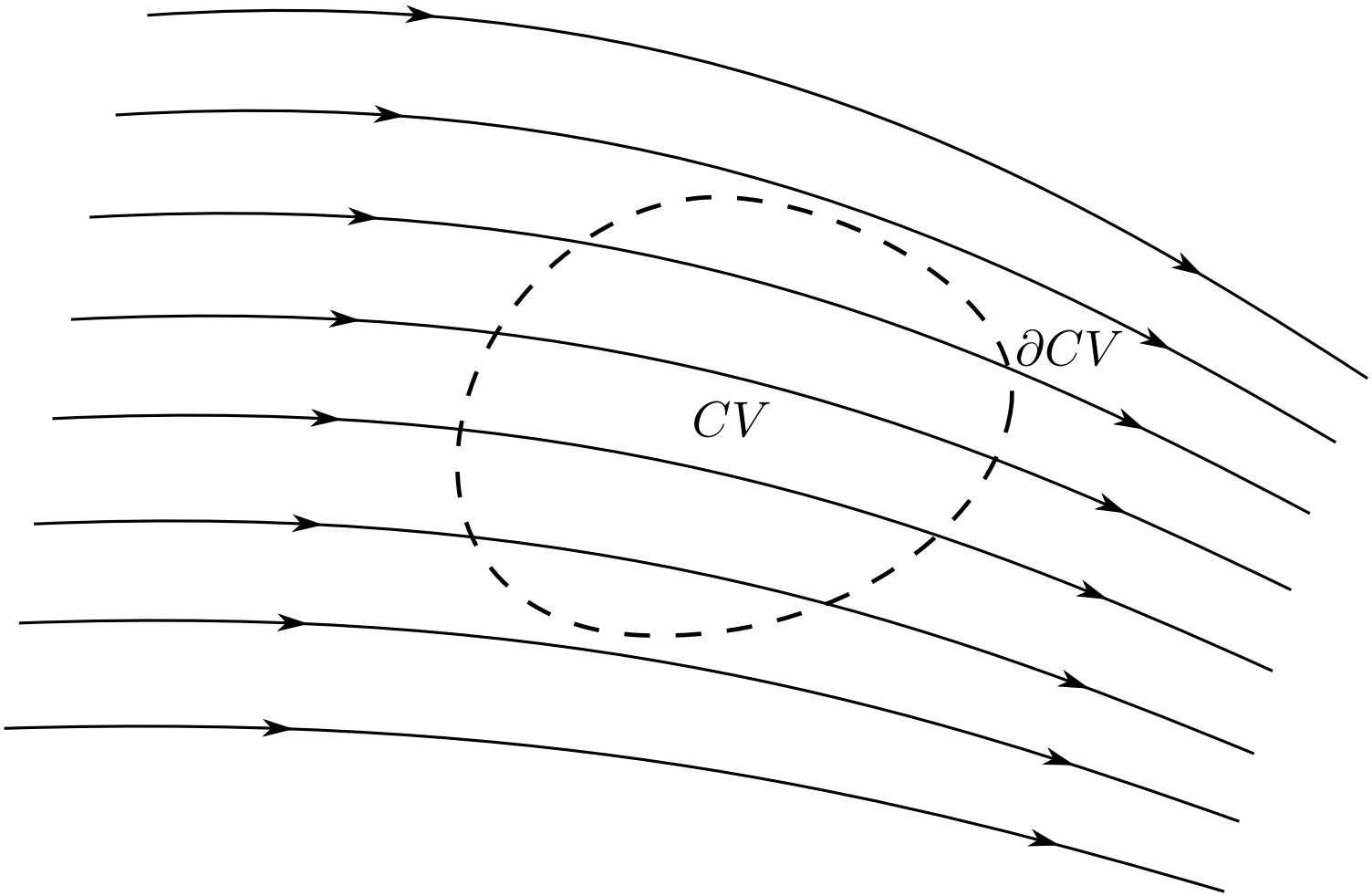
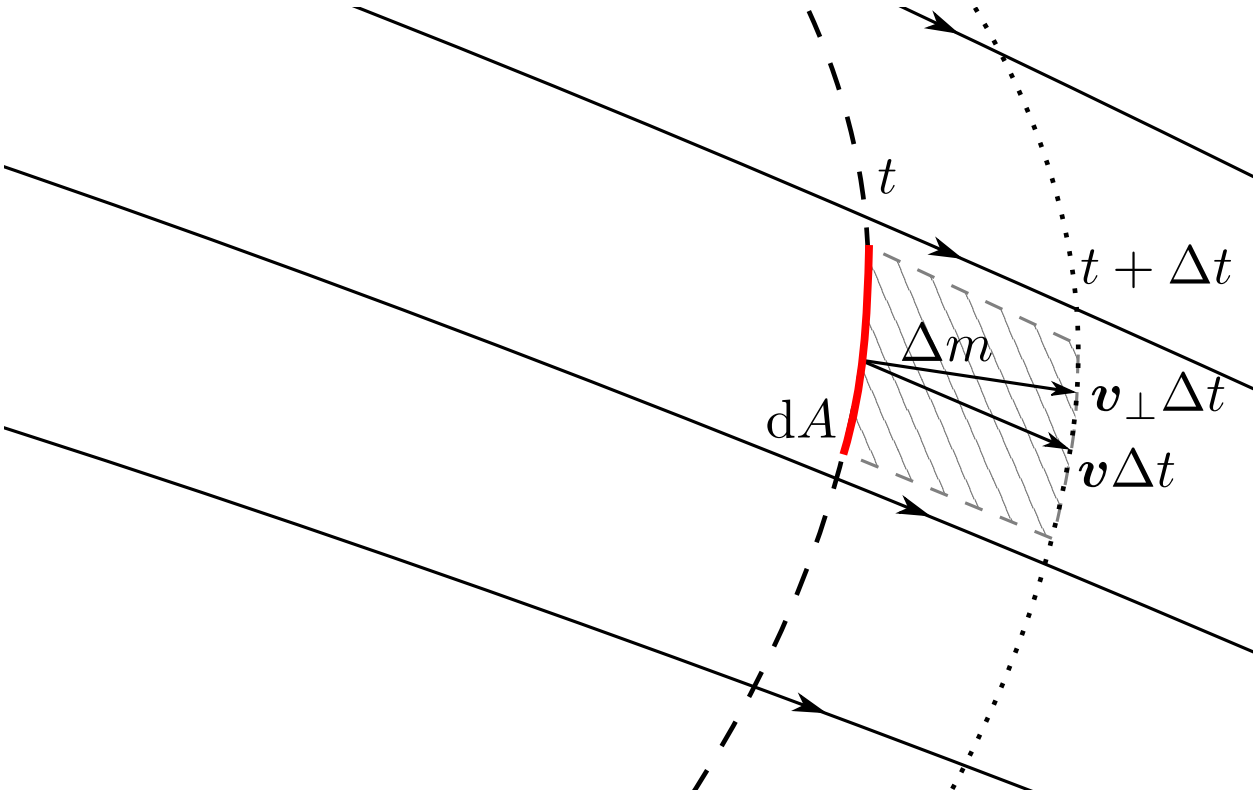
Controlevolume



Behoud van massa

$$\left[\begin{array}{c}\text{De verandering}\\ \text{van massa in}\\ \text{het controlevolume}\end{array}\right] + \left[\begin{array}{c}\text{De netto}\\ \text{massastroom uit}\\ \text{het controlevolume}\end{array}\right] = 0$$

Massastroom



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$$\frac{\mathrm{d}m_{CV}}{\mathrm{d}t} + \dot{m}_{\partial CV} = 0 \tag{4}$$

Behoud van impuls

$$\left[\begin{array}{c}\text{De verandering}\\ \text{van impuls}\\ \text{in het}\\ \text{controlevolume}\end{array}\right] + \left[\begin{array}{c}\text{De netto}\\ \text{impulsstroom}\\ \text{uit het}\\ \text{controlevolume}\end{array}\right] = \left[\begin{array}{c}\text{De totale}\\ \text{kracht}\\ \text{op het}\\ \text{controlevolume}\end{array}\right]$$

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$$\frac{\mathrm{d}\boldsymbol{P}_{CV}}{\mathrm{d}t} + \dot{\boldsymbol{P}}_{\partial CV} = \boldsymbol{F} \tag{5}$$

Behoud van energie

$$\left[\begin{array}{c}\text{De verandering}\\ \text{van energie}\\ \text{in het}\\ \text{controlevolume}\end{array}\right] + \left[\begin{array}{c}\text{De netto}\\ \text{energiestroom}\\ \text{uit het}\\ \text{controlevolume}\end{array}\right] = \left[\begin{array}{c}\text{De warmtesroom}\\ \text{toegevoegd en}\\ \text{arbeidsstroom}\\ \text{onttrokken aan}\\ \text{het controlevolume}\end{array}\right]$$

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$$\frac{\mathrm{d}E_{CV}}{\mathrm{d}t} + \dot{E}_{\partial CV} = \dot{Q} - \dot{W} \tag{6}$$

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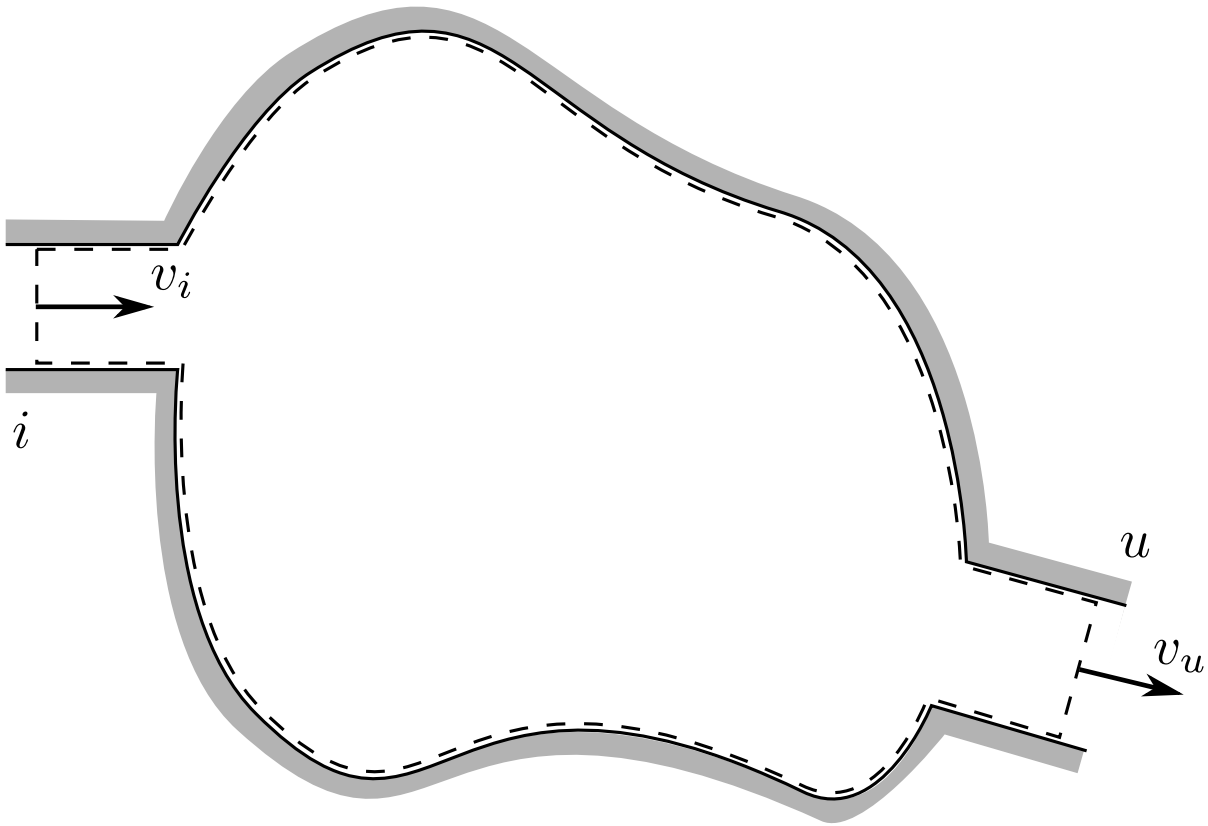

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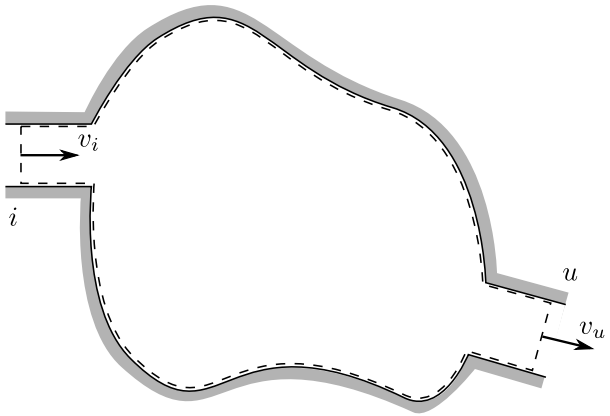

$$\rho_i v_i A_i = \rho_u v_u A_u \tag{7}$$

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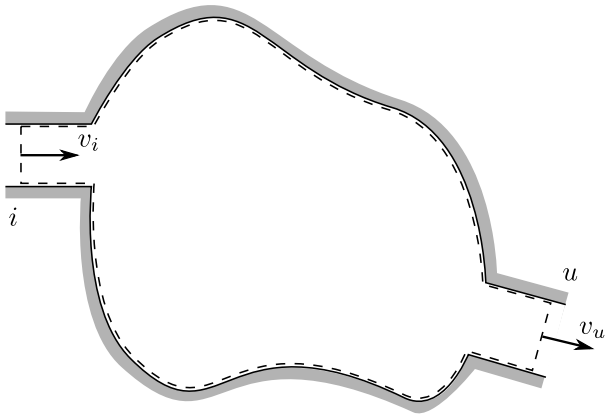

$$\rho_i v_i A_i = \rho_u v_u A_u \tag{7}$$

$$\begin{aligned} F_{x,R} &= p_u A_u n_{x,u} + p_i A_i n_{x,i} + \dot{m}(v_{x,u} - v_{x,i}) \\ F_{y,R} &= p_u A_u n_{y,u} + p_i A_i n_{y,i} + \dot{m}(v_{y,u} - v_{y,i}) \\ F_{z,R} &= p_u A_u n_{z,u} + p_i A_i n_{z,i} + \dot{m}(v_{z,u} - v_{z,i}) \end{aligned} \tag{8}$$

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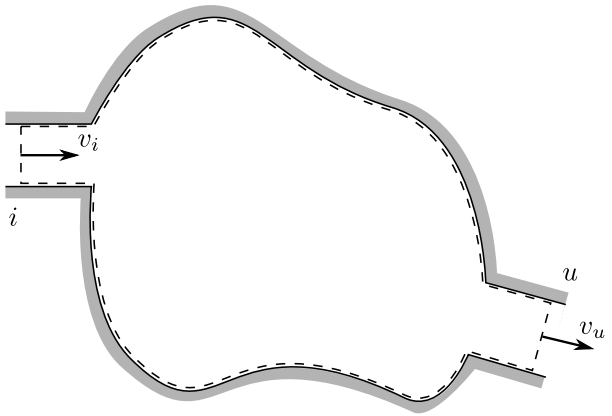

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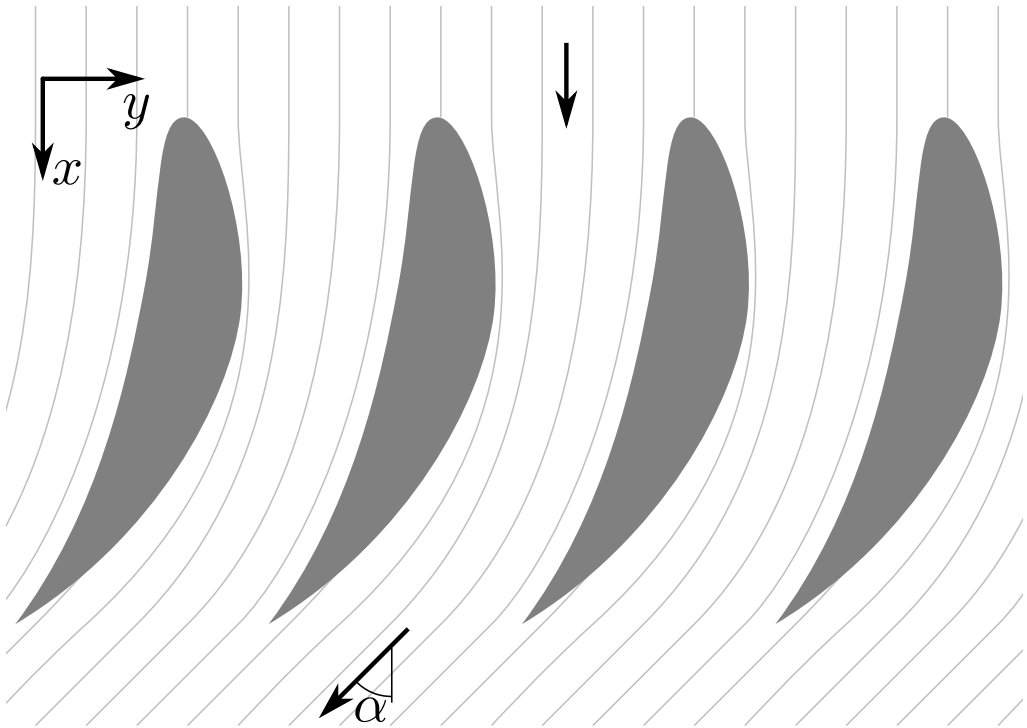
$$\dot{m}(u_u + \frac{p_u}{\rho_u} + \frac{1}{2}v_u^2 + g z_u) - \dot{m}(u_i + \frac{p_i}{\rho_i} + \frac{1}{2}v_i^2 + g z_i) = \dot{Q} - \dot{W}_a \tag{9}$$

Toepassing



Bepaal de horizontale en verticale kracht op één schoep, veronderstel isotherme stroming zonder warmteoverdracht