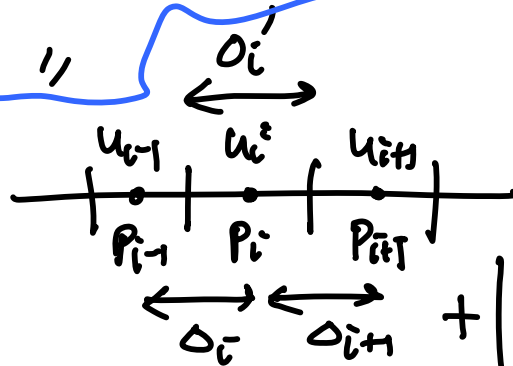
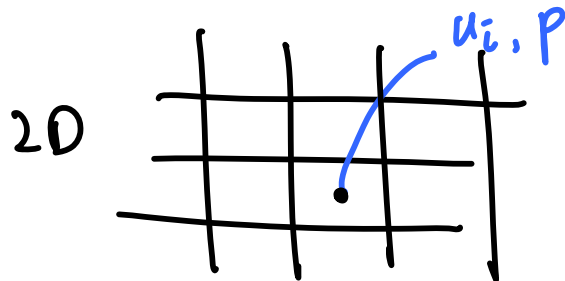


①  $G_i$  : backward difference  
 $D_i$  : forward "

i) collocated mesh



$$u_i G_i p \Delta \Omega|_i = u_i \frac{p_i - p_{i+1}}{\Delta_i'} \Delta_i'$$

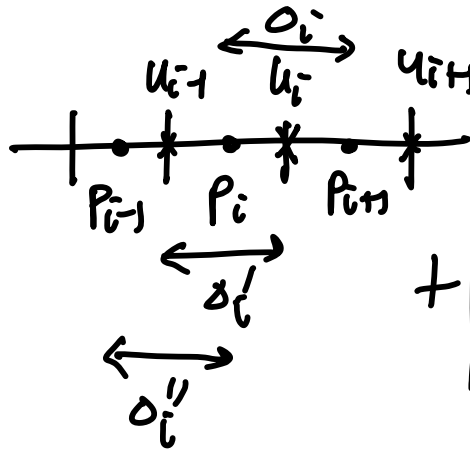
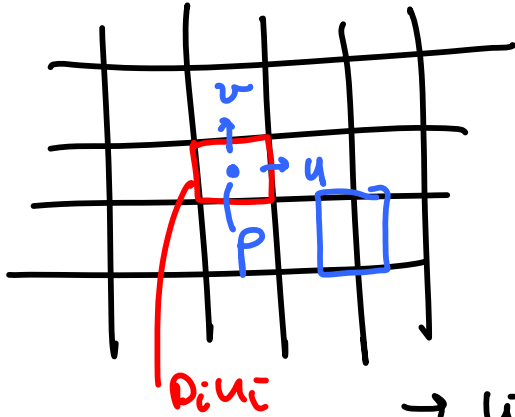
$$p D_i u_i \Delta \Omega|_i = p_i \frac{u_{i+1} - u_i}{\Delta_{i+1}} \Delta_{i+1}$$

$$(u_i G_i p \Delta \Omega + p D_i u_i \Delta \Omega)|_i = (-u_i p_{i+1} + p_i u_{i+1})$$

(if  $\Delta_i' = \Delta_i = \Delta_{i+1}$ )

$$\sum_i ( \text{ " } ) = -u_1 p_0 + u_{N+1} p_N \therefore \text{OK}$$

ii) Staggered mesh



$$u_i G_i \rho \Delta R \Big|_* = u_i \frac{P_i - P_{i-1}}{\delta_i''} \cdot \delta_i'$$

$$+ \Big|_{\bullet} \rho D_i u_i \Delta R = P_i \frac{u_{i+1/2} - u_{i-1/2}}{\delta_i''} \cdot \delta_i'$$

$$\rightarrow u_i G_i \rho \Delta R + \rho D_i u_i \Delta R = -u_i P_{i-1} + P_i u_{i+1/2} \quad \text{if } \delta_i'' = \delta_i' = \delta_i$$

$$\sum_i ( \quad ) = -u_i P_0 + u_{N+1} P_N \quad \underline{OK}$$

②  $G_i$  : CD2      collocated mesh      staggered mesh

$D_i$  : CD2       $\downarrow$        $\downarrow$   
not good      good

③  $G_i$  : forward       $\rightarrow$  not good.  
 $D_i$  : "      "

HW5

When applying the 1-1. CD2 and 1-2. forward difference to both terms ( $G_i$  and  $D_i$ ) in the 2-1. collocated mesh and 2-2. staggered mesh, show that it is good or bad in terms of kinetic energy conservation.