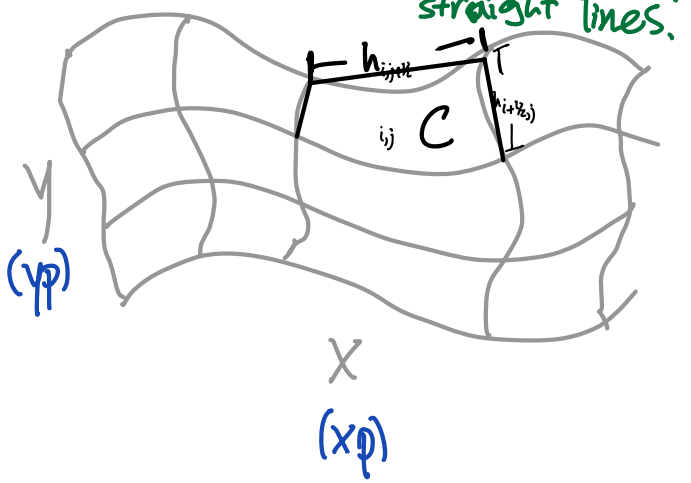
Mapped grids

FVMHP Ch. 23

Reference (computational) grid

Physical (mapped) grid

Cell edges approximated by straight lines.



$$\phi(\xi,\eta) = (x,y)$$

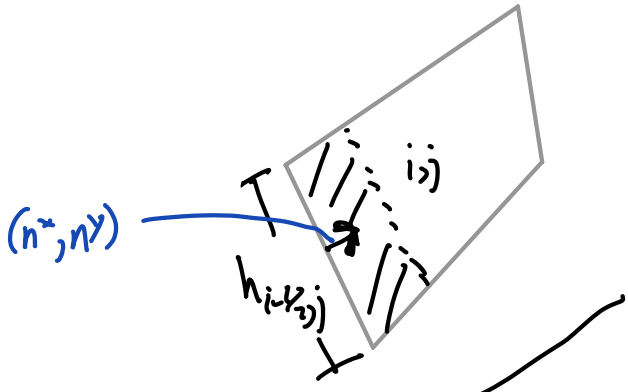
$$\gamma_{i\pm\frac{1}{2},j} = h_{i\pm\frac{1}{2},j}/\Delta\eta$$

$$\gamma_{i,j\pm\frac{1}{2}} = h_{i,j\pm\frac{1}{2}}/\Delta\xi$$

$$\kappa_{ij} = \frac{|C_{ij}|}{\Delta\xi\,\Delta\eta}$$

Approach:

- Solve a Riemann problem on each face
- Wave contributions must be rescaled
- Q_{ij} is an average so we divide by κ_{ij}



Contribution of one wave to cell average:

$$\frac{\Delta t\, h_{i-\frac{1}{2},j}\, \overset{v}{S}^{p}_{i-\frac{1}{2},j}\, W^{p}_{i-\frac{1}{2},j}}{|C_{ij}|}$$

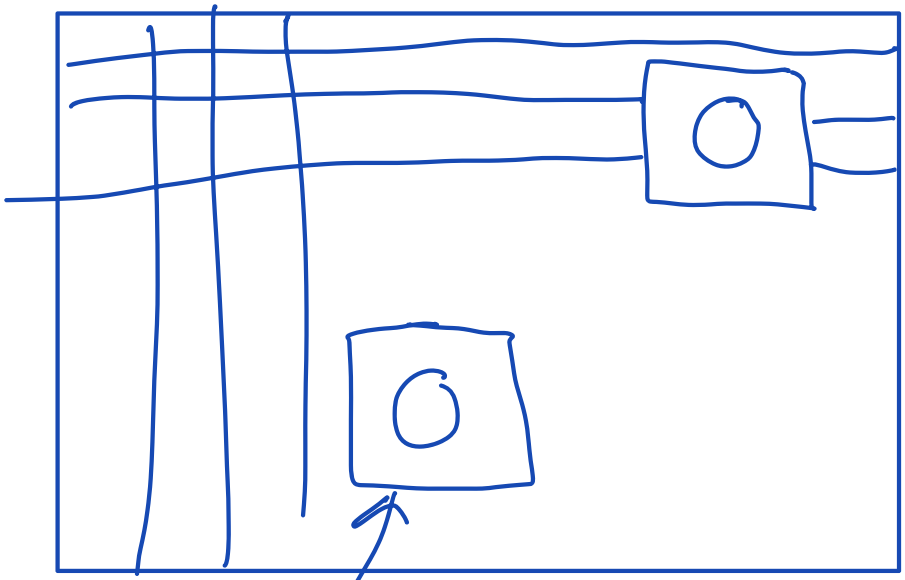
$$|C_{ij}| = \kappa_{ij}\, \Delta\xi\, \Delta\eta$$

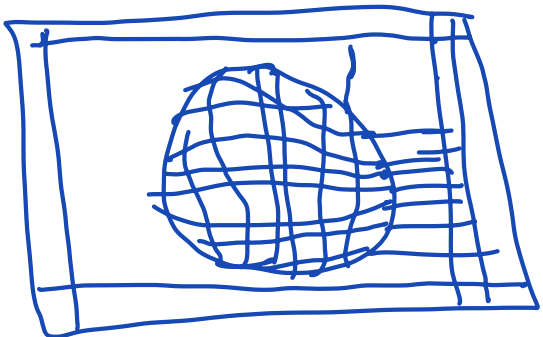
$$\frac{\Delta t}{\kappa_{ij}\Delta\xi} \cdot \frac{h_{i-\frac{1}{2},j}}{\Delta\eta}\, \overset{v}{S}_{i-\frac{1}{2},j}\, W^{p}_{i-\frac{1}{2},j}$$

$$\frac{s\Delta t}{\Delta x} \leq 1$$

$$S^{p}_{i-\frac{1}{2},j} = \overset{v}{S}^{p}_{i-\frac{1}{2}}\, \gamma_{i-\frac{1}{2},j}$$

$$\gamma = \underline{h}$$





$$dtdx|d = \frac{\Delta t}{\Delta \xi_K} = \frac{\Delta t \Delta \eta}{|c_{ij}|}$$

$$S = \vec{S} \cdot \frac{h}{\Delta \eta}$$

$$CFL = \frac{S \Delta t}{|c_{ij}|}$$