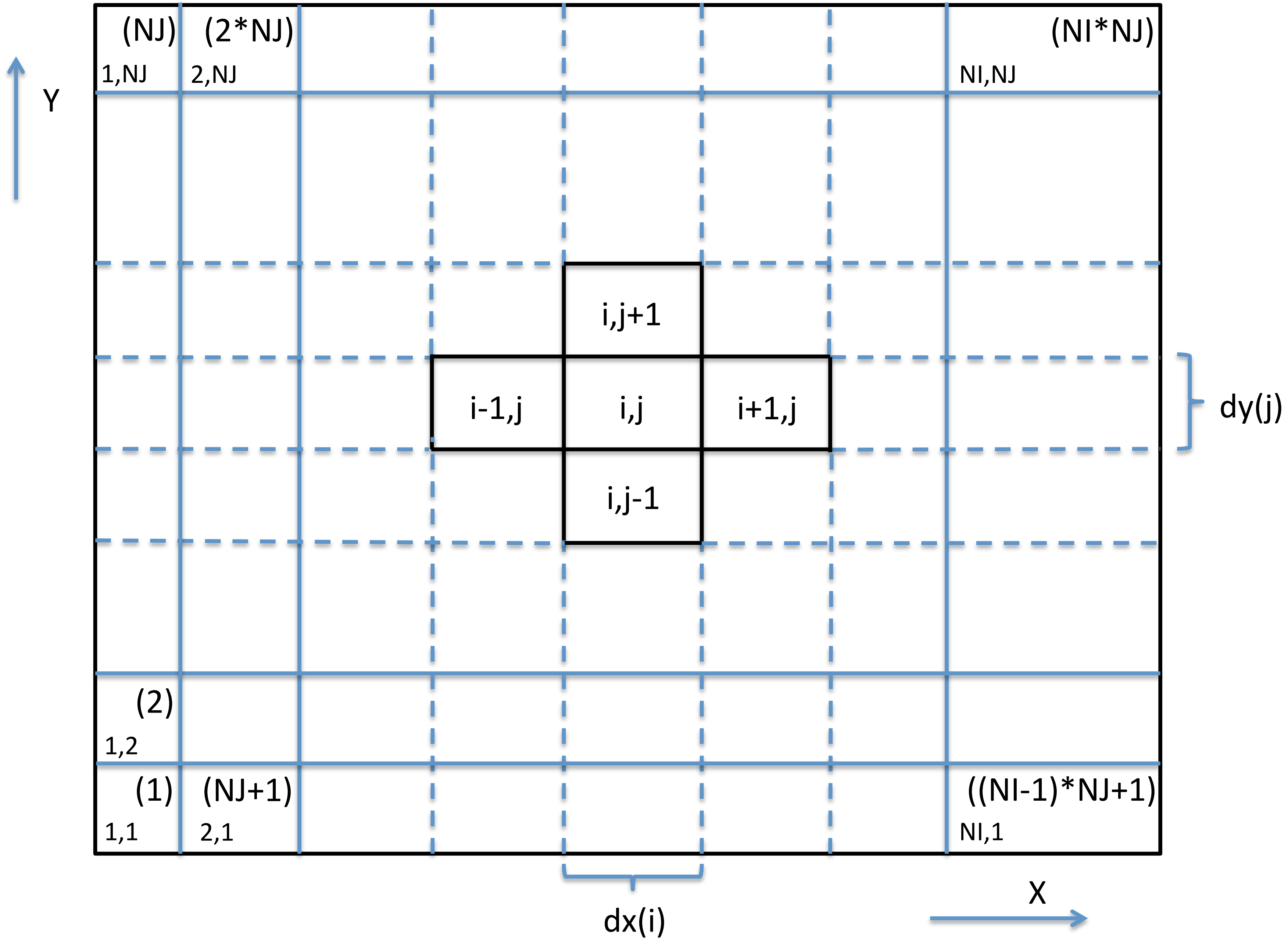
(NJ)
1,NJ
(2*NJ)
2,NJ
(NI*NJ)
NI,NJ
Y
i,j+1
i-1,j
i,j
i+1,j
i,j-1
dy(j)
(2)
1,2
(1)
1,1
(NJ+1)
2,1
((NI-1)*NJ+1)
NI,1
dx(i)
X

STEADY

$$-\int_{\partial\Omega} \mu(\nabla w \cdot \check{n}) d\Gamma = -\int_{\Omega} \frac{dp}{dz} d\Omega$$

$$-\left[\int_{E} \mu \frac{\partial w}{\partial x} d\Gamma - \int_{W} \mu \frac{\partial w}{\partial x} d\Gamma + \cdots\right] = -\int_{\Omega} \frac{dp}{dz} d\Omega$$

$$-\left[\mu_E \frac{W_{i+1,j} - W_{i,j}}{\Delta x(i)} \Delta y(j) + \cdots\right] = -\int_{\Omega} \frac{dp}{dz} d\Omega$$

$$\alpha_{i,j} W_{i,j} + \alpha_{i+1,j} W_{i+1,j} + \alpha_{i-1,j} W_{i-1,j} + \ldots = \beta_{i,j}$$

ONE EQUATION FOR EACH CELL (i,j)

STEADY

$$\alpha_{i,j}W_{i,j} + \alpha_{i+1,j}W_{i+1,j} + \alpha_{i-1,j}W_{i-1,j} + ... = \beta_{i,j}$$

APPLYING MAPPING: i,j → NJ*(i-1) + j

$$\begin{array}{rcl} \alpha_{i,j} & \rightarrow & a_{I,I} \\ \alpha_{i+1,j} & \rightarrow & a_{I,J} \\ \alpha_{i-1,j} & \rightarrow & a_{I,K} \end{array} \qquad \begin{array}{rcl} W_{i,j} & \rightarrow & W_I \\ W_{i+1,j} & \rightarrow & W_J \\ W_{i-1,j} & \rightarrow & W_K \end{array} \qquad \begin{array}{rcl} \beta_{i,j} & \rightarrow & b_I \end{array}$$

$$a_{I,I}W_I + a_{I,J}W_J + a_{I,K}W_K = b_I$$

$$
\begin{bmatrix}
a_{1,1} & a_{1,2} & \cdots & a_{1,NI*NJ} \\
a_{2,1} & a_{2,2} & \cdots & a_{2,NI*NJ} \\
\vdots & \ddots & (A) & \\
a_{NI*NJ,1} & & & a_{NI*NJ,NI*NJ}
\end{bmatrix}
\begin{bmatrix}
x_1 \\ x_2 \\ \vdots \\ (x) \\ \vdots \\ x_{NI*NJ}
\end{bmatrix}
=
\begin{bmatrix}
b_1 \\ b_2 \\ \vdots \\ (b) \\ \vdots \\ b_{NI*NJ}
\end{bmatrix}
$$

REDUCING MATRIX BANDWIDTH →

$$
\begin{cases}
NI < NJ: & NIJ = NI*(j-1) + i \\
NJ < NI: & NIJ = NJ*(i-1) + j
\end{cases}
$$

STEADY

$$-\int_{\partial\Omega} \mu(\nabla w \cdot \check{n})d\Gamma = -\int_{\Omega} \frac{dp}{dz} d\Omega$$

$$\boxed{A_f \mathrm{W} = b_p}$$

TRANSIENT

$$\int_{\Omega} \rho \frac{\partial w}{\partial t} d\Omega - \int_{\partial\Omega} \mu(\nabla w \cdot \check{n})d\Gamma = -\int_{\Omega} \frac{dp}{dz} d\Omega$$

$$\rho A_m \left(\frac{W^{n+1} - W^n}{\Delta t} \right) + \theta A_f W^{n+1} = b_p^{n+\theta} - (1-\theta) A_f W^n$$

$$\boxed{\left(\frac{\rho}{\Delta t} A_m + \theta A_f \right) W^{n+1} = \left(\frac{\rho}{\Delta t} A_m - (1-\theta) A_f \right) W^n + b_p^{n+\theta}}$$

CONVECTION-DIFFUSION-REACTION

$$\int_{\Omega} \frac{\partial u}{\partial t} d\Omega + \int_{\partial\Omega} u(v \cdot \check{n}) d\Gamma + \int_{\Omega} r u d\Omega - \int_{\partial\Omega} k(\nabla u \cdot \check{n}) d\Gamma = \int_{\Omega} f d\Omega$$

$$\int_{\Omega} (\frac{\partial u}{\partial t} + r u) d\Omega + \int_{\partial\Omega} (-k\nabla u + u v) \cdot \check{n}) d\Gamma = \int_{\Omega} f d\Omega$$

$$A_m \left(\frac{U^{n+1} - U^n}{\Delta t} \right) + \theta r A_m U^{n+1} + \theta A_f U^{n+1} =$$
$$b_f - (1-\theta) r A_m U^n - (1-\theta) A_f U^n$$

$$\left((\frac{1}{\Delta t} + \theta r) A_m + \theta A_f \right) U^{n+1} =$$
$$\left((\frac{1}{\Delta t} - (1-\theta) r) A_m - (1-\theta) A_f \right) U^n + b_f$$