sum over a local window around pt. x_i

$$E_{AC}(\underline{u}) = \sum_i \omega(\underline{x}_i)\left[I_0(\underline{x}_i + \Delta\underline{u}) - I_0(\underline{x}_i)\right]^2$$

$$I_0(\underline{x}_i + \Delta\underline{u}) \simeq I_0(\underline{x}_i) + \nabla I_0(\underline{x}_i)^T \Delta\underline{u}$$

$$E_{AC}(\underline{u}) = \sum_i \omega(\underline{x}_i)\left[I_0(\underline{x}_i) + \nabla I_0(\underline{x}_i)^T \Delta\underline{u} - I_0(\underline{x}_i)\right]^2$$

$$= \sum_i \omega(\underline{x}_i)\left(\nabla I_0(\underline{x}_i)^T \Delta\underline{u}\right)^2$$

$$= \sum_{i=1} \omega(\underline{x}_i)\left(\Delta\underline{u}^T \nabla I_0(\underline{x}_i) \nabla I_0(\underline{x}_i)^T \Delta\underline{u}\right)^2$$

$$[- \ ] \begin{bmatrix}- \\ -\end{bmatrix} \quad [- \ -] \quad \begin{bmatrix}- \\ -\end{bmatrix}$$

$$\underbrace{}_{2 \times 2}$$

$$= \Delta\underline{u}^T \underbrace{\left[\sum_i \omega(\underline{x}_i)\, \nabla I_0(\underline{x}_i)\, \nabla I_0^T(\underline{x}_i)\right]}_{A} \Delta\underline{u}$$

$$= \Delta\underline{u}^T \begin{bmatrix} \sum_i \omega(\underline{x}_i) I_x^2(\underline{x}_i) & \left(\sum_i \omega(\underline{x}_i) I_x(\underline{x}_i)\right) * \\ & \left(\sum \omega(\underline{x}_i) I_y(\underline{x}_i)\right) \\[2em] \left(\sum_i \omega(\underline{x}_i) I_x(\underline{x}_i)\right) * & \\ \left(\sum_i \omega(\underline{x}_i) I_y(\underline{x}_i)\right) & \sum \omega(\underline{x}_i) I_y^2(\underline{x}_i) \end{bmatrix}$$

$$\Delta\underline{u}$$

$$A$$