$$= \max_{\underline{v}_C} \frac{\| E_{IC}\underline{v}_C + K_I^{-1}K_{IC}\underline{v}_C \|_{K_I}^2}{\|\underline{v}_C\|_{S_C}^2}$$

$$= \max_{\underline{v}_C} \frac{\left\| \begin{bmatrix} \underline{v}_C \\ E_{IC}\underline{v}_C \end{bmatrix} - \begin{bmatrix} \underline{v}_C \\ -K_I^{-1}K_{IC}\underline{v}_C \end{bmatrix} \right\|_K^2}{\|\underline{v}_C\|_{S_C}^2}$$

Since

$$\left(\begin{bmatrix} \underline{v}_C \\ E_{IC}\underline{v}_C \end{bmatrix}, \begin{bmatrix} \underline{v}_C \\ -K_I^{-1}K_{IC}\underline{v}_C \end{bmatrix} \right)_K =$$

$$= \left(\underbrace{\begin{pmatrix} K_C & K_{CI} \\ K_{IC} & K_I \end{pmatrix} \begin{bmatrix} \underline{v}_C \\ -K_I^{-1}K_{IC}\underline{v}_C \end{bmatrix}}_{= \begin{bmatrix} (K_C - K_{CI}K_I^{-1}K_{IC})\underline{v}_C \\ (K_{IC} - K_I K_I^{-1}K_{IC})\underline{v}_C \end{bmatrix} = \begin{bmatrix} S_C\underline{v}_C \\ \mathbb{O} \end{bmatrix}}, \begin{bmatrix} \underline{v}_C \\ E_{IC}\underline{v}_C \end{bmatrix} \right)$$

$$= (S_C\underline{v}_C, \underline{v}_C) = \|\underline{v}_C\|_{S_C}^2$$

and

$$\left\| \begin{bmatrix} \underline{v}_C \\ -K_I^{-1}K_{IC}\underline{v}_C \end{bmatrix} \right\|_K^2 = (S_C\underline{v}_C, \underline{v}_C) = \|\underline{v}_C\|_{S_C}^2,$$

we get together with assumption (E1)

$$\left\| \begin{bmatrix} \underline{v}_C \\ E_{IC}\underline{v}_C \end{bmatrix} - \begin{bmatrix} \underline{v}_C \\ -K_I^{-1}K_{IC}\underline{v}_C \end{bmatrix} \right\|_K^2 =$$

$$= \left\| \begin{bmatrix} \underline{v}_C \\ E_{IC}\underline{v}_C \end{bmatrix} \right\|_K^2 - 2\left(\begin{bmatrix} \underline{v}_C \\ E_{IC}\underline{v}_C \end{bmatrix}, \begin{bmatrix} \underline{v}_C \\ -K_I^{-1}K_{IC}\underline{v}_C \end{bmatrix} \right)_K + \left\| \begin{bmatrix} \underline{v}_C \\ -K_I^{-1}K_{IC}\underline{v}_C \end{bmatrix} \right\|_K^2$$

$$= \left\| \begin{bmatrix} \underline{v}_C \\ E_{IC}\underline{v}_C \end{bmatrix} \right\|_K^2 - 2\|\underline{v}_C\|_{S_C}^2 + \|\underline{v}_C\|_{S_C}^2 \leq$$

$$\overset{(E1)}{\leq} c_E^2 \|\underline{v}_C\|_{S_C}^2 - \|\underline{v}_C\|_{S_C}^2 = (c_E^2 - 1)\|\underline{v}_C\|_{S_C}^2 \quad \text{q.e.d.}$$