$$\boldsymbol{\rho}_{ii'}(n) = \boldsymbol{\Xi} \times \mathbf{CSIPD}(n)$$

$$\boldsymbol{\Xi} = \begin{bmatrix} 1 & 0 & \cdots & \cos(2\pi k_{\min}\frac{f}{F}) & -\sin(2\pi k_{\min}\frac{f}{F}) & \cdots & \cos(\pi k_{\min}) & -\sin(\pi k_{\min}) \\ \vdots & \vdots & & \vdots & \vdots & & \vdots & \vdots \\ 1 & 0 & \cdots & \cos(2\pi k_{\max}\frac{f}{F}) & -\sin(2\pi k_{\max}\frac{f}{F}) & \cdots & \cos(\pi k_{\max}) & -\sin(\pi k_{\max}) \end{bmatrix}$$

$$\mathbf{CSIPD}(n) = \left[\cos\phi_{ii'}(n,0), \sin\phi_{ii'}(n,0), ..., \cos\phi_{ii'}\left(n, \frac{F}{2}\right), \sin\phi_{ii'}\left(n, \frac{F}{2}\right)\right]^T$$

$$\phi_{ii'}(n,f) = \angle x_i(n,f) - \angle x_{i'}(n,f)$$