Linear Constraints in the Coefficient Space

$$p_1(Z_{1p}^2 + Z_{2p}^2) + p_2(Z_{1p}Z_{3p} - Z_{2p}Z_{4p}) + p_3(Z_{2p}Z_{3p} + Z_{1p}Z_{4p})$$
$$+p_4(Z_{1p}Z_{3p} + Z_{2p}Z_{4p}) + p_5(Z_{2p}Z_{3p} - Z_{1p}Z_{4p}) + p_6 Z_{3p}Z_{4p}$$
$$+p_7(Z_{3p}^2 - Z_{4p}^2) + p_8(Z_{3p}^2 + Z_{4p}^2) = 0,$$

$$-L_1 p_4 - L_2 p_5 + L_3 p_1 = 0, \qquad -l_1 p_2 - l_2 p_3 + l_3 p_1 = 0$$

$$X_f p_1 + p_4 = 0, \qquad x_m p_1 + p_2 = 0,$$
$$Y_f p_1 + p_5 = 0 \qquad y_m p_1 + p_3 = 0,$$

Unified Form

$$\sum_{j=1}^{8} A_j p_j = 0,$$

Algebraic Fitting of Linear Constraints

- We form a system of linear equations given by,

$$[A]\begin{bmatrix} p_1 \\ p_2 \\ \vdots \\ p_8 \end{bmatrix} = 0, \text{ where } [A] = \begin{bmatrix} A_{11} & A_{12} & A_{13} & A_{14} & \cdots & \cdots & A_{18} \\ A_{21} & A_{22} & A_{23} & A_{24} & \cdots & \cdots & A_{28} \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ A_{n1} & A_{n2} & A_{n3} & A_{n4} & \cdots & \cdots & A_{n8}, \end{bmatrix}.$$

where $n < 5$ are number of exact linear constraints

- Singular Value Decomposition $[A] = [U][S][V]^T$
- Null space formed by right singular vectors corresponding to zero singular value is the solution space for optimization given by

$$\mathbf{p} = \alpha_1 \mathbf{v}_1 + \alpha_2 \mathbf{v}_2 + \ldots + \alpha_{8-n} \mathbf{v}_{8-n}$$