Constraints on Homogeneous Form

$$p_1(Z_1^2 + Z_2^2) + p_2(Z_1Z_3 - Z_2Z_4) + p_3(Z_2Z_3 + Z_1Z_4)$$
$$+p_4(Z_1Z_3 + Z_2Z_4) + p_5(Z_2Z_3 - Z_1Z_4) + p_6Z_3Z_4$$
$$+p_7(Z_3^2 - Z_4^2) + p_8(Z_3^2 + Z_4^2) = 0,$$

- Above is defined by a set of 8 homogeneous coordinates ($p_1 \ldots p_8$)
- However, there are only 5 independent mechanism parameters related by

$$p_1 = -a_0, \quad p_2 = a_0x \quad p_3 = a_0y, \quad p_4 = a_1, \quad p_5 = a_2,$$
$$p_6 = -a_1y + a_2x, \quad p_7 = -(a_1x + a_2y)/2,$$
$$p_8 = (a_3 - a_0(x^2 + y^2))/4,$$

- There are two quadratic conditions on ($p_1 \ldots p_8$)

$$p_1p_6 + p_2p_5 - p_3p_4 = 0,$$

$$2p_1p_7 - p_2p_4 - p_3p_5 = 0.$$

Geometric Constraints on Planar Mechanisms

- Pose Constraint on Coupler

Pose having parameters $(Z_{1p}, Z_{2p}, Z_{3p}, Z_{4p})$

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