Example:

Consider a transistor with the following S-parameters (common emitter):

$S_{11}^E = 0.33 \angle 85°$ $\quad S_{12}^E = 0.34 \angle 56°$

$S_{21}^E = 1.39 \angle 39.6°$ $\quad S_{22}^E = 0.26 \angle -47°$

3-port S-parameters

$$S = \begin{bmatrix} 0.50\angle -84° & 0.49\angle 39.6° & 0.60\angle 17.8° \\ 1.31\angle 45.4° & 0.39\angle -69.7° & 0.56\angle -95.3° \\ 0.43\angle -85.8° & 0.49\angle 16.12° & 0.61\angle 38.2° \end{bmatrix}$$

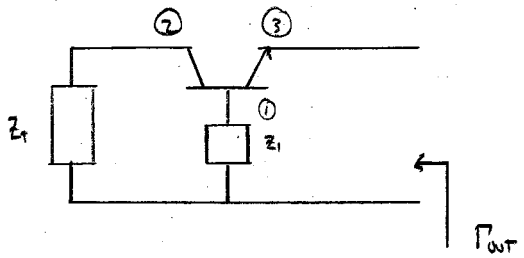
I am going to put the load off the emitter. So, I want to first pick Γ_1 to maximize $|S_{33}^T|$

$$S_{33}^T = S_{33} + \frac{S_{31}S_{13}\Gamma_1}{1 - S_{11}\Gamma_1} = \frac{S_{33} - \Delta_3\Gamma_1}{1 - S_{11}\Gamma_1} \qquad \text{where } \Delta_3 = S_{11}S_{33} - S_{31}S_{13}$$

$$\Gamma_1 = \frac{S_{33} - S_{33}^T}{\Delta_3 - S_{11}S_{33}^T}$$

$$C_1 = \frac{S_{33} - \Delta_3 S_{11}^*}{1 - |S_{11}|^2} = 0.76\angle 68°$$

$$r_1 = \left|\frac{S_{13}S_{31}}{1 - |S_{11}|^2}\right| = 0.60$$



$S_{33,max}^T = (0.76 + 0.60)\angle 68° = 1.36\angle 68°$

$\Gamma_1 = 1\angle 144°$

Use value of Γ_1 to compute $S_{22}^T, S_{23}^T, S_{32}^T, S_{33}^T$

$$\Gamma_{OUT} = S_{33}^T + \frac{S_{32}^T S_{23}^T \Gamma_T}{1 - S_{22}^T\Gamma_T} = \frac{S_{33}^T - \Delta^T\Gamma_T}{1 - S_{22}^T\Gamma_T} \qquad \Delta^T = S_{33}^T S_{22}^T - S_{23}^T S_{32}^T$$

$$\Gamma_T = \frac{S_{33}^T - \Gamma_{OUT}}{\Delta^T - S_{22}^T\Gamma_{OUT}}$$

$$C_{OUT} = \frac{S_{33}^T - \Delta^T S_{22}^{T*}}{1 - |S_{22}^T|^2} = 2.56\angle 46°$$

$$r_{OUT} = \left|\frac{S_{23}^T S_{32}^T}{1 - |S_{22}^T|^2}\right| = 1.75$$

$\Gamma_{OUT,max} = (2.56 + 1.75)\angle 46°$

$\Gamma_T = 1\angle 112°$

$Z_{OUT} = -64.5 + j22.8\ \Omega$