Bilateral case

$$G_A = \frac{P_{AVN}}{P_{AVS}} = \frac{power\ available\ from\ the\ network}{power\ available\ from\ the\ source}$$

The derivation of the constant available power-gain, G_A can be express in the form

$$G_A = \frac{|S_{21}|^2\,(1 - |\Gamma_s|^2)}{\left(1 - \left|\frac{S_{22} - \Delta\Gamma_s}{1 - S_{11}\Gamma_s}\right|^2\right)\,|1 - S_{11}\Gamma_s|^2} = |S_{21}|^2 g_a$$

where

$$g_a = \frac{G_A}{|S_{21}|^2} = \frac{1 - |\Gamma_s|^2}{1 - |S_{22}|^2 + {\Gamma_s}^2(|S_{11}|^2 - |\Delta|^2) - 2\,Re(\Gamma_s C_1)}$$

and

$$C_1 = S_{11} - \Delta S_{22}^*$$

The center C_a and radius r_a of constant operating power gain circles can now be written as

$$C_a = \frac{g_a C_1^*}{1 + g_a(|S_{11}|^2 - |\Delta|^2)}$$

and

$$r_a = \frac{[1 - 2K|S_{12}S_{21}|g_a + |S_{12}S_{21}|^2 g_a^2]^{1/2}}{|1 + g_a(|S_{11}|^2 - |\Delta|^2)|}$$

Where

$$\Delta = S_{11}S_{22} - S_{12}S_{21}$$

and

$$K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2|S_{12}S_{21}|}$$