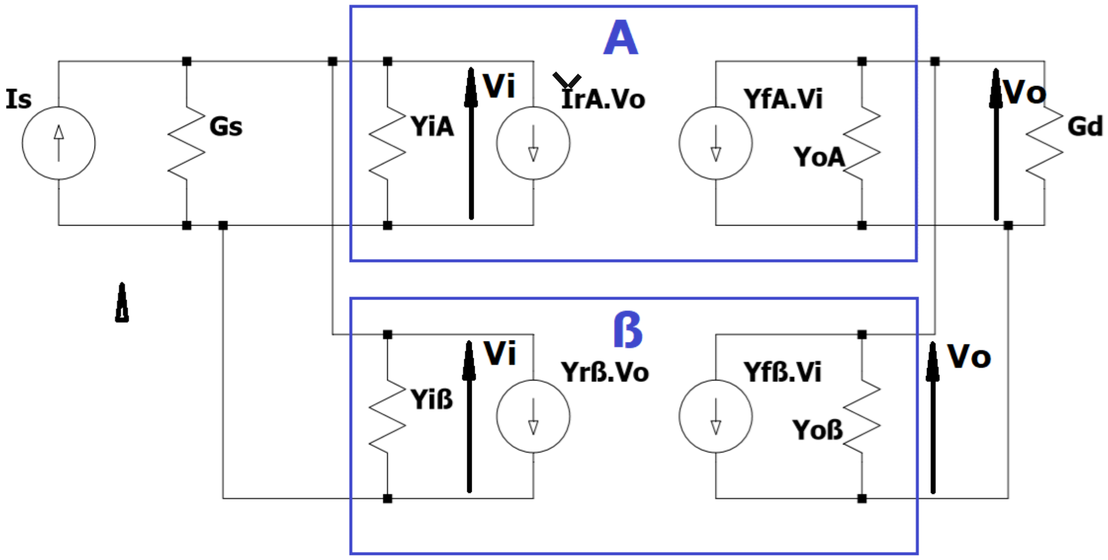
Análisis de la configuración Transresistencia utilizando cuadripolos



$$\begin{cases} I_s = (G_s + Y_{iA} + Y_{i\beta})V_i + (Y_{r\beta} + Y_{rA})V_o \\ 0 = (Y_{fA} + Y_{f\beta})V_i + (Y_{oA} + Y_{o\beta} + G_d)V_o \end{cases}$$

Definimos:

- $Y_{is} = G_s + Y_{iA} + Y_{i\beta}$ **Admitancia de entrada del sistema**
- $Y_{os} = Y_{oA} + Y_{o\beta} + G_d$ **Admitancia de salida del sistema**

Además como $Y_{fA} \gg Y_{f\beta}$ y $Y_{r\beta} \gg Y_{rA}$ $\Rightarrow$ A y β son unilaterales

$$\begin{cases} I_s = Y_{is}V_i + Y_{r\beta}V_o \\ 0 = Y_{fA}V_i + Y_{os}V_o \end{cases}$$

El sistema es realimentado porque existe un generador de corriente controlado de transferencia inversa.

Se desea obtener $R_{Msf} = \frac{V_o}{I_s}$

$$V_i = \frac{-Y_{os}V_o}{Y_{fA}}$$

$$I_s = \frac{-Y_{is}Y_{os}V_o}{Y_{fA}} + Y_{r\beta}V_o$$

$$V_o\left(Y_{r\beta} - \frac{Y_{is}Y_{os}}{Y_{fA}}\right) = I_s$$

$$R_{Msf} = \frac{V_o}{I_s} = \frac{1}{Y_{r\beta} - \frac{Y_{is}Y_{os}}{Y_{fA}}}$$

$$R_{Msf} = \frac{-\frac{Y_{fA}}{Y_{is}Y_{os}}}{1 + Y_{r\beta}\left(-\frac{Y_{fA}}{Y_{is}Y_{os}}\right)}$$

Como $A_f = \frac{A}{1+\beta A}$

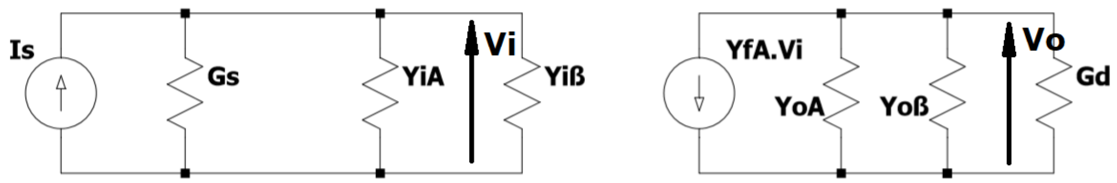
$$R_{Ms} = \frac{-Y_{fA}}{Y_{is}Y_{os}} \qquad \beta = Y_{r\beta}$$

$$\therefore \boxed{R_{Msf} = \frac{R_{Ms}}{1 + \beta R_{Ms}}}$$

Por lo tanto, para resolver el sistema realimentado se debe obtener $Y_{r\beta}$ del cuadripolo β.

Se necesita un modelo de lazo abierto que cumpla con R_{Ms}(**circuito ficticio**).

Se propone eliminar el único elemento de transferencia inversa de β pero mantener las admitancias de β.



$$\begin{cases} I_s = (G_s + Y_{iA} + Y_{i\beta})V_i \\ 0 = Y_{fA}V_i + (Y_{oA} + Y_{o\beta} + G_d)V_o \end{cases}$$

Como ya definimos Y_{is} e Y_{os}

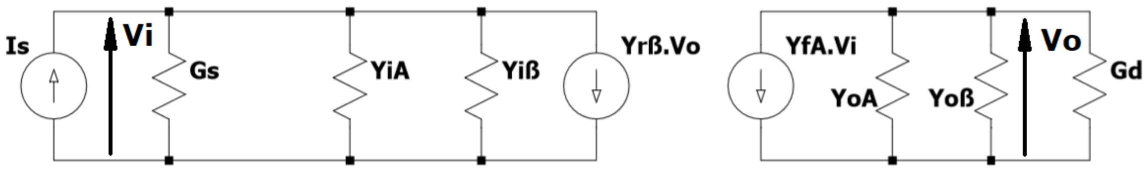
$$\begin{cases} I_s = Y_{is}V_i \\ 0 = Y_{fA}V_i + Y_{os}V_o \end{cases}$$

Se busca $R_{Ms} = \frac{V_o}{I_s}$

Operando $R_{Ms} = \frac{-Y_{fA}}{Y_{is}Y_{os}}$

Admitancia de entrada del sistema realimentado

Partimos de los cuadripolos unilaterales



$$\begin{cases} I_s = (G_s + Y_{iA} + Y_{i\beta})V_i + (Y_{r\beta})V_o \\ 0 = (Y_{fA})V_i + (Y_{oA} + Y_{o\beta} + G_d)V_o \end{cases}$$

Ya habíamos definido:

- $Y_{is} = G_s + Y_{iA} + Y_{i\beta}$
- $Y_{os} = Y_{oA} + Y_{o\beta} + G_d$

$$\therefore \begin{cases} I_s = Y_{is}V_i + Y_{r\beta}V_o \\ 0 = Y_{fA}V_i + Y_{os}V_o \end{cases}$$

$$Y_{isf} = \frac{I_s}{V_i}$$

$$V_o = \frac{-Y_{fA}V_i}{Y_{os}}$$

$$I_s = Y_{is}V_i - \frac{Y_{r\beta}Y_{fA}V_i}{Y_{os}}$$

$$I_s = V_i\left(Y_{is} - \frac{Y_{r\beta}Y_{fA}}{Y_{os}}\right)$$

$$Y_{isf} = \frac{I_s}{V_i} = Y_{is} - \frac{Y_{r\beta}Y_{fA}}{Y_{os}}$$

Como $\quad R_{Ms} = \frac{-Y_{fA}}{Y_{is}Y_{os}} \quad$ y $\quad \beta = Y_{r\beta}$

$$\beta R_{Ms} = -\frac{Y_{r\beta}Y_{fA}}{Y_{is}Y_{os}}$$

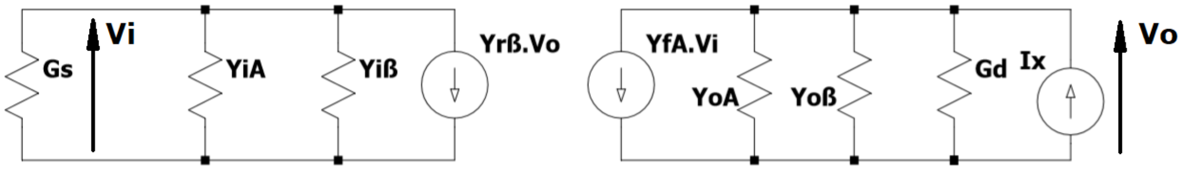
$$Y_{is}\beta R_{Ms} = -\frac{Y_{r\beta}Y_{fA}}{Y_{os}}$$

$$\therefore \; Y_{isf} = Y_{is} + Y_{is}\beta R_{Ms}$$

$$Y_{isf} = Y_{is}(1 + \beta R_{Ms})$$

$$\boxed{Y_{isf} = DY_{is}} \qquad \boxed{R_{isf} = \frac{R_{is}}{D}}$$

Admitancia de salida del sistema realimentado



$$\begin{cases} 0 = (G_s + Y_{iA} + Y_{i\beta})V_i + Y_{r\beta}V_o \\ I_x = Y_{fA}V_i + (Y_{oA} + Y_{o\beta} + G_d)V_o \end{cases}$$

$$\begin{cases} 0 = Y_{is}V_i + Y_{r\beta}V_o \\ I_x = Y_{fA}V_i + Y_{os}V_o \end{cases}$$

$$Y_{osf} = \frac{I_x}{V_o}$$

$$V_i = \frac{-Y_{r\beta}V_o}{Y_{is}}$$

$$I_x = -\frac{Y_{r\beta}Y_{fA}V_o}{Y_{is}} + Y_{os}V_o$$

$$I_x = V_o\left(Y_{os} - \frac{Y_{r\beta}Y_{fA}}{Y_{is}}\right)$$

$$Y_{osf} = \frac{I_x}{V_o} = Y_{os} - \frac{Y_{r\beta}Y_{fA}}{Y_{is}}$$

$$\beta R_{Ms} = -\frac{Y_{r\beta}Y_{fA}}{Y_{is}Y_{os}}$$

$$Y_{os}\beta R_{Ms} = -\frac{Y_{r\beta}Y_{fA}}{Y_{is}}$$

$$\therefore\ Y_{osf} = Y_{os} + Y_{os}\beta R_{Ms}$$

$$Y_{osf} = Y_{os}(1 + \beta R_{Ms})$$

$$\boxed{Y_{osf} = DY_{os}} \qquad \boxed{R_{osf} = \frac{R_{os}}{D}}$$