$$\overline{i_{nch}^2} = 4KT\delta g_{do}\left(\frac{\omega C_{gs}}{\sqrt{5}\, g_{do}}\right)^2 \Delta f$$

$$= 4KT\delta\left(\frac{g_m}{\alpha}\right)\left(\frac{\omega C_{gs}}{\sqrt{5}\,(g_m/\alpha)^*}\right)^2 \Delta f$$

$$= 4KT\alpha\cdot\delta\cdot g_m\left(\frac{\omega C_{gs}}{\sqrt{5}\, g_m}\right)^2 \Delta f \Rightarrow \text{another expression in terms of } g_m.$$

NOTE) - Drain thermal noise current and induced gate noise are originated from same source.

- The two noise sources can thus to be expected to be correlated.
- They are completely correlated?

  No, because of the capacitive coupling there is only a partial correlation.

Let's separate $\overline{i_{nch}}$ into correlated and non-correlated part to drain noise current.

$$\overline{i_{nch}^2} = 4KT\delta g_{do}\left(\frac{\omega C_{gs}}{\sqrt{5}\, g_{do}}\right)^2 \left(1-|c|^2\right)\Delta f \Rightarrow \text{uncorrelated part}$$

$$+ 4KT\delta g_{do}\left(\frac{\omega C_{gs}}{\sqrt{5}\, g_{do}}\right)^2 |c|^2 \Delta f \Rightarrow \text{correlated part}$$

$$= 4KT\delta g_g\left(1-|c|^2\right)\Delta f + 4KT\delta g_g |c|^2 \Delta f$$

where, $g_g = \frac{\omega^2 C_{gs}^2}{5 g_{do}} = \alpha\frac{\omega^2 C_{gs}^2}{5\cdot g_m} = \alpha g_m\left(\frac{\omega^2 C_{gs}^2}{5 g_m^2}\right)$

$$= \alpha g_m\left(\pm\frac{1}{\sqrt{5}}\frac{\omega}{\omega_T}\right)^2$$

$$C = \frac{\overline{i_{nch}\cdot i_{nd}^*}}{\sqrt{\overline{i_{nch}^2}\cdot\overline{i_{nd}^2}}} \simeq ; 0.395$$