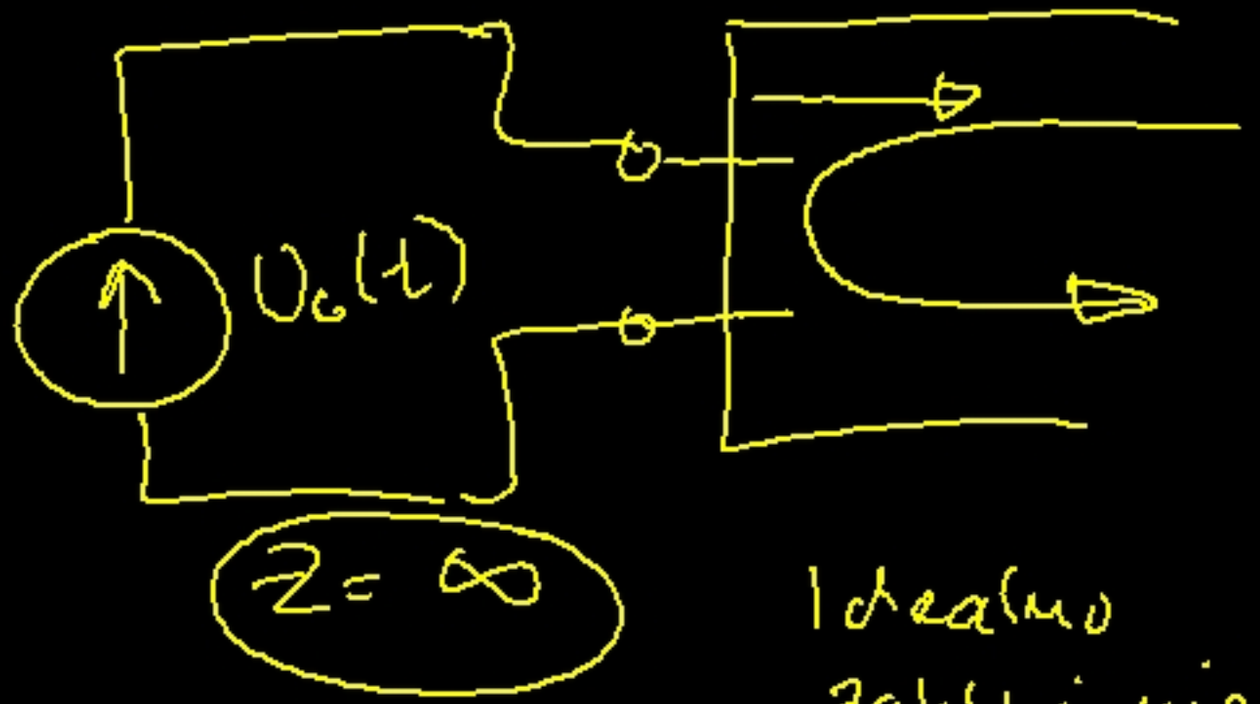
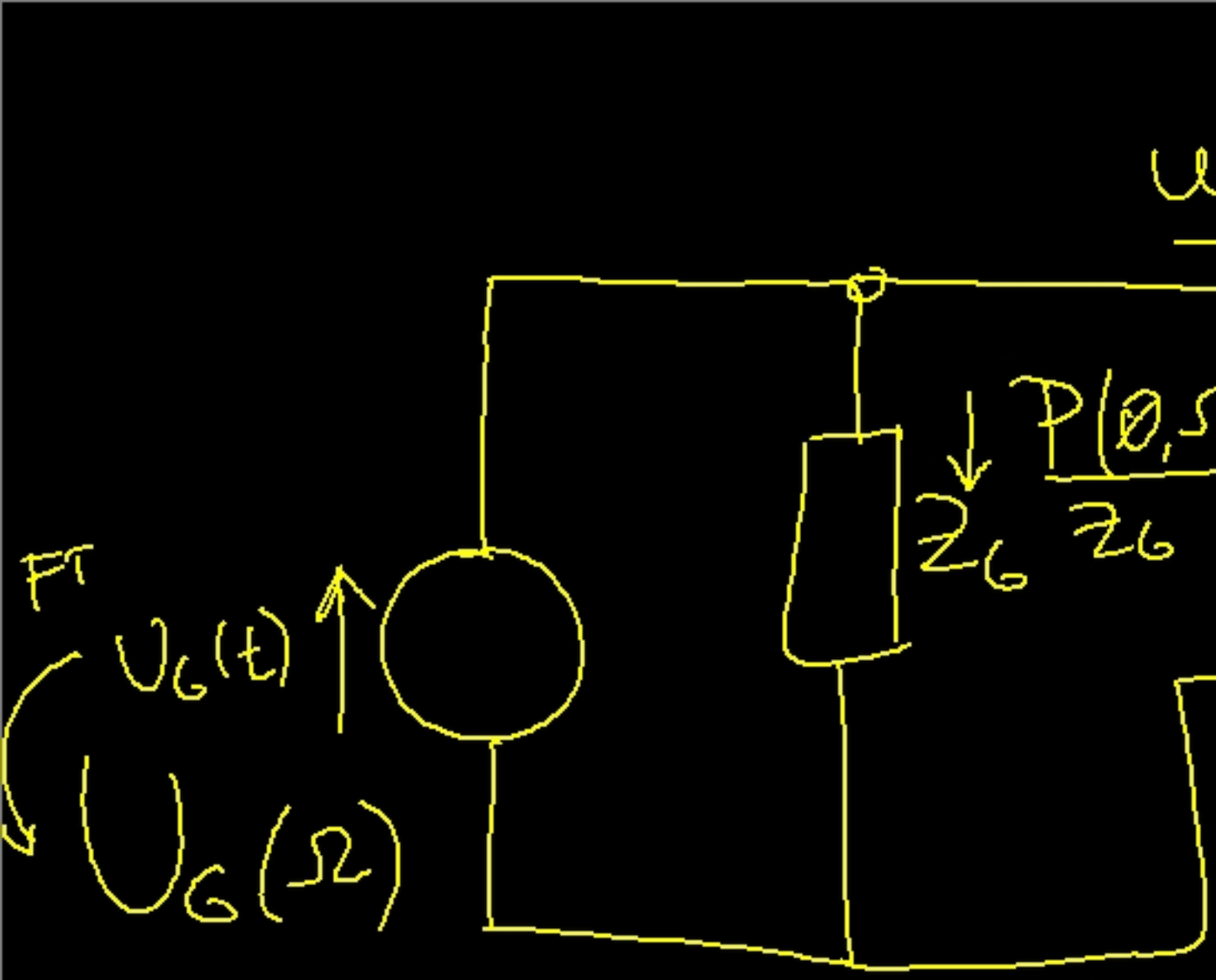


Idealno
zanemarujemo
na glasnicama

DC pobuda

U stacionarnosti:
je pobuda
tlak iz
pluća koji
se nalazi
ispred
glasnica

$U_c(t)$... funkcija:
tlaka ispred glasnica
otvora glasnica (kada nisu napete)
krutosti/elastičnosti/napetosti glasnica



$Z_G = R_G + L_G j\omega$

$2\alpha\ \omega \nearrow \quad |Z_G| \nearrow$

gubitci izraženi za male ω

$$U_G(\Omega) = U(\emptyset,\Omega) + \frac{P(\emptyset,\Omega)}{Z_G}$$

$$U(\emptyset,\Omega) = U_G(\Omega) - \frac{P(\emptyset,\Omega)}{Z_G}$$

→ definira rubni uvjet na Γ_{GS}.

1. Realna komp. R_G glotalne imp.
   utječe na širenje | visko-fren. form.

2. Realna komp. R_L (imp. na usnicama)
   utječe na širenje | visoko-frekv. form.

3. Elastičnost stijenki:
   ⇒ na visko-frekv. form.

3 klasične izvora gub.

$u_k^+(\emptyset, t)$ ....

$\Downarrow$

$u_k^+(t)$

$u_k^-(\emptyset, t)$ ...

$\downarrow$

$u_k^-(t)$

na gore

$u_k^+(\ell_k, t) = u_k^+(\emptyset, t - \frac{\ell_k}{c})$

$\Downarrow$

$u_k^+(t - \frac{\ell_k}{c})$

$u_{k\text{ulaz}}^-(\emptyset, t) = u_k^-(\ell_k, t - \frac{\ell_k}{c})$

$u_k^-(\ell_k, t) = u_{k\text{izlaz}}^-(\emptyset, t + \frac{\ell_k}{c})$

$\downarrow$

$u_k^-(t + \frac{\ell_k}{c})$

na niže

na spoju dviju cijevi
$\Rightarrow$ tražimo ... kontinuitet $\boxed{p, u}$

$$p_k(l_k, t) = p_{k+1}(0, t)$$

na kraju k-te cijevi — na početku $k+1$

$$u_k(l_k, t) = u_{k+1}(0, t)$$

$$\frac{1}{A_k}\left(u_k^+\left(t-\frac{l_k}{c}\right) + u_k^-\left(t+\frac{l_k}{c}\right)\right) = \frac{1}{A_{k+1}}\left(u_{k+1}^+(t) + u_{k+1}^-(t)\right) \quad (1)$$

$$\left(u_k^+\left(t-\frac{l_k}{c}\right) - u_k^-\left(t+\frac{l_k}{c}\right)\right) = \left(u_{k+1}^+(t) - u_{k+1}^-(t)\right) \quad (2)$$

$$\left(u_k^+\left(t-\frac{l_k}{c}\right) - u_k^-\left(t+\frac{l_k}{c}\right)\right) = \left(u_{k+1}^+(t) - u_{k+1}^-(t)\right)$$

$$u_k^-(t+\tau_k) = -u_{k+1}^-(t) + u_{k+1}^-(t) + u_k^+(t-\tau_k)$$

↳ ovvero $u(1)$ ... i iz $\wedge$ izrazimo $u_{k+1}^+(t)$

$$\frac{1}{A_k}\left(u_k^+\left(t-\frac{l_k}{c}\right) + u_k^-\left(t+\frac{l_k}{c}\right)\right) = \frac{1}{A_{k+1}}\left(u_{k+1}^+(t) + u_{k+1}^-(t)\right)$$

$$\frac{1}{A_k}\left(u_k^+(t-\tau_k) - u_{k+1}^+(t) + u_{k+1}^-(t) + u_k^+(t-\tau_k)\right) = \frac{1}{A_{k+1}}\left(u_{k+1}^+(t) - u_{k+1}^-(t)\right)$$

$$u_{k+1}^+(t)\left(\frac{+1}{A_k} + \frac{1}{A_{k+1}}\right) = u_k^+(t-\tau_k)\left(+\frac{1}{A_k}\cdot 2\right) + u_{k+1}^-(t)\left(-\frac{1}{A_k} + \frac{1}{A_{k+1}}\right)$$

$$\gamma_k = \frac{A_{k+1} - A_k}{A_{k+1} + A_k}$$

$$\frac{\frac{2}{A_k}}{\frac{A_{k+1} + A_k}{A_{k+1}\cdot A_k}} = \frac{2A_{k+1}}{A_{k+1} + A_k} \qquad \frac{2}{A_k} = 1 + \gamma_k$$

$$\frac{-\frac{1}{A_k}+\frac{1}{A_{k+1}}}{\frac{1}{A_k}+\frac{1}{A_{k+1}}} = \frac{-\frac{A_{k+1}+A_k}{A_k A_{k+1}}}{\frac{A_{k+1}+A_k}{A_k A_{k+1}}}$$

$$= \frac{A_k - A_{k+1}}{A_k + A_{k+1}}$$

$$V_k = \frac{A_{k+1} - A_k}{A_{k+1} + A_k}$$

$$(1+r_k) = \frac{A_{k+1} + A_k + A_{k+1} - A_k}{A_{k+1} + A_k}$$

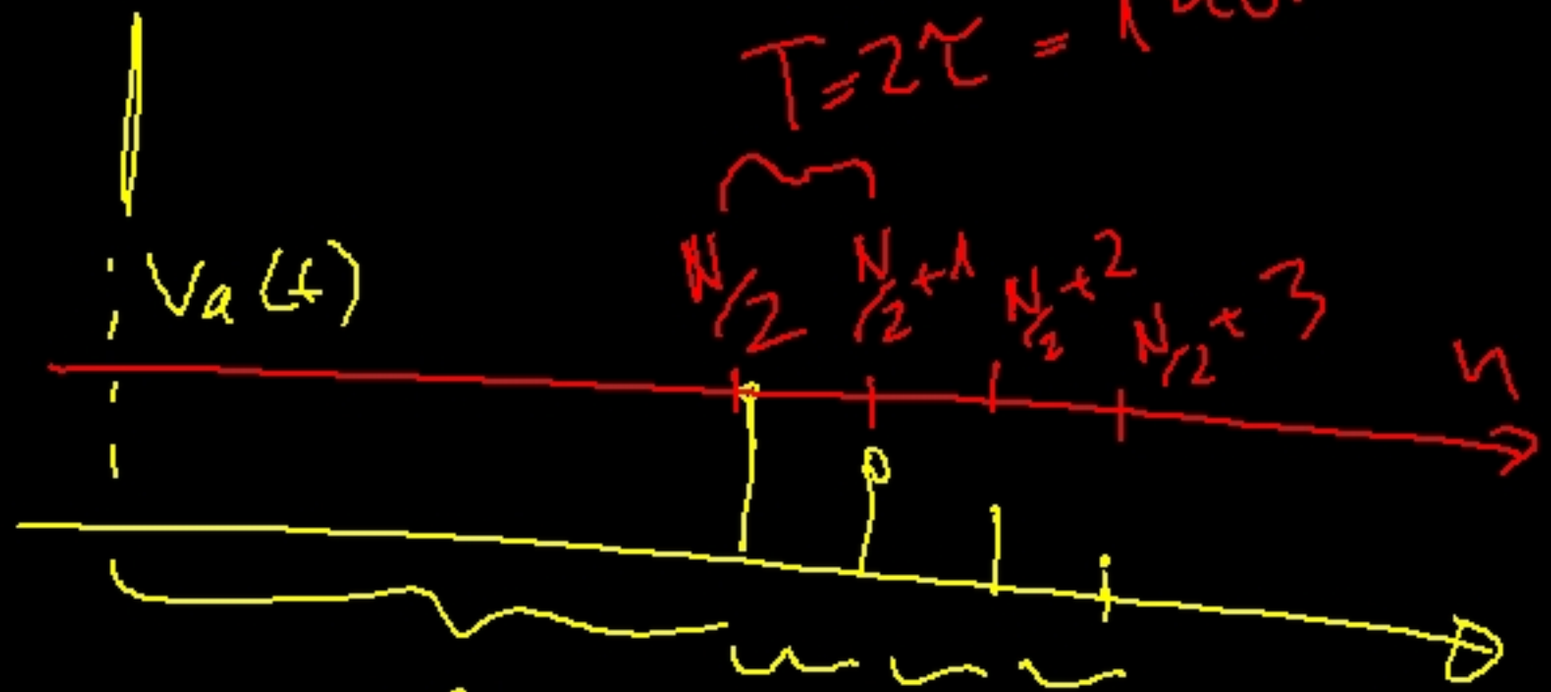
$$\frac{2A_{k+1}}{A_{k+1} + A_k}$$

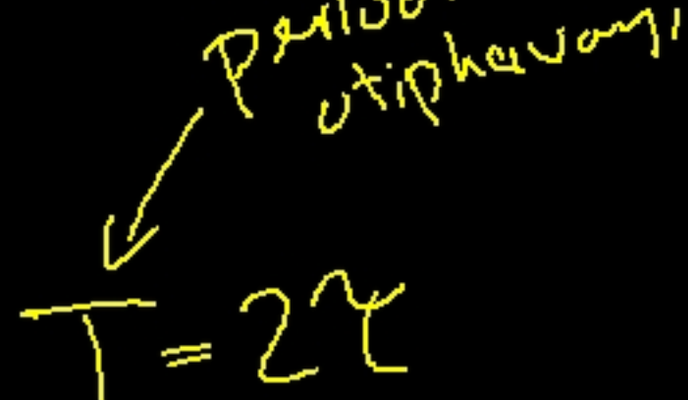
① $\Leftarrow \quad U_{k+1}^{+}(t) = (1+r_k)\, U_k^{+}(t-\tau_k) + r_k\, U_{k+1}^{+}(t)$

② $\Leftarrow \quad U_k^{-}(t+\tau_k) = -r_k \cdot U_k^{+}(t-2\tau_k) + (1-r_k)\, U_{k+1}^{-}(t)$

$$U_{k+1}^{+}(t) + U_k^{-}(t+\tau_k) = U_k^{+}(t-\tau_k) + U_{k+1}^{-}(t)$$

Suma ① + ② traži da suma U-ova koji ulaze / izlaze iz spoja bude $\emptyset$





Otipkavanjem $V_a(t)$ u trenutcima $t = k \cdot (\tau/2)$

dobijamo niz brojeva.

Sve je sadržano upravo u tim brojevima.