Electrotechique-II
MICRO-101: week 5

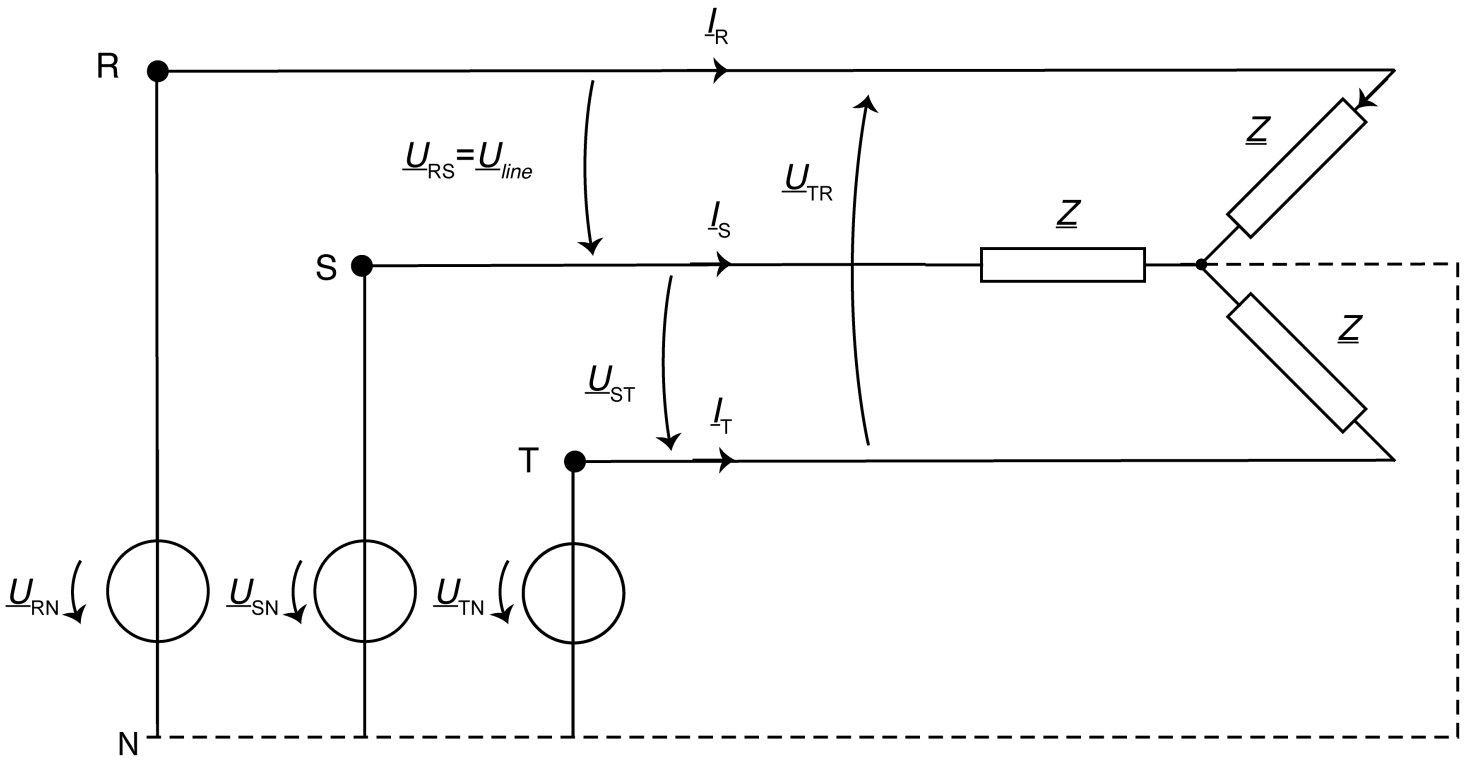
I.-C. Benea-Chelmus

Today

- Three-phase systems:
  - Delta and Y-networks
  - Dissipated power
  - Instantaneous power

- What you should know after the class:
  - Currents and voltages in Delta and Y-networks
  - Time-dependency of powers

Balanced Y-network



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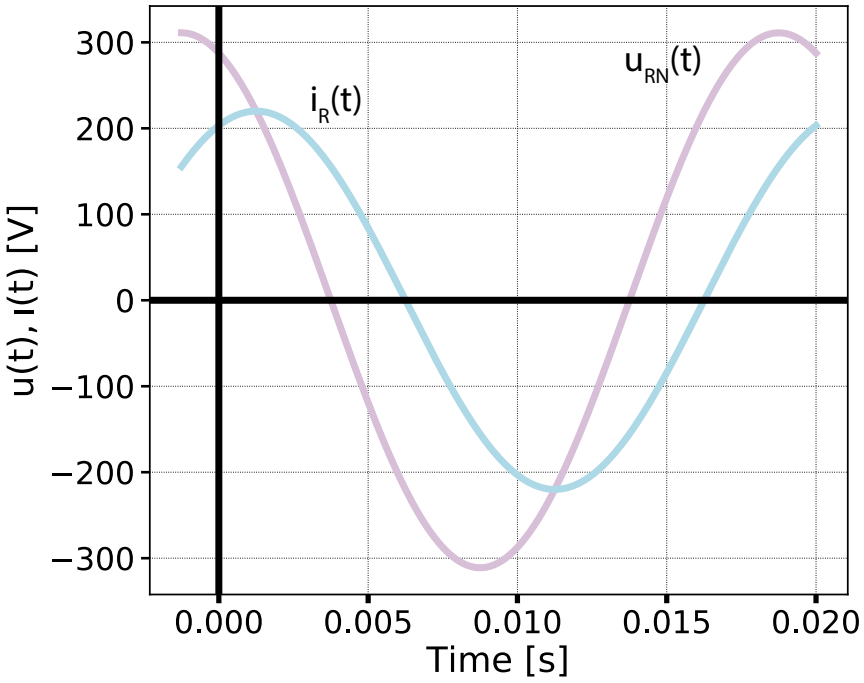
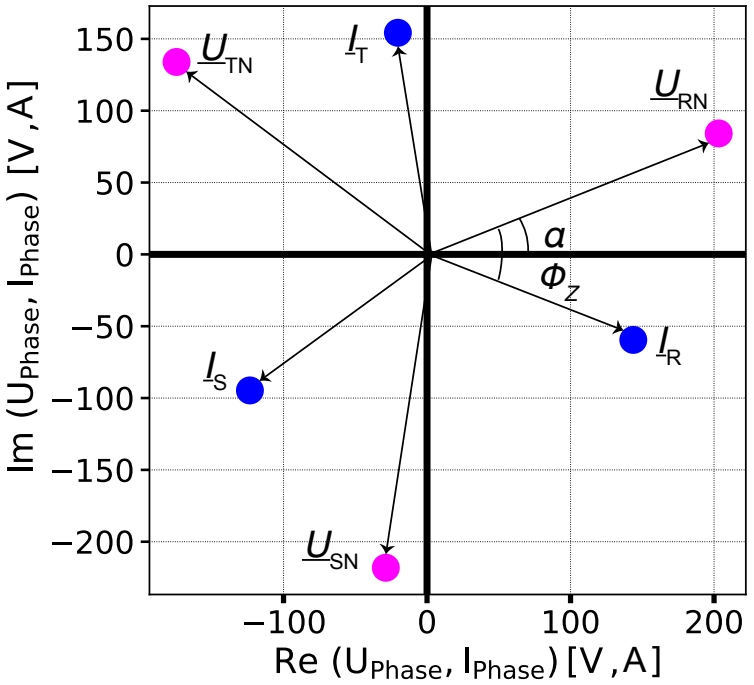
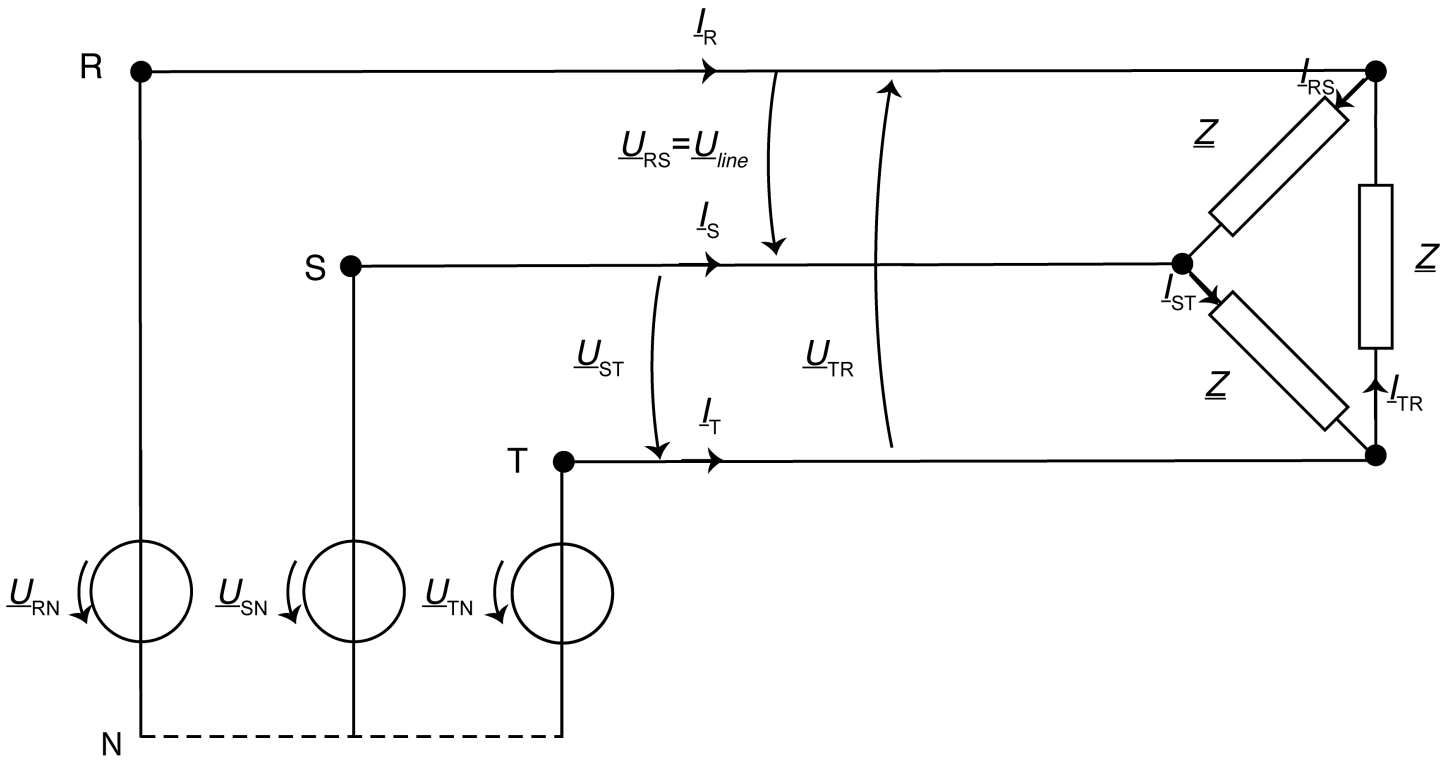
Balanced Y-network





Balanced Δ-network



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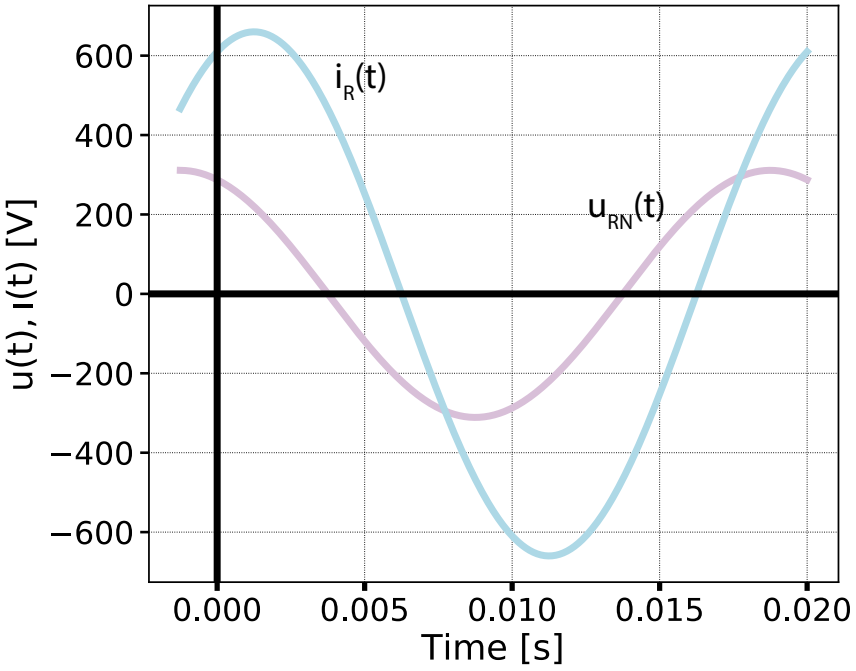
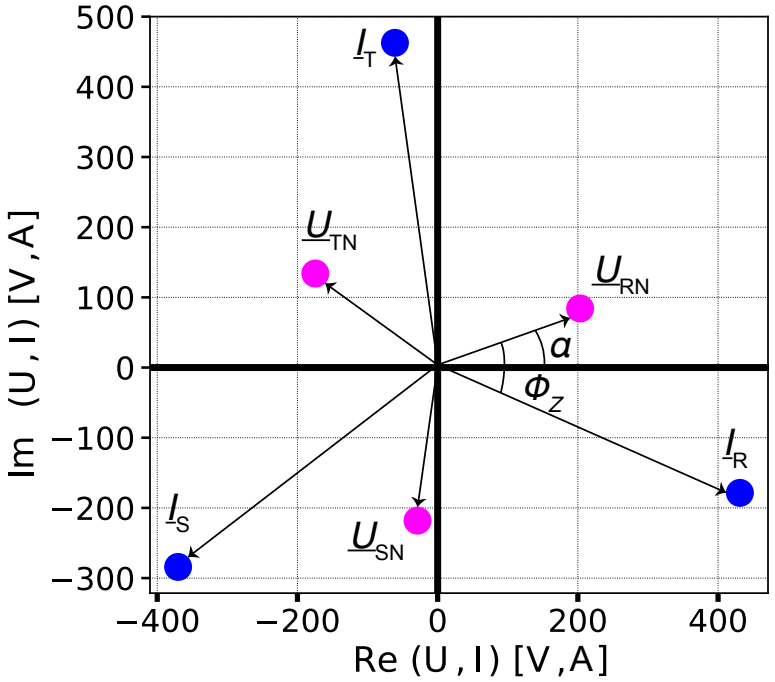
Balanced Δ-network





Summary

	Y-network	Δ-network
Phase voltages	$\underline{U}_{RN} = Ue^{j\alpha}$ $\underline{U}_{SN} = Ue^{j\alpha}e^{-j\frac{2\pi}{3}}$ $\underline{U}_{TN} = Ue^{j\alpha}e^{-j\frac{4\pi}{3}}$	$\underline{U}_{RS} = \sqrt{3}Ue^{j\alpha}e^{j\frac{\pi}{6}}$ $\underline{U}_{ST} = \sqrt{3}Ue^{j\alpha}e^{j\frac{\pi}{6}}e^{-j\frac{2\pi}{3}}$ $\underline{U}_{TR} = \sqrt{3}Ue^{j\alpha}e^{j\frac{\pi}{6}}e^{-j\frac{4\pi}{3}}$
Line voltages	$\underline{U}_{RS} = \sqrt{3}\underline{U}_{RN}e^{j\frac{\pi}{6}} = \sqrt{3}Ue^{j(\alpha+\frac{\pi}{6})}$ $\underline{U}_{ST} = \sqrt{3}\underline{U}_{SN}e^{j\frac{\pi}{6}} = \sqrt{3}Ue^{j(\alpha+\frac{\pi}{6})}e^{-j\frac{2\pi}{3}}$ $\underline{U}_{TR} = \sqrt{3}\underline{U}_{TN}e^{j\frac{\pi}{6}} = \sqrt{3}Ue^{j(\alpha+\frac{\pi}{6})}e^{-j\frac{4\pi}{3}}$	same as for Y-network
Phase currents	$\underline{I}_R = \frac{\underline{U}_{RN}}{\underline{Z}} = \frac{U}{Z}e^{j(\alpha-\phi_z)}$ $\underline{I}_S = \frac{\underline{U}_{SN}}{\underline{Z}} = \frac{U}{Z}e^{j(\alpha-\phi_z)}e^{-j\frac{2\pi}{3}}$ $\underline{I}_T = \frac{\underline{U}_{TN}}{\underline{Z}} = \frac{U}{Z}e^{j(\alpha-\phi_z)}e^{-j\frac{4\pi}{3}}$	$\underline{I}_{RS} = \frac{\underline{U}_{RS}}{\underline{Z}} = \frac{\sqrt{3}U}{Z}e^{j(\alpha+\frac{\pi}{6}-\phi_z)}$ $\underline{I}_{ST} = \frac{\underline{U}_{ST}}{\underline{Z}} = \frac{\sqrt{3}U}{Z}e^{j(\alpha+\frac{\pi}{6}-\phi_z)}e^{-j\frac{2\pi}{3}}$ $\underline{I}_{TR} = \frac{\underline{U}_{TR}}{\underline{Z}} = \frac{\sqrt{3}U}{Z}e^{j(\alpha+\frac{\pi}{6}-\phi_z)}e^{-j\frac{4\pi}{3}}$
Line currents	$\underline{I}_R = \frac{\underline{U}_{RN}}{\underline{Z}} = \frac{U}{Z}e^{j(\alpha-\phi_z)}$ $\underline{I}_S = \frac{\underline{U}_{SN}}{\underline{Z}} = \frac{U}{Z}e^{j(\alpha-\phi_z)}e^{-j\frac{2\pi}{3}}$ $\underline{I}_T = \frac{\underline{U}_{TN}}{\underline{Z}} = \frac{U}{Z}e^{j(\alpha-\phi_z)}e^{-j\frac{4\pi}{3}}$	$\underline{I}_R = 3\frac{\underline{U}_{RN}}{\underline{Z}} = \frac{3U}{Z}e^{j(\alpha-\phi_z)}$ $\underline{I}_S = \frac{3\underline{U}_{SN}}{\underline{Z}} = \frac{3U}{Z}e^{j(\alpha-\phi_z)}e^{-j\frac{2\pi}{3}}$ $\underline{I}_T = \frac{3\underline{U}_{TN}}{\underline{Z}} = \frac{3U}{Z}e^{j(\alpha-\phi_z)}e^{-j\frac{4\pi}{3}}$
Power	$\underline{S}_Y = 3\frac{U^2}{\underline{Z}}e^{j\phi_Z}$	$\underline{S}_\Delta = 9\frac{U^2}{\underline{Z}}e^{j\phi_Z}$