Structured Electronic Design

EE3C11 Topics from Network Theory Modified Nodal Analysis

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Modified Nodal Analysis

Voltage-controlled notation

Nodal Analysis only suited for networks with elements of which the(ir) branch current(s) can be expressed in terms of branch voltage(s)

Voltage source (example)

Current cannot be written as a function of the voltage Voltage can be written as a functon of the current:

$$\bigvee_{V} \stackrel{\bullet}{\longrightarrow} (j) \\ \bigvee_{V} I_{Vi} \\ \stackrel{\bullet}{\longrightarrow} (k)$$

$$V_j - V_k = V, \,\forall I_{Vi}$$

Branch voltage equation in current-controlled notation.

Procedure

nodal currents



- Add the branch relation in current-controlled notation to the set of matrix equations:
 - Unknown current is added to vector with nodal voltages. It flows from node j to node k
 - Known voltage is added to vector with

Transfer function

Transfer from independent variable k to dependent variable j

$$\frac{\mathbf{V}_j}{\mathbf{I}_k} = \mathbf{M}_{j,k}^{-1} = \frac{(-1)^{j+k} \det(\mathcal{M}_k)}{\det(\mathbf{M}_k)}$$

Minor matrix: $\mathcal{M}_{k,j}$ equals M after leaving out row k and column j. Poles: $det(\mathbf{M}) = 0$ Zeros: $det(\mathcal{M}_{k,j}) = 0$

 $_{k,j})$