EE215 – FUNDAMENTALS OF ELECTRICAL ENGINEERING

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WEEK 4
CIRCUIT ANALYSIS (II)

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MESH CURRENT ANALYSIS

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QUESTIONS TO ANSWER

- Mesh current analysis
  - How to establish mesh current equations for an electric circuit?
- Supermesh
  - What is a supermesh?
  - How to apply the technique to analyze an electric circuit?
- Source transformation
  - How to apply the technique to analyze an electric circuit?
- Superposition
  - How to apply the technique to analyze an electric circuit?

MESH CURRENT METHOD (1)

- Def.: Mesh Current – a current that only exists in the perimeter of a mesh.
  - The mesh-current method is similar ("dual") to the node-voltage method:

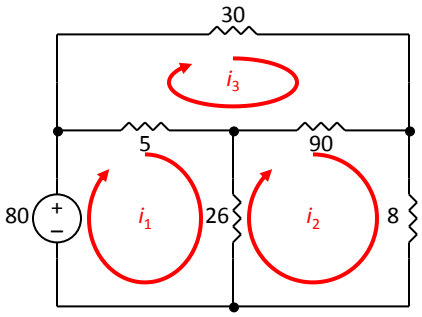
Node Voltage Method	Mesh Current Method

MESH CURRENT METHOD (2)

- Write KVL for every mesh in terms of *mesh currents*.
- What's a *mesh*? A loop that does not contain any other loops within it.
- In essence, every "window" in a planar circuit is a mesh.
- *Mesh current* is current that flows in the mesh.
- Branches have either one or two mesh currents flowing through them. If two, they usually flow in opposite directions.

EXAMPLE

- Mesh 1:
- Mesh 2:
- Mesh 3:

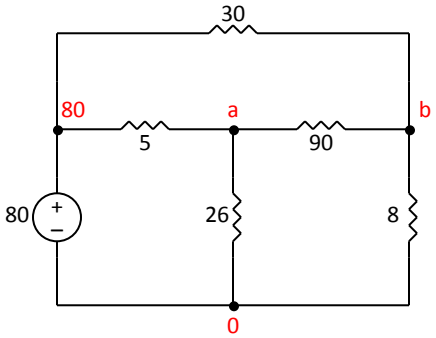


Multiplying out the terms:

Solving this system yields

COMPARE WITH NODE VOLTAGE METHOD

- Node a:
- Node b:



- Solving this system yields
- In this example, node voltage method is more efficient than mesh current method. **Why?**

SUPERMESHES

- Two neighboring meshes that "share" a current source can be combined into a "supermesh".

- Principle:

MESH CURRENT METHOD

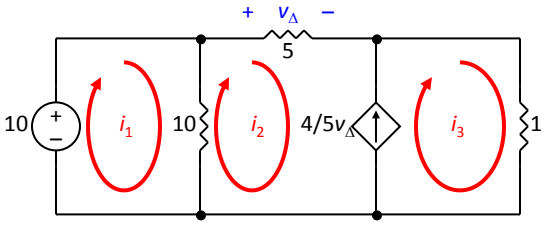
- Example (with dependent current source)

+ –

- Supermesh:

MESH CURRENT METHOD

- Example (with dependent current source)



SOURCE TRANSFORMATION

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SOURCE TRANSFORMS (1)

… another technique to simplify circuits

- Def.: Equivalence –

SOURCE TRANSFORMS (2)

- Example

SOURCE TRANSFORMS (3)

- Example

SOURCE TRANSFORMS (4)

- Example

SOURCE TRANSFORMS (5)

- Example

SOURCE TRANSFORMS (6)

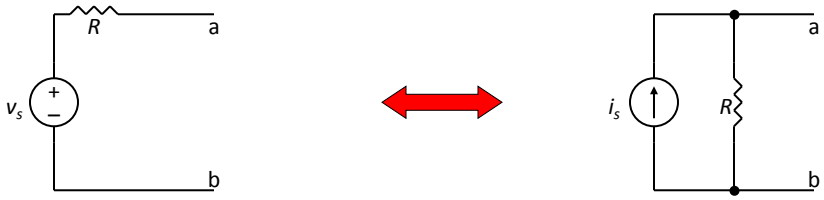
- Example

SOURCE TRANSFORMS (7)

- Example

SOURCE TRANSFORMS (8)

Equivalent circuits:



- Condition:

SOURCE TRANSFORMS (9)

- What if there is a resistor R_p parallel to v_s, or a resistor R_s in series to i_s?
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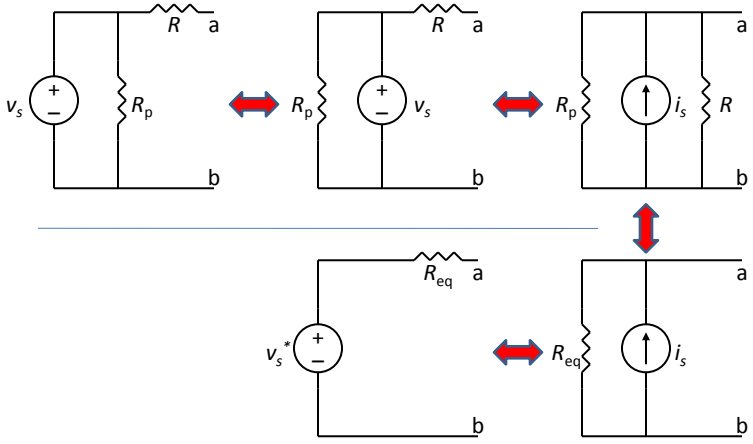
  - –
  - –

SOURCE TRANSFORMS (10)

- What is wrong with this series of transforms?



SOURCE TRANSFORMS (11)

- Example: $R = R_p = R_L$ in first and last circuit

- Source transforms cannot be done at arbitrary locations in the circuit

SUPERPOSITION

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SUPERPOSITION (1)

- Example: Circuit 1

- Circuit 2

SUPERPOSITION (2)

- Example: Circuit 3

SUPERPOSITION (3)

- Circuit 1 is like Circuit 3 with current source switched off (current $i_0 = 0$).
- Circuit 2 is like Circuit 3 with voltage source switched off (voltage drop $v_0 = 0$).
- Effects of v_0 and i_0 are independent; they can be added (or superimposed).
- Reason: resistive circuits are linear systems.