# MESH CURRENT ANALYSIS WITH CURRENT SOURCES

When there are only independent voltage sources, mesh current analysis boils down to

* identifying the meshes
* writing the KVL equation for each mesh
  if there are Nm meshes ⇒ Nm equations in Nm unknowns

The presence of current sources

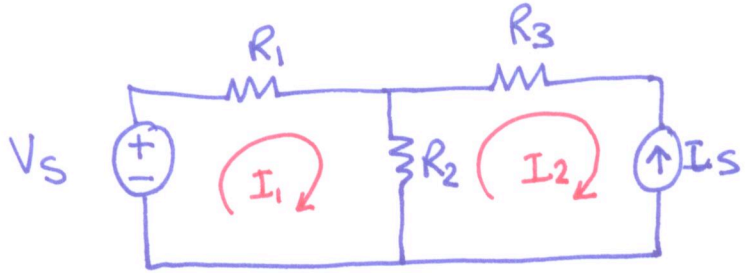
- sometimes makes things easier
- sometimes makes things a bit more complicated

This depends on where the current source is located

# CURRENT SOURCES ON AN "EDGE" OF THE CIRCUIT

- Make things easier
- Current source affects only one mesh
- Hence we immediately know the current in the mesh
- We do not need to do KVL for that mesh
- Solve the KVLs for the other meshes

## EXAMPLE



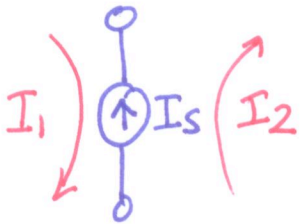

$$I_2 = -I_S$$

KVL Loop 1: $\quad -V_S + R_1 I_1 + R_2 (I_1 - I_2) = 0$

$$\Rightarrow I_1 = \frac{V_S - R_2 I_S}{R_1 + R_2}$$

# CURRENT SOURCE IN A BRANCH THAT IS SHARED BY TWO MESHES

- Makes things a little more complicated
- Just writing KVLs around each mesh yields an undetermined linear system
- We need an additional equation




$I_1 - I_2 = I_S$

- Can become cumbersome
- Can we streamline the procedure?

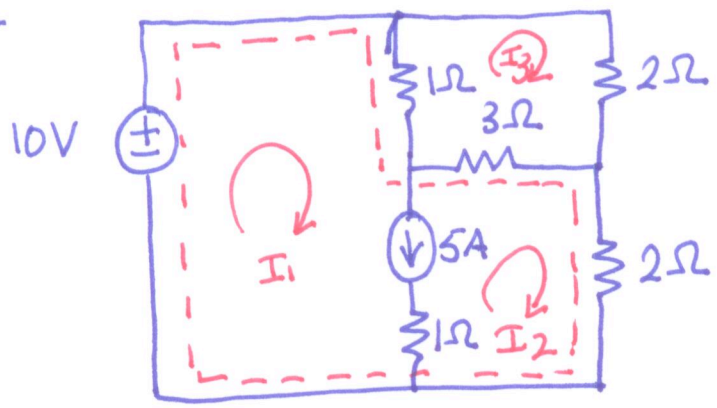
# SUPER MESH

(A) Construct a supermesh by fusing the meshes that share the current source

(B) write KVL around the supermesh

(C) Use the source to relate mesh currents

## EXAMPLE




KVL around supermesh $-10 + 1(I_1 - I_3) + 3(I_2 - I_3) + 2I_2 = 0$

Use source $I_1 - I_2 = 5$

KVL for other mesh $1(I_3 - I_1) + 2I_3 + 3(I_3 - I_2) = 0$

3 equations, 3 unknowns

& Rewrite

$$I_1 + 5I_2 - 4I_3 = 10$$
$$-I_1 - 3I_2 + 6I_3 = 0$$
$$I_1 - I_2 = 5$$

SOLVE

$I_1 = 7.5A$

$I_2 = 2.5A$

$I_3 = 2.5A$

# NODE OR MESH?

- Depends on circuit and question
- Question:
  - if required answer is current, tempting to use mesh
  - if required answer is voltage, tempting to use node

- However, the circuit is the key factor

① Count number of nodes, $N_n$

② Count number of meshes, $N_m$

③ Count number of voltage sources connected to reference node, $N_{Vr}$

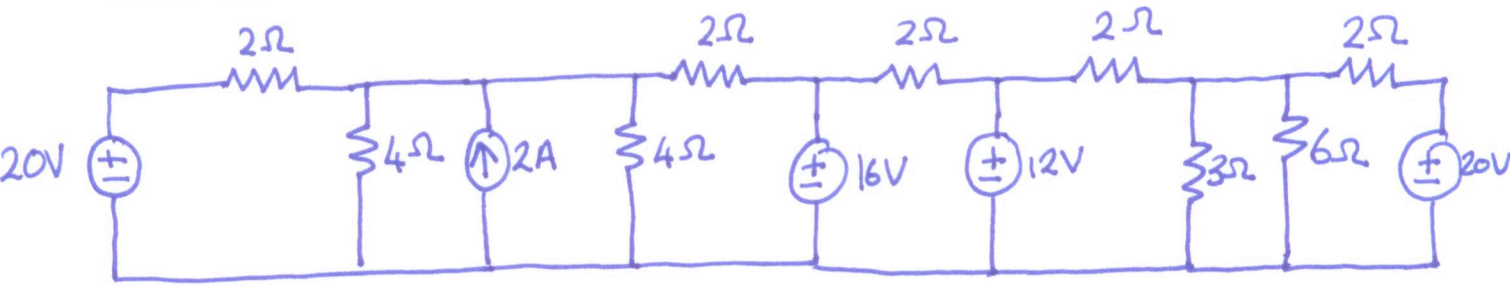
Remember you can choose the reference node. Try to make $N_{Vr}$ large

④ Count number of current sources that affect only one mesh current, $N_{Ie}$

⑤ NODE requires $N_n - N_{Vr} - 1$ equations

MESH requires $N_m - N_{Ie}$ equations

EXAMPLE




~~Number of nodes~~

Number of nodes $N_n = 7$

Number of meshes $N_m = 8$

Choose ref node to be the bottom node

Number of indep. voltage sources connected to ref. node $N_{Vr} = 4$

Number of indep current sources on an edge $N_{Ie} = 0$

Number of equations for mesh analysis: $N_m - N_{Ie} = 8$

Number of equations for node analysis: $N_n - N_{Vr} - 1 = 2$