

Mid-term project report

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Purpose:

Develop a linear calculation system to simulate and solve simple circuit (DC source, steady state, common electronic component).

Design Proposal:

Develop environment:

Windows OS, Matlab IDE, Atom editor.

Algorithm:

A circuit is exactly a graph in mathematical perspective.

Based on Ohm's law

$$I = \frac{V}{R} \quad \text{or} \quad V = IR \quad \text{or} \quad R = \frac{V}{I}.$$

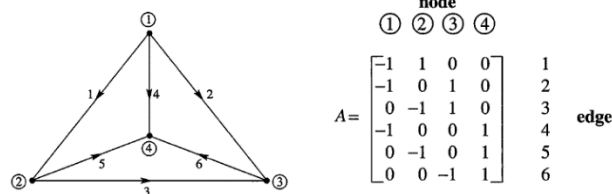
and Kirchhoff's current law,

$$\sum_{k=1}^n I_k = 0$$

We can derive a simplest mathematical model:

$$A^T \begin{bmatrix} C1 & \cdots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & Cn \end{bmatrix} A * \begin{bmatrix} v1 \\ \vdots \\ vn \end{bmatrix} = \begin{bmatrix} i1 \\ \vdots \\ in \end{bmatrix}$$

The A here is incidence matrix, C is conductance in each edge, v is voltage of corresponding node relative to ground, i is external current flow in corresponding node.



Since it's a linear system, we can solve all state of elements if we get enough information. So the core part of program is handle different request from input, design a **efficient, structured and relative user-friendly** calculation system. Further more, add more common electric components to system.

Semi-finished program:

The screenshot displays a MATLAB GUI for circuit simulation. The top window, titled "table", contains a table with the following data:

	Type	Component Name	Source(+)	Sink(-)	Voltage(V)	Current(A)	Resistor(R)
1	Resistor	r1	1	0		1	
2	Resistor	r2	2	0		1	
3	Resistor	r3	3	0		1	
4	Resistor	r4	1	2		1	
5	Resistor	r5	1	3		1	
6	Resistor	r6	2	3		1	
7	Current So	i1	1	0		4	
8							
9							
10							
11							
12							
13							
14							
15							
16							

A "Goto" button is located to the right of the table. The bottom window shows the MATLAB Command Window with the following code and output:

```
>> conductanceM
conductanceM =
    1     0     0     0     0     0
    0     1     0     0     0     0
    0     0     1     0     0     0
    0     0     0     1     0     0
    0     0     0     0     1     0
    0     0     0     0     0     1

>> incidenceM
incidenceM =
    1    -1     0     0
    1     0    -1     0
    1     0     0    -1
    0    -1     1     0
    0    -1     0     1
    0     0    -1     1

>> currentM
currentM =
    4
    0
    0
```

The Workspace window shows the following variables:

Name	Value
ans	'r1'
conducta...	6x6 double
currentM	[4;0;0]
data	16x8 cell
ele	[]
elementM	3x3 cell
i	3
incidence...	6x4 double
j	3
nodeN	3
operateM	[3,-1,-1;-1,3,-1;-

I have finished framing the overall structure(object oriented program), determine standard input format, here I'd like to list some features.

Support resistor, independent voltage and current source only at present.

Calculate from enough information to solve any other information you want.

Some exciting bugs are to be found.

Some trouble in designing GUI callback functions may effect calculation efficiency.

Hope any of your advise.