Dependent sources

This example showcases how ELABorate deals with circuits containing dependent sources.

Voltage-Controlled-Voltage-Sources

```
circuit = Circuit('circuits/E_src.txt');
circuit.list
```

```
ans =
    'V1 1 0 DC 12
     R1 1 2 2000
     R2 2 0 4000
     R3 3 4 20000
     C1 1 2 0.0001
     C2 4 0 0.001
     E1 3 2 1 2 100
     '
```

```
ELAB.analyze(circuit)
```

```
Symbolic analysis successful (0.504304 sec).
```

```
circuit.symbolic_node_voltages
```

```
ans =
```

$$\begin{pmatrix} v_1 = V_1 \\ v_2 = \dfrac{R_2\,V_1\,\left(C_1\,R_1\,s + C_2\,R_3\,s - C_2\,E_1\,R_1\,s + C_1\,C_2\,R_1\,R_3\,s^2 + 1\right)}{\sigma_1} \\ v_3 = \dfrac{V_1\,\left(C_2\,R_3\,s + 1\right)\,\left(R_2 + E_1\,R_1 + C_1\,R_1\,R_2\,s\right)}{\sigma_1} \\ v_4 = \dfrac{V_1\,\left(R_2 + E_1\,R_1 + C_1\,R_1\,R_2\,s\right)}{\sigma_1} \end{pmatrix}$$

where

$$\sigma_1 = R_1 + R_2 + C_1\,R_1\,R_2\,s + C_2\,R_1\,R_2\,s + C_2\,R_1\,R_3\,s + C_2\,R_2\,R_3\,s - C_2\,E_1\,R_1\,R_2\,s + C_1\,C_2\,R_1\,R_2\,R_3\,s^2$$

```
TF = ELAB.ec2tf(circuit,1,3)
```

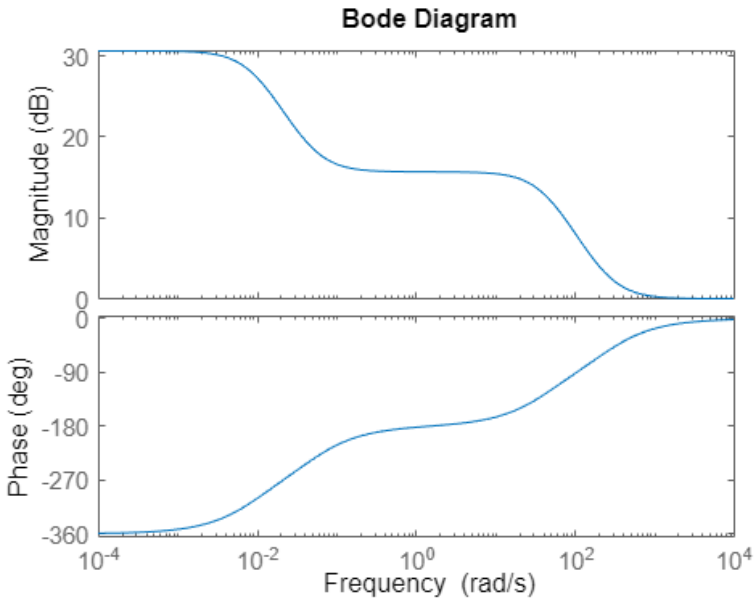
```
Numerical evaluation successful (0.168125 sec).
Transfer function object created successfully (1.922969e-01 sec).

TF =

  s^2 + 255.1 s + 12.75
  ---------------------
  s^2 - 41.95 s + 0.375

Continuous-time transfer function.
```

```
bode(TF)
```



Voltage-Controlled-Current-Sources

```
circuit = Circuit('circuits/G_src.txt');
circuit.list
```

```
ans =
    'V1 1 0 DC 12
     R1 1 2 2000
     R2 3 0 4000
     R3 4 0 8000
     L1 4 0 0.2
     C1 2 3 0.001
     G1 4 3 2 3 50
     '
```

```
ELAB.analyze(circuit)
```

```
Symbolic analysis successful (0.393459 sec).
```

```
circuit.symbolic_node_voltages
```

```
ans =
```

$$\begin{pmatrix} v_1 = V_1 \\ v_2 = \dfrac{V_1\ (G_1 R_2 + C_1 R_2 s + 1)}{\sigma_1} \\ v_3 = \dfrac{R_2 V_1\ (G_1 + C_1 s)}{\sigma_1} \\ v_4 = -\dfrac{G_1 L_1 R_3 V_1 s}{(R_3 + L_1 s)\,\sigma_1} \end{pmatrix}$$

where

$$\sigma_1 = G_1 R_2 + C_1 R_1 s + C_1 R_2 s + 1$$

```
TF = ELAB.ec2tf(circuit,1,4)
```

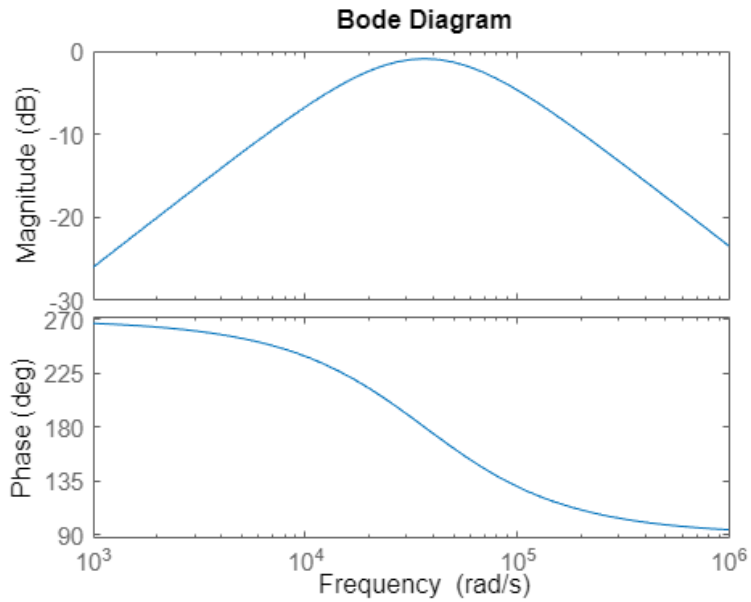
```
Numerical evaluation successful (0.0932147 sec).
Transfer function object created successfully (1.176469e-01 sec).

TF =

          -6.667e04 s
  ---------------------------
  s^2 + 7.333e04 s + 1.333e09

Continuous-time transfer function.
```

```
bode(TF)
```



Current-Controlled-Voltage-Sources

```
circuit = Circuit('circuits/H_src.txt');
circuit.list
```

```
ans =
    'V1 1 0 DC 12
     R1 1 2 2000
     R2 2 0 4000
     L1 3 0 0.02
     C1 3 0 0.0002
     H1 3 2 V1 10
     '
```

```
ELAB.analyze(circuit)
```

```
Symbolic analysis successful (0.482394 sec).
```

```
circuit.symbolic_node_voltages
```

```
ans =
```

$$\begin{pmatrix} v_1 = V_1 \\ v_2 = \dfrac{R_2\, V_1\, \left(C_1\, H_1\, L_1\, s^2 + L_1\, s + H_1\right)}{\sigma_1} \\ v_3 = -\dfrac{L_1\, V_1\, s\, \left(H_1 - R_2\right)}{\sigma_1} \end{pmatrix}$$

where

$$\sigma_1 = R_1\, R_2 + H_1\, R_2 + L_1\, R_1\, s + L_1\, R_2\, s + C_1\, H_1\, L_1\, R_2\, s^2 + C_1\, L_1\, R_1\, R_2\, s^2$$

```
TF = ELAB.ec2tf(circuit,1,3)
```

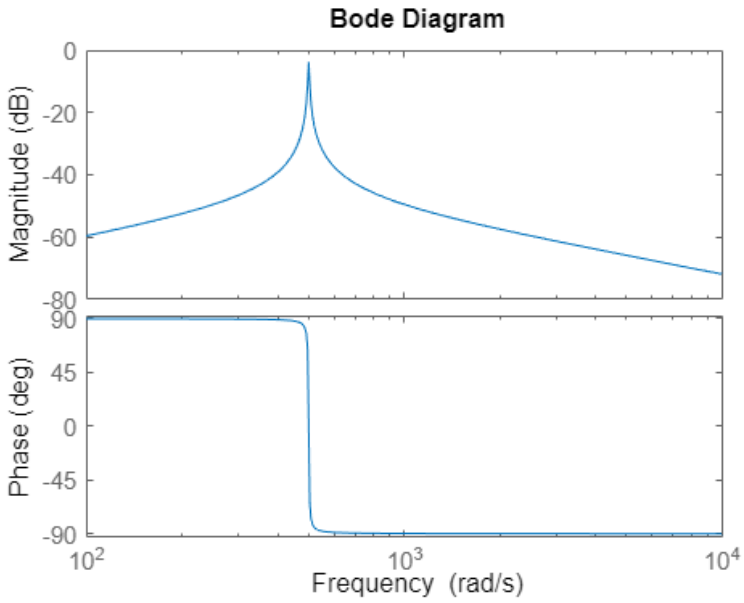
```
Numerical evaluation successful (0.120139 sec).
Transfer function object created successfully (1.810424e-01 sec).

TF =

         2.481 s
  ----------------------
  s^2 + 3.731 s + 2.5e05

Continuous-time transfer function.
```

```
bode(TF)
```



Current-Controlled-Current-Sources

```
circuit = Circuit('circuits/F_src.txt');
circuit.list
```

```
ans =
    'V1 1 0 DC 12
     R1 1 2 2000
     R2 2 0 4000
     R3 3 0 8000
     L1 2 0 0.001
     C1 3 0 0.000001
     F1 3 2 V1 200
     '
```

```
ELAB.analyze(circuit)
```

```
Symbolic analysis successful (0.411323 sec).
```

```
circuit.symbolic_node_voltages
```

```
ans =
```

$$\begin{pmatrix} v_1 = V_1 \\ v_2 = -\dfrac{L_1 R_2 V_1 s\ (F_1 - 1)}{R_1 R_2 + L_1 R_1 s + L_1 R_2 s - F_1 L_1 R_2 s} \\ v_3 = \dfrac{F_1 R_3 V_1\ (R_2 + L_1 s)}{(C_1 R_3 s + 1)\ (R_1 R_2 + L_1 R_1 s + L_1 R_2 s - F_1 L_1 R_2 s)} \end{pmatrix}$$

```
TF = ELAB.ec2tf(circuit,1,3)
```

```
Numerical evaluation successful (0.108263 sec).
Transfer function object created successfully (1.477153e-01 sec).

TF =
```

```
  -251.9 s - 1.008e09
-----------------------
s^2 - 9951 s - 1.259e06

Continuous-time transfer function.
```

```
bode(TF)
```