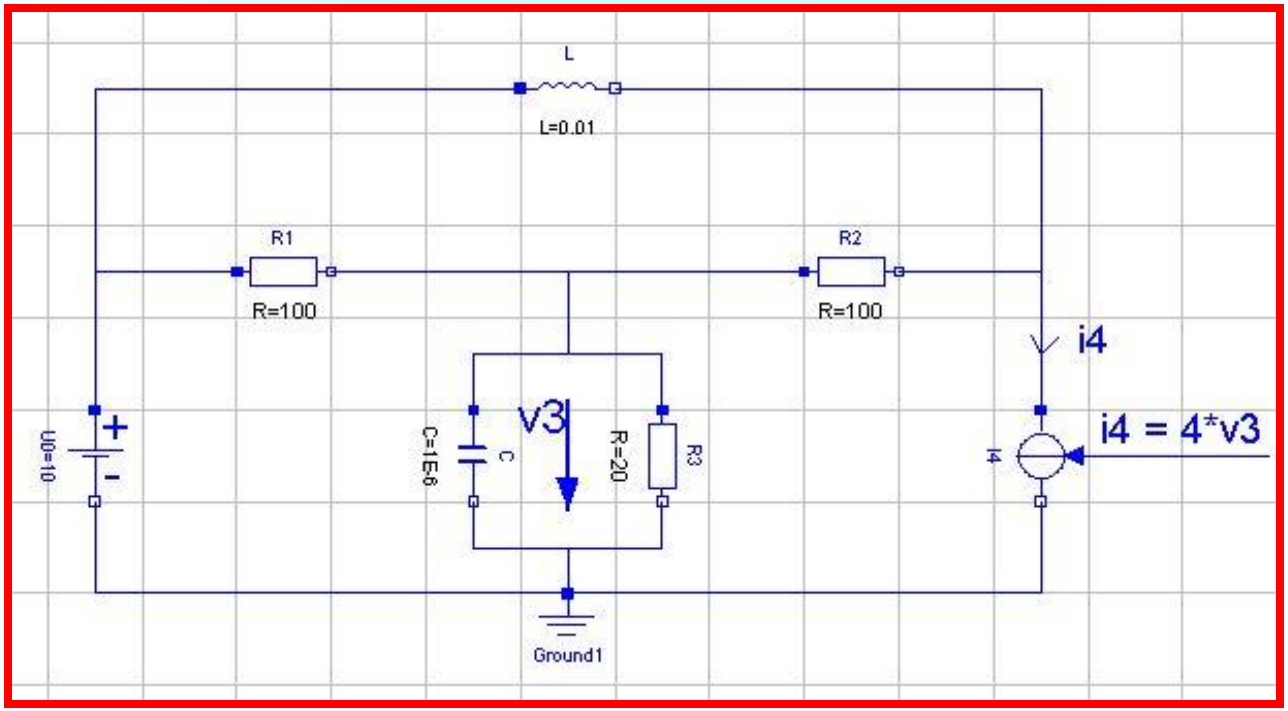
5th Homework - Solution

- In this homework, we shall exercise the modeling of a simple electrical circuit using bond graphs.
- We shall also model the same electrical circuit using a circuit diagram (a wrapped bond graph).
- We shall finally determine the overhead associated with the wrapping technique.

Electrical Circuit

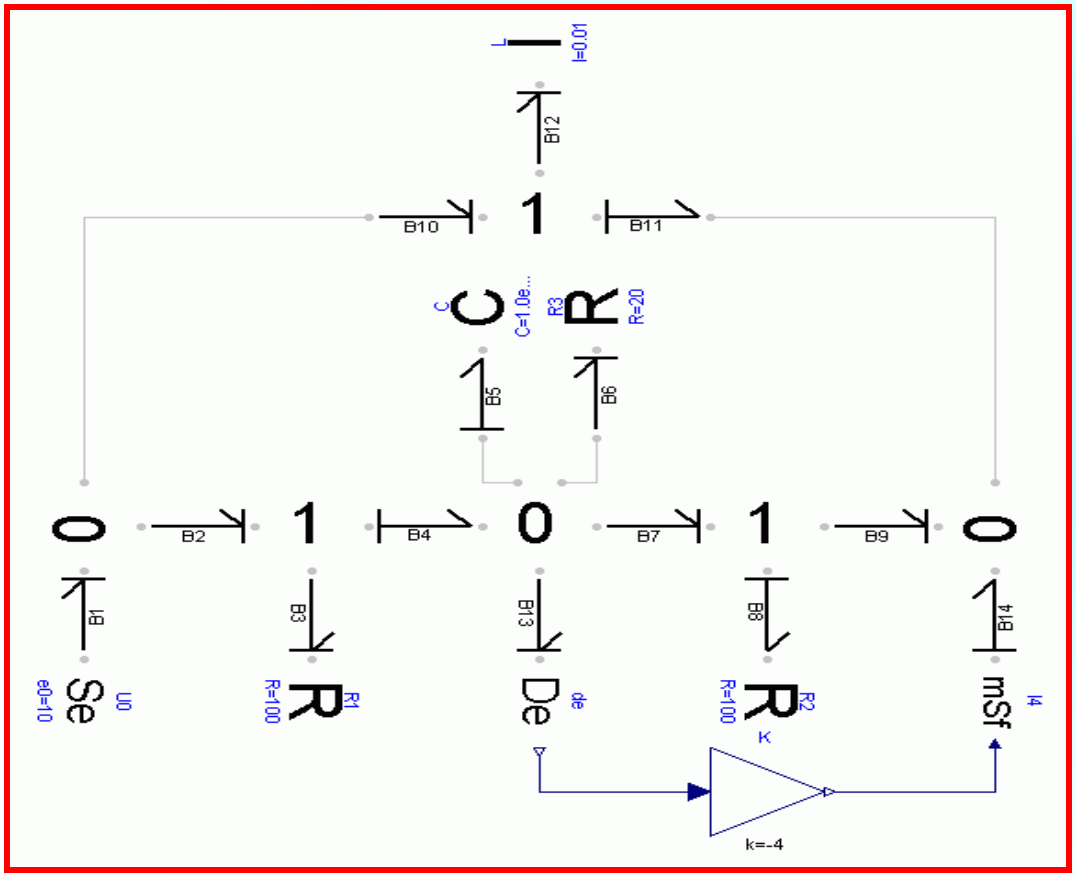
- Given the following circuit:



Electrical Circuit II

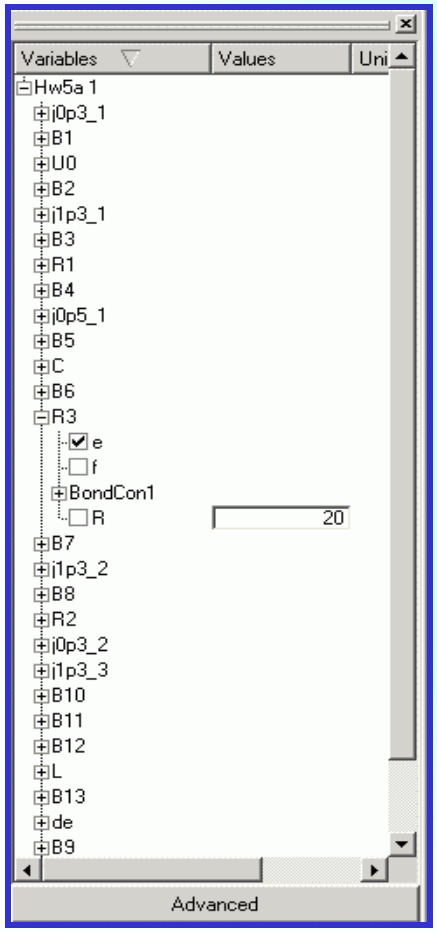
- The circuit is to be modeled using bond graphs without wrapping.
- Use a sensor (detector) element together with a modulated source element to implement the non-linear current source in the circuit.
- Simulate the circuit during $50\ \mu sec$, and plot v_3 as a function of time.

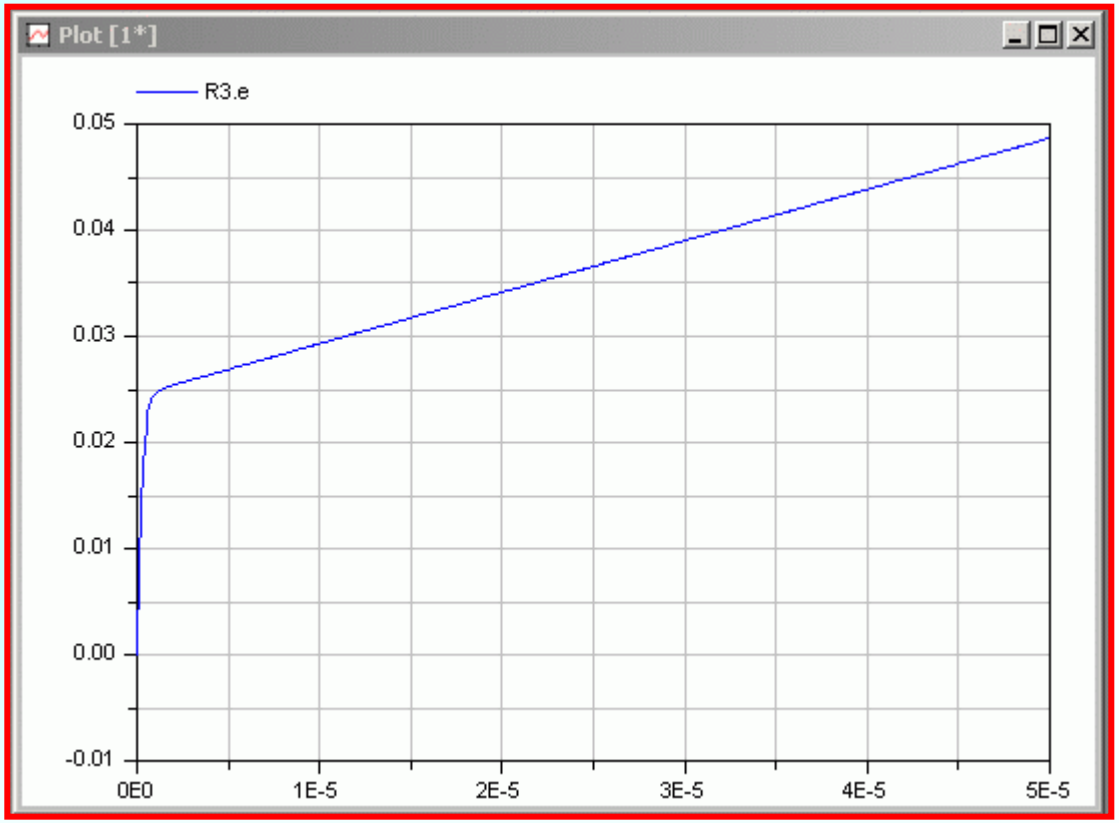
Bond Graph of Circuit



- Since flow sources in bond-graphic notation are defined with their positive flow pointing ***into*** the system, we need to make the gain factor negative in order to compensate for the directional sign change.

Simulation Results

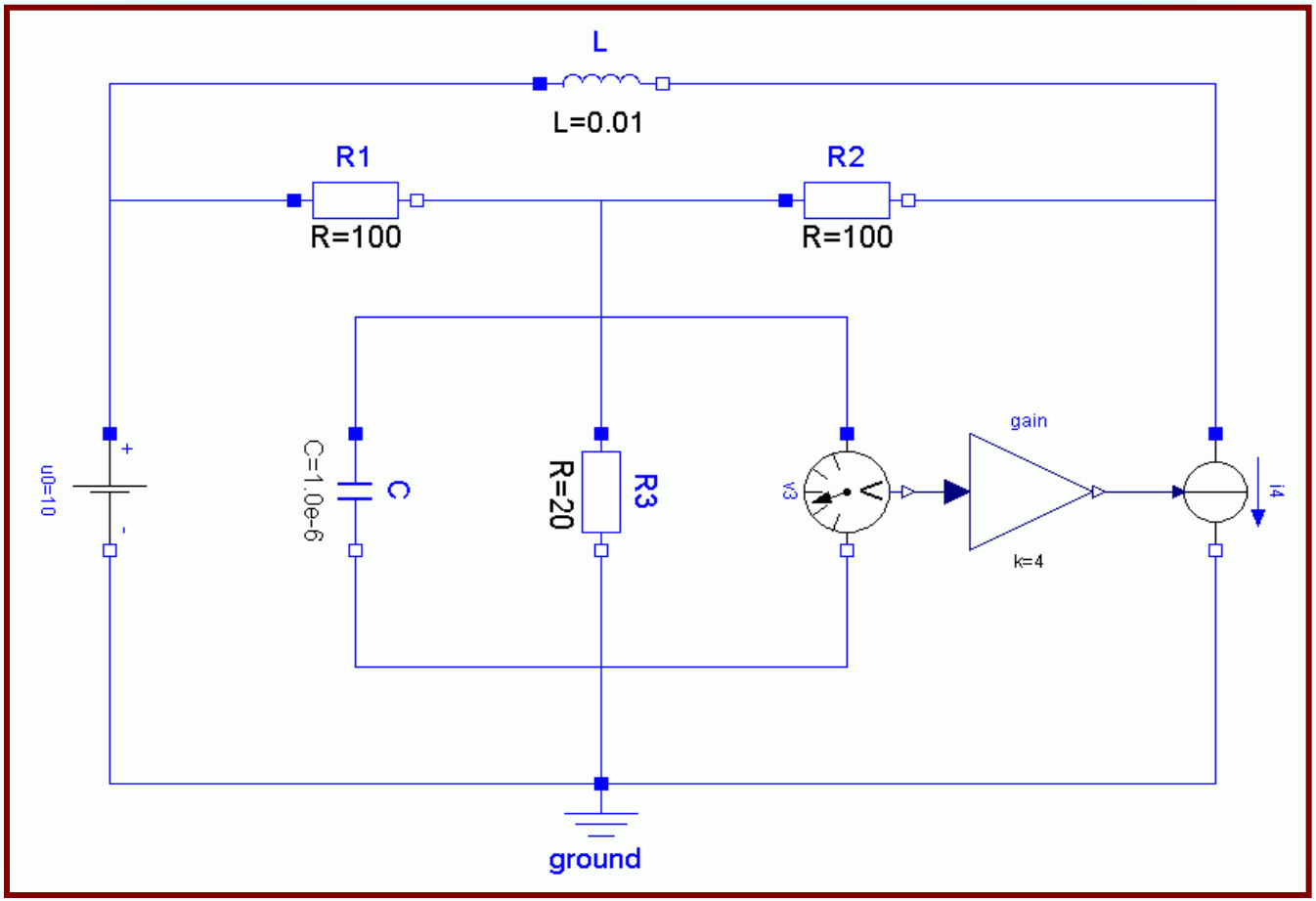




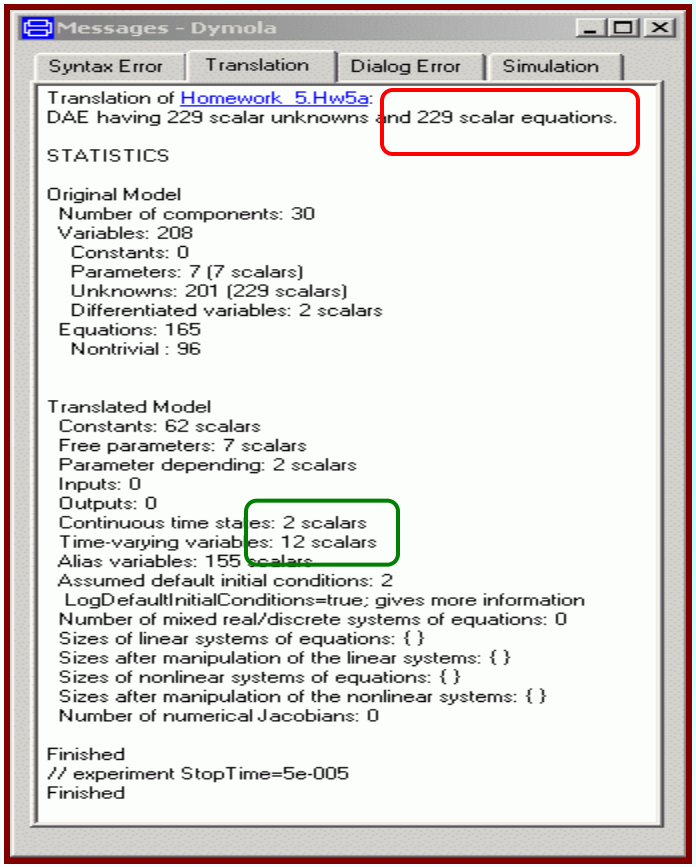
Electrical Circuit III

- The circuit is to be modeled using bond graphs with wrapping, i.e., using the bond graph electrical library.
- Simulate the circuit during $50\ \mu sec$, and plot v_3 as a function of time.
- Compare the number of initial and final equations as well as the simulation time with those obtained in the unwrapped bond-graph solution.

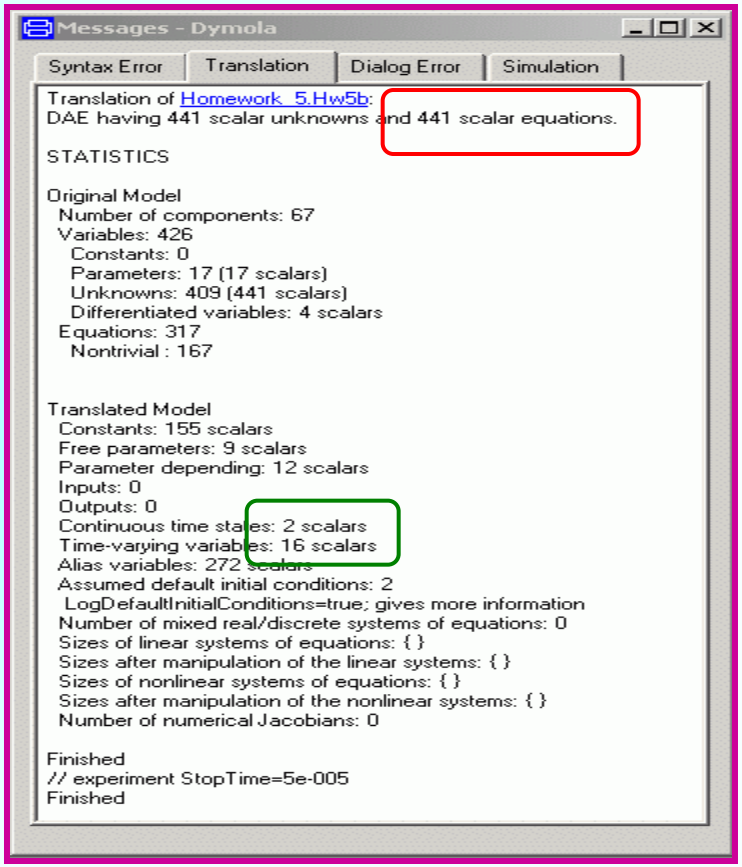
Bond Graph Electrical Library Model



Comparison of Translation Logs



Bond Graph Model



BG Electrical Model

Comparison of Simulation Logs

Messages - Dymola

Syntax Error | Translation | Dialog Error | Simulation

```
Log-file of program ./dymosim
(generated: Mon Oct 22 16:08:14 2007)

dymosim started
... "dsin.txt" loading (dymosim input file)
... "Hw5a.mat" creating (simulation result file)

Integration started at T = 0 using integration method DASSL
(DAE multi-step solver (dassl/dasslrt of Petzold modified by Dynasim))
Integration terminated successfully at T = 5e-005
   CPU-time for integration      : 0.02 seconds
   CPU-time for one GRID interval: 0.04 milli-seconds
   Number of result points       : 501
   Number of GRID   points       : 501
   Number of (successful) steps  : 36
   Number of F-evaluations       : 99
   Number of Jacobian-evaluations: 17
   Number of (model) time events : 0
   Number of (U) time events     : 0
   Number of state    events     : 0
   Number of step     events     : 0
   Minimum integration stepsize  : 1e-010
   Maximum integration stepsize  : 1.18e-005
   Maximum integration order     : 4
Calling terminal section
... "dsfinal.txt" creating (final states)
```

Graphical Model

Messages - Dymola

Syntax Error | Translation | Dialog Error | Simulation

```
Log-file of program ./dymosim
(generated: Mon Oct 22 16:14:14 2007)

dymosim started
... "dsin.txt" loading (dymosim input file)
... "Hw5b.mat" creating (simulation result file)

Integration started at T = 0 using integration method DASSL
(DAE multi-step solver (dassl/dasslrt of Petzold modified by Dynasim))
Integration terminated successfully at T = 5e-005
   CPU-time for integration      : 0.04 seconds
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   Minimum integration stepsize  : 1e-010
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Calling terminal section
... "dsfinal.txt" creating (final states)
```

BG Electrical Model

Simulation Results