Report on Sensitivity

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Part I

Sensitivity

Chapter 1

sRCc

1.1 sRCc_abg.tex

MTT command:

```
mtt sRCc abg tex
```

The acausal bond graph of system **sRCc** is displayed in Figure 1.1 (on page 10) and its label file is listed in Section 1.1.1 (on page 9). The subsystems are listed in Section 1.1.2 (on page 12).

The system **sRCc** is the the sensitivity version of the simple electrical sRCc circuit shown in Figure 1.1 (on page 10). The circuit itself can be regarded as a single-input single-output system with input e_1 and output e_2; the sensitivity system has *two* outputs: e_2 and $\frac{\partial e_2}{\partial r}$.

All bonds are two-bond vector bonds, and the **sR** and **sC** components are two-port versions of the usual **R** and **C** components respectively. One port conveys the usual effort/flow pair; the other port conveys the sensitivity of the effort and flow with respect to the *c* parameter.

1.1.1 Summary information

System sRCc:Sensitivity of output of RC circuit wrt value of r Uses the sR and sC components and vector bonds

Interface information:

This component has no ALIAS declarations

Variable declarations:

This component has no PAR declarations

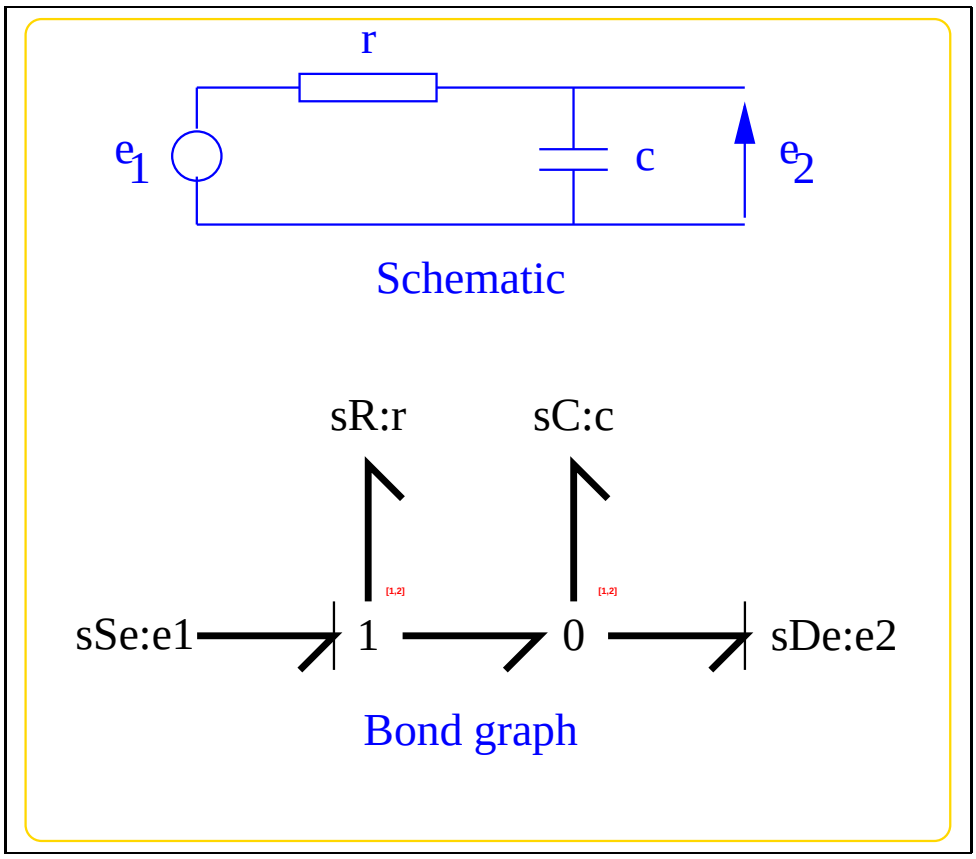

Figure 1.1: System **sRCc**: acausal bond graph

Units declarations:

This component has no UNITs declarations

The label file: sRCc_lbl.txt

```
%% Label file for system sRCc (sRCc_lbl.txt)
%SUMMARY sRCc Sensitivity of output of RC circuit wrt value of r
%DESCRIPTION Uses the sR and sC components and vector bonds

% %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% %% Version control history
% %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% %% $Id: sRCc_lbl.txt,v 1.2 2003/06/11 16:09:45 gawthrop Exp $
% %% $Log: sRCc_lbl.txt,v $
% %% Revision 1.2  2003/06/11 16:09:45  gawthrop
% %% Updated examples for latest MTT.
% %%
% %% Revision 1.1  1999/10/18 07:34:32  peterg
% %% Initial revision
% %%
% %% Revision 1.1  1999/07/29 05:18:59  peterg
% %% Initial revision
% %%
% %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%


% Port aliases

% Argument aliases

%% Each line should be of one of the following forms:
%      a comment (ie starting with %)
%      component-name cr_name arg1,arg2,..argn
%      blank

% ---- Component labels ----

% Component type sSe
e1       slin external;0
```

```
% Component type sDe
e2

% Component type sC
c  slin effort,c;1

% Component type sR
r  slin flow,r;0
```

1.1.2 Subsystems

- sC Sensitivity C component (1) No subsystems.
- sDe Sensitivity version of Effort detector (De) (1) No subsystems.
- sR Sensitivity R component (1) No subsystems.
- sSe Sensitivity version of effort source (Se) (1)
  - Se Simple effort source (2)

1.1.3 Se

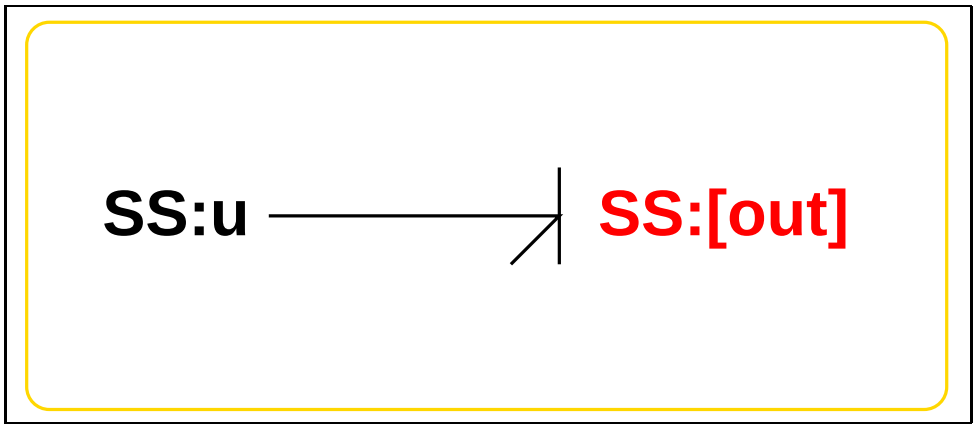

Figure 1.2: System **Se**: acausal bond graph

The acausal bond graph of system **Se** is displayed in Figure 2.2 (on page 30) and its label file is listed in Section 2.1.3 (on page 31). The subsystems are listed in Section 2.1.3 (on page 32).

Summary information

System Se:Simple effort source Simple effort source constructed from SS with fixed causality

Interface information:

Parameter $1 represents actual parameter **e_s**

Port in represents actual port **out**

Port out represents actual port **out**

Variable declarations:

This component has no PAR declarations

Units declarations:

This component has no UNITs declarations

The label file: Se_lbl.txt

```
%% Label file for system Se (Se_lbl.txt)
%SUMMARY Se Simple effort source
%DESCRIPTION Simple effort source constructed from SS with fixed causali


% %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% %% Version control history
% %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% %% $Id: Se_lbl.txt,v 1.3 1999/08/05 07:31:39 peterg Exp $
% %% $Log: Se_lbl.txt,v $
% %% Revision 1.3  1999/08/05 07:31:39  peterg
% %% Added in alias
% %%
% %% Revision 1.2  1999/03/12 04:04:27  peterg
% %% Single argument - the effort value e_s
% %%
% %% Revision 1.1  1999/03/03 21:55:46  peterg
% %% Initial revision
% %%
```

```
% %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%


% Port aliases
%ALIAS out|in out

% Argument aliases
%ALIAS $1 e_s

%% Each line should be of one of the following forms:
%       a comment (ie starting with %)
%       component-name cr_name arg1,arg2,..argn
%       blank

% ---- Component labels ----

% Component type SS
[out] SS external,external
u SS e_s,internal
```

Subsystems

No subsystems.

1.1.4 sC

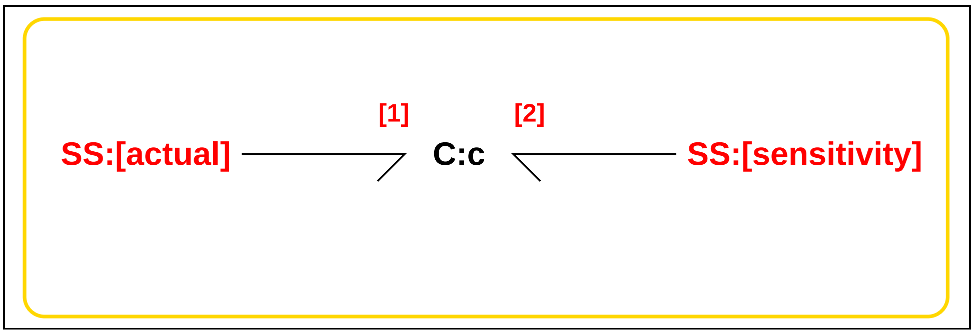

Figure 1.3: System **sC**: acausal bond graph

The acausal bond graph of system **sC** is displayed in Figure 2.3 (on page 32) and its label file is listed in Section 2.1.4 (on page 33). The subsystems are listed in Section 2.1.4 (on page 34).

Summary information

System sC:Sensitivity C component

Interface information:

Parameter $1 represents actual parameter **effort,c**

Parameter $1 represents actual parameter **slin**

Parameter $2 represents actual parameter **cs**

Port in represents actual port **actual,sensitivity**

Variable declarations:

This component has no PAR declarations

Units declarations:

This component has no UNITs declarations

The label file: sC_lbl.txt

```
%% Label file for system sC (sC_lbl.txt)
%SUMMARY sC Sensitivity C component
%DESCRIPTION

% %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% %% Version control history
% %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% %% $Id: sC_lbl.txt,v 1.3 2001/04/24 16:41:54 gawthrop Exp $
% %% $Log: sC_lbl.txt,v $
% %% Revision 1.3  2001/04/24 16:41:54  gawthrop
% %% New 2-port sensitivity components
% %%
% %% Revision 1.1  2001/04/05 12:00:18  gawthrop
% %% Identification example
% %%
% %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%


% Port aliases
```

```
%ALIAS in actual,sensitivity

% Argument aliases
%ALIAS $1 effort,c
%ALIAS $2 cs

%CR alias
%ALIAS $1 slin

%% Each line should be of one of the following forms:
%      a comment (ie starting with %)
%      component-name cr_name arg1,arg2,..argn
%      blank

% ---- Component labels ----
% Component type C
c slin  effort,c;cs

% Component type SS
[actual] SS external,external
[sensitivity] SS external,external
```

Subsystems

No subsystems.

1.1.5 sDe

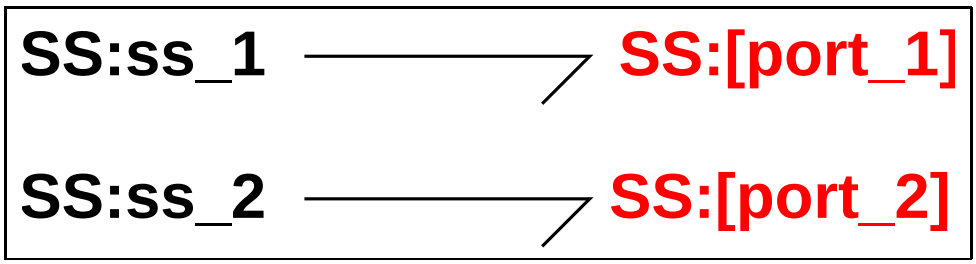

Figure 1.4: System **sDe**: acausal bond graph

The acausal bond graph of system **sDe** is displayed in Figure 2.4 (on page 34) and its label file is listed in Section 2.1.5 (on page 35). The subsystems are listed in Section 2.1.5 (on page 36).

Summary information

System sDe:Sensitivity version of Effort detector (De)

Interface information:

Parameter $1 represents actual parameter **external**

Port in represents actual port **port_1,port_2**

Port out represents actual port **port_1,port_2**

Variable declarations:

This component has no PAR declarations

Units declarations:

This component has no UNITs declarations

The label file: sDe_lbl.txt

```
%% Label file for system sDe (sDe_lbl.txt)
%SUMMARY sDe Sensitivity version of Effort detector (De)
%DESCRIPTION

% %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% %% Version control history
% %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% %% $Id: sDe_lbl.txt,v 1.2 2002/04/16 11:15:08 gawthrop Exp $
% %% $Log: sDe_lbl.txt,v $
% %% Revision 1.2  2002/04/16 11:15:08  gawthrop
% %% Forgot to do this ..
% %%
% %% Revision 1.1  1999/07/29 04:53:34  peterg
% %% Initial revision
% %%
% %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
```

```
% Port aliases
%ALIAS in|out port_1,port_2

% Argument aliases
%ALIAS $1 external

%% Each line should be of one of the following forms:
%      a comment (ie starting with %)
%      component-name cr_name arg1,arg2,..argn
%      blank

% ---- Component labels ----

% Component type SS
[port_1] SS external,external
[port_2] SS external,external
ss_1 SS external,0
ss_2 SS external,0
```

Subsystems

No subsystems.

1.1.6 sR

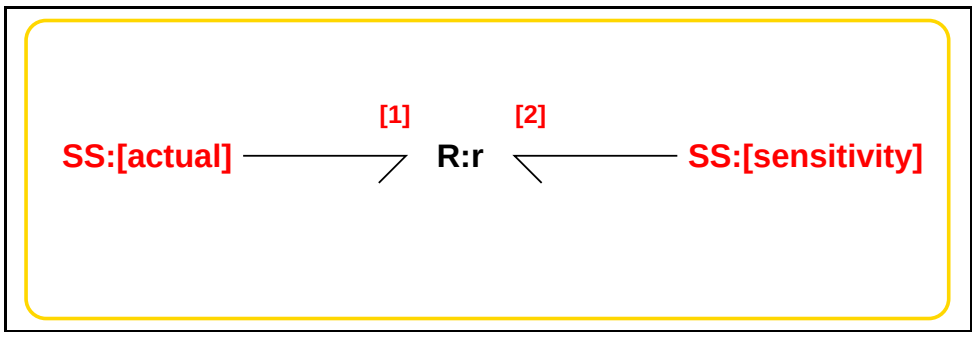

Figure 1.5: System **sR**: acausal bond graph

The acausal bond graph of system **sR** is displayed in Figure 2.5 (on page 36)

and its label file is listed in Section 2.1.6 (on page 37). The subsystems are listed in Section 2.1.6 (on page 38).

Summary information

System sR:Sensitivity R component

Interface information:

Parameter $1 represents actual parameter **flow,r**

Parameter $1 represents actual parameter **slin**

Parameter $2 represents actual parameter **rs**

Port in represents actual port **actual,sensitivity**

Variable declarations:

This component has no PAR declarations

Units declarations:

This component has no UNITs declarations

The label file: sR_lbl.txt

```
%% Label file for system sR (sR_lbl.txt)
%SUMMARY sR Sensitivity R component
%DESCRIPTION

% %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% %% Version control history
% %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% %% $Id: sR_lbl.txt,v 1.2 2001/04/24 16:41:54 gawthrop Exp $
% %% $Log: sR_lbl.txt,v $
% %% Revision 1.2  2001/04/24 16:41:54  gawthrop
% %% New 2-port sensitivity components
% %%
% %% Revision 1.1  2001/04/05 12:00:18  gawthrop
% %% Identification example
% %%
% %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
```

```
% Port aliases
%ALIAS in actual,sensitivity

% Argument aliases
%ALIAS $1 flow,r
%ALIAS $2 rs

%CR alias
%ALIAS $1 slin

%% Each line should be of one of the following forms:
%      a comment (ie starting with %)
%      component-name cr_name arg1,arg2,..argn
%      blank

% ---- Component labels ----
r slin  flow,r;rs

% Component type SS
[actual] SS external,external
[sensitivity] SS external,external
```

Subsystems

No subsystems.

1.1.7 sSe

The acausal bond graph of system **sSe** is displayed in Figure 2.6 (on page 39) and its label file is listed in Section 2.1.7 (on page 38). The subsystems are listed in Section 2.1.7 (on page 40).

Summary information

System sSe:Sensitivity version of effort source (Se)

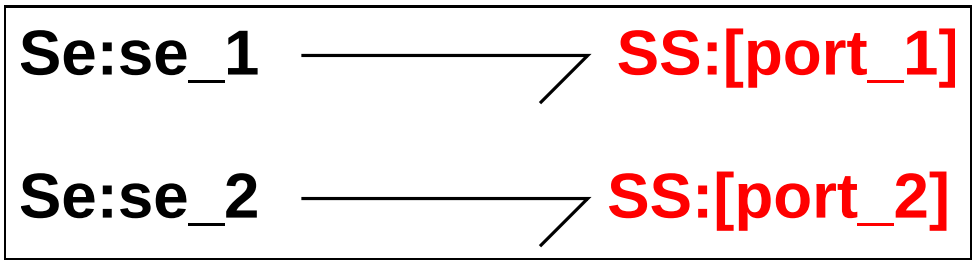

Figure 1.6: System **sSe**: acausal bond graph

Interface information:

Parameter $1 represents actual parameter **e_s**

Parameter $2 represents actual parameter **k_s**

Port in represents actual port **port_1,port_2**

Port out represents actual port **port_1,port_2**

Variable declarations:

This component has no PAR declarations

Units declarations:

This component has no UNITs declarations

The label file: sSe_lbl.txt

```
%% Label file for system sSe (sSe_lbl.txt)
%SUMMARY sSe Sensitivity version of effort source (Se)
%DESCRIPTION

% %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% %% Version control history
% %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% %% $Id: sSe_lbl.txt,v 1.1 2000/12/27 16:35:36 peterg Exp $
% %% $Log: sSe_lbl.txt,v $
% %% Revision 1.1  2000/12/27 16:35:36  peterg
% %% Initial revision
% %%
```

```
% %% Revision 1.1  1999/07/29 04:54:41  peterg
% %% Initial revision
% %%
% %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%


% Port aliases
%ALIAS in|out port_1,port_2

% Argument aliases
%ALIAS $1 e_s
%ALIAS $2 k_s


%% Each line should be of one of the following forms:
%       a comment (ie starting with %)
%       component-name cr_name arg1,arg2,..argn
%       blank

% ---- Component labels ----

% Component type SS
[port_1] SS external,external
[port_2] SS external,external

% Component type Se
se_1 SS e_s
se_2 SS k_s
```

Subsystems

- Se Simple effort source (2) No subsystems.

1.2 sRCc_struc.tex

MTT command:

```
mtt sRCc struc tex
```

List of inputs for system sRCc			
	Component	System	Repetition
1	u	sRCc__e1__se_1__u	1

List of outputs for system sRCc			
	Component	System	Repetition
1	ss_1	sRCc__e2__ss_1	1
2	ss_2	sRCc__e2__ss_2	1

List of states for system sRCc			
	Component	System	Repetition
1	c	sRCc__c__c	1
2	c	sRCc__c__c_2	1

1.3 sRCc_ode.tex

MTT command:

```
mtt sRCc ode tex
```

$$\begin{aligned} \dot{x}_1 &= \frac{(cu_1 - x_1)}{(cr)} \\ \dot{x}_2 &= \frac{(-cx_2 + x_1)}{(c^2 r)} \end{aligned} \tag{1.1}$$

$$\begin{aligned} y_1 &= \frac{x_1}{c} \\ y_2 &= \frac{(cx_2 - x_1)}{c^2} \end{aligned} \tag{1.2}$$

1.4 sRCc_sm.tex

MTT command:

```
mtt sRCc sm tex
```

$$A = \begin{pmatrix} \frac{(-1)}{(cr)} & 0 \\ \frac{1}{(c^2 r)} & \frac{(-1)}{(cr)} \end{pmatrix} \tag{1.3}$$

$$B = \begin{pmatrix} \frac{1}{r} \\ 0 \end{pmatrix} \tag{1.4}$$

$$C = \begin{pmatrix} \frac{1}{c} & 0 \\ \frac{(-1)}{c^2} & \frac{1}{c} \end{pmatrix} \tag{1.5}$$

$$D = \begin{pmatrix} 0 \end{pmatrix} \tag{1.6}$$

1.5 sRCc_tf.tex

MTT command:

```
mtt sRCc tf tex
```

$$G = \begin{pmatrix} \frac{1}{(crs+1)} \\ \frac{(-rs)}{(c^2 r^2 s^2 + 2crs + 1)} \end{pmatrix} \tag{1.7}$$

1.6 sRCc_lmfr.ps

MTT command:

```
mtt sRCc lmfr ps
```

This representation is given as Figure 1.7 (on page 25).

1.7 sRCc_odeso.ps

MTT command:

```
mtt sRCc odeso ps
```

This representation is given as Figure 1.8 (on page 25).

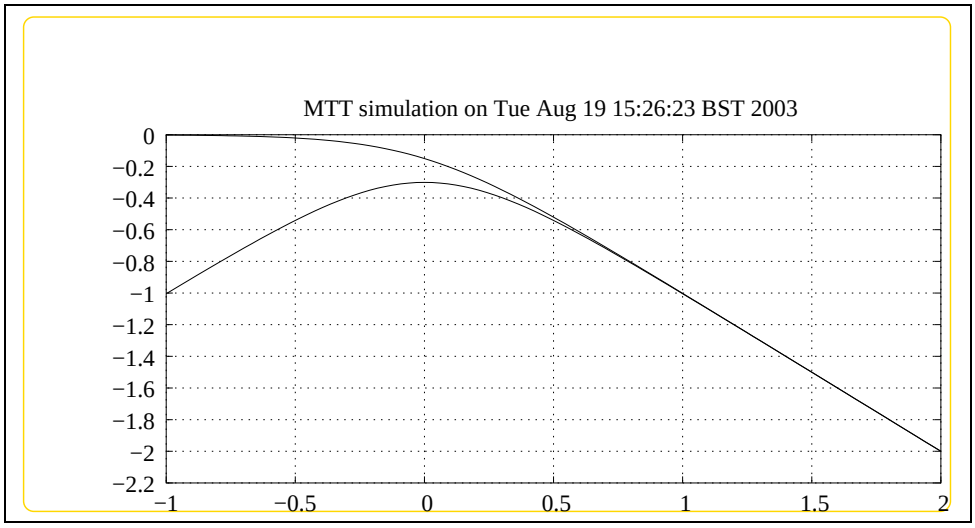

Figure 1.7: System **sRCc**, representation lmfr (-noargs)

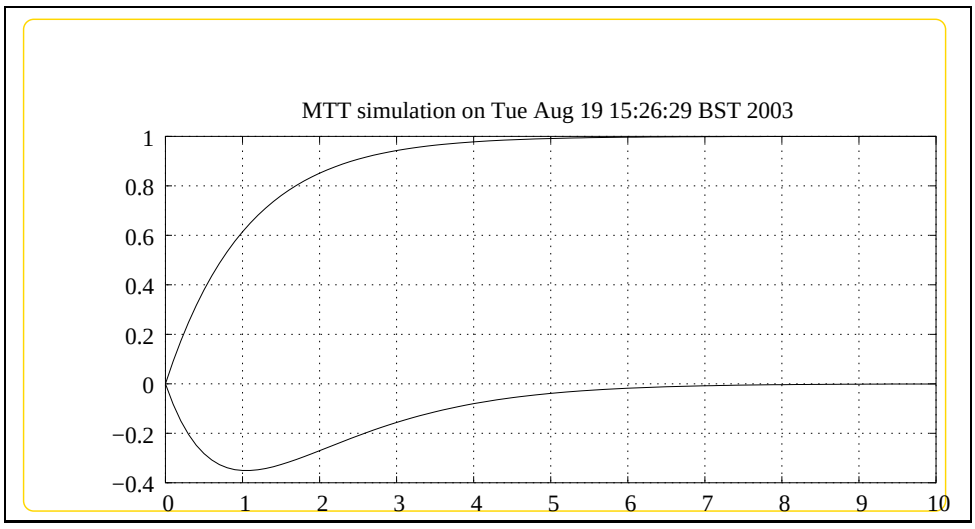

Figure 1.8: System **sRCc**, representation odeso (-noargs)

Chapter 2

sRCr

2.1 sRCr_abg.tex

MTT command:

```
mtt sRCr abg tex
```

The acausal bond graph of system **sRCr** is displayed in Figure 2.1 (on page 28) and its label file is listed in Section 2.1.1 (on page 27). The subsystems are listed in Section 2.1.2 (on page 30).

The system **sRCr** is the the sensitivity version of the simple electrical sRCr circuit shown in Figure 2.1 (on page 28). The circuit itself can be regarded as a single-input single-output system with input e_1 and output e_2; the sensitivity system has *two* outputs: e_2 and $\frac{\partial e_2}{\partial r}$.

All bonds are two-bond vector bonds, and the **sR** and **sC** components are two-port versions of the usual **R** and **C** components respectively. One port conveys the usual effort/flow pair; the other port conveys the sensitivity of the effort and flow with respect to the *r* parameter.

2.1.1 Summary information

System sRCr:Sensitivity of output of RC circuit wrt value of r Uses the sR and sC components and vector bonds

Interface information:

This component has no ALIAS declarations

Variable declarations:

This component has no PAR declarations

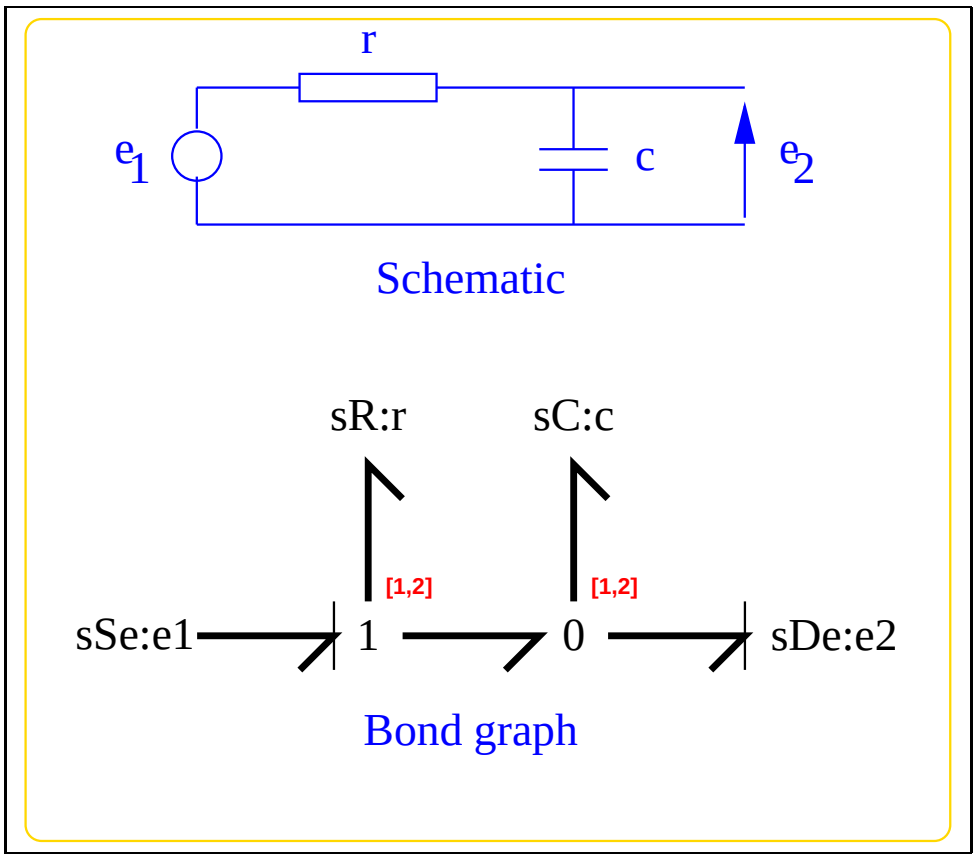

Figure 2.1: System **sRCr**: acausal bond graph

Units declarations:

This component has no UNITs declarations

The label file: sRCr_lbl.txt

```
%% Label file for system sRCr (sRCr_lbl.txt)
%SUMMARY sRCr Sensitivity of output of RC circuit wrt value of r
%DESCRIPTION Uses the sR and sC components and vector bonds

% %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% %% Version control history
% %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% %% $Id: sRCr_lbl.txt,v 1.3 2003/06/11 16:10:01 gawthrop Exp $
% %% $Log: sRCr_lbl.txt,v $
% %% Revision 1.3  2003/06/11 16:10:01  gawthrop
% %% Updated examples for latest MTT.
% %%
% %% Revision 1.2  2000/12/28 18:04:59  peterg
% %% To RCS
% %%
% %% Revision 1.1  1999/07/29 05:18:59  peterg
% %% Initial revision
% %%
% %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%


% Port aliases

% Argument aliases

%% Each line should be of one of the following forms:
%      a comment (ie starting with %)
%      component-name cr_name arg1,arg2,..argn
%      blank

% ---- Component labels ----

% Component type sSe
e1       slin external;0
```

```
% Component type sDe
e2

% Component type sC
c  slin effort,c;0

% Component type sR
r  slin flow,r;1
```

2.1.2 Subsystems

- sC Sensitivity C component (1) No subsystems.
- sDe Sensitivity version of Effort detector (De) (1) No subsystems.
- sR Sensitivity R component (1) No subsystems.
- sSe Sensitivity version of effort source (Se) (1)
  - Se Simple effort source (2)

2.1.3 Se

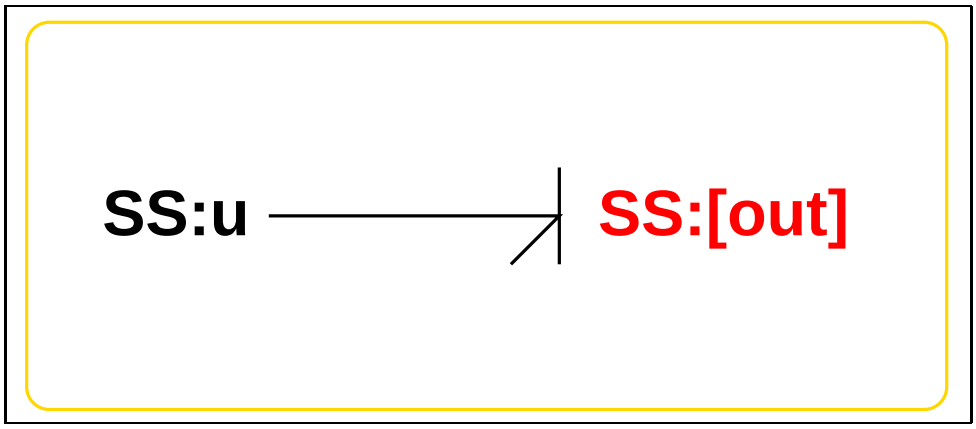

Figure 2.2: System **Se**: acausal bond graph

The acausal bond graph of system **Se** is displayed in Figure 2.2 (on page 30) and its label file is listed in Section 2.1.3 (on page 31). The subsystems are listed in Section 2.1.3 (on page 32).

Summary information

System Se:Simple effort source Simple effort source constructed from SS with fixed causality

Interface information:

Parameter $1 represents actual parameter **e_s**

Port in represents actual port **out**

Port out represents actual port **out**

Variable declarations:

This component has no PAR declarations

Units declarations:

This component has no UNITs declarations

The label file: Se_lbl.txt

```
%% Label file for system Se (Se_lbl.txt)
%SUMMARY Se Simple effort source
%DESCRIPTION Simple effort source constructed from SS with fixed causali


% %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% %% Version control history
% %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% %% $Id: Se_lbl.txt,v 1.3 1999/08/05 07:31:39 peterg Exp $
% %% $Log: Se_lbl.txt,v $
% %% Revision 1.3  1999/08/05 07:31:39  peterg
% %% Added in alias
% %%
% %% Revision 1.2  1999/03/12 04:04:27  peterg
% %% Single argument - the effort value e_s
% %%
% %% Revision 1.1  1999/03/03 21:55:46  peterg
% %% Initial revision
% %%
```

```
% %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%


% Port aliases
%ALIAS out|in out

% Argument aliases
%ALIAS $1 e_s

%% Each line should be of one of the following forms:
%       a comment (ie starting with %)
%       component-name cr_name arg1,arg2,..argn
%       blank

% ---- Component labels ----

% Component type SS
[out] SS external,external
u SS e_s,internal
```

Subsystems

No subsystems.

2.1.4 sC

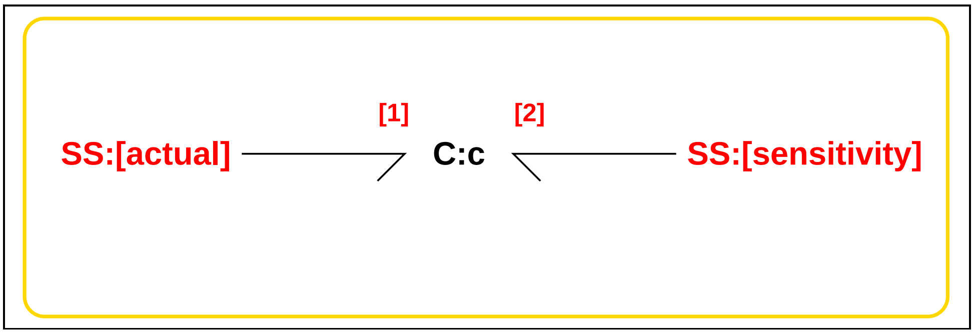

Figure 2.3: System **sC**: acausal bond graph

The acausal bond graph of system **sC** is displayed in Figure 2.3 (on page 32) and its label file is listed in Section 2.1.4 (on page 33). The subsystems are listed in Section 2.1.4 (on page 34).

Summary information

System sC:Sensitivity C component

Interface information:

Parameter $1 represents actual parameter **effort,c**

Parameter $1 represents actual parameter **slin**

Parameter $2 represents actual parameter **cs**

Port in represents actual port **actual,sensitivity**

Variable declarations:

This component has no PAR declarations

Units declarations:

This component has no UNITs declarations

The label file: sC_lbl.txt

```
%% Label file for system sC (sC_lbl.txt)
%SUMMARY sC Sensitivity C component
%DESCRIPTION

% %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% %% Version control history
% %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% %% $Id: sC_lbl.txt,v 1.3 2001/04/24 16:41:54 gawthrop Exp $
% %% $Log: sC_lbl.txt,v $
% %% Revision 1.3  2001/04/24 16:41:54  gawthrop
% %% New 2-port sensitivity components
% %%
% %% Revision 1.1  2001/04/05 12:00:18  gawthrop
% %% Identification example
% %%
% %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%


% Port aliases
```

```
%ALIAS in actual,sensitivity

% Argument aliases
%ALIAS $1 effort,c
%ALIAS $2 cs

%CR alias
%ALIAS $1 slin

%% Each line should be of one of the following forms:
%      a comment (ie starting with %)
%      component-name cr_name arg1,arg2,..argn
%      blank

% ---- Component labels ----
% Component type C
c slin  effort,c;cs

% Component type SS
[actual] SS external,external
[sensitivity] SS external,external
```

Subsystems

No subsystems.

2.1.5 sDe

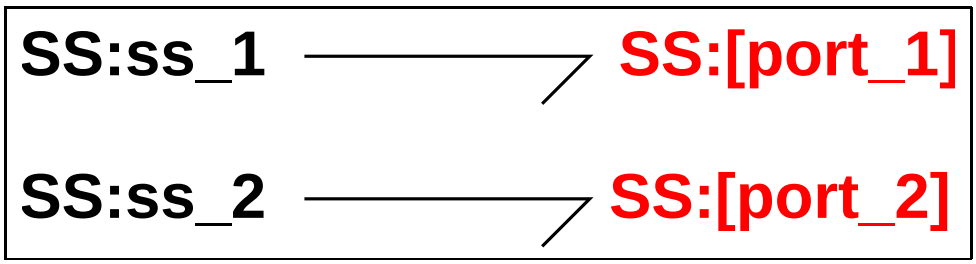

Figure 2.4: System **sDe**: acausal bond graph

The acausal bond graph of system **sDe** is displayed in Figure 2.4 (on page 34) and its label file is listed in Section 2.1.5 (on page 35). The subsystems are listed in Section 2.1.5 (on page 36).

Summary information

System sDe:Sensitivity version of Effort detector (De)

Interface information:

Parameter $1 represents actual parameter **external**

Port in represents actual port **port_1,port_2**

Port out represents actual port **port_1,port_2**

Variable declarations:

This component has no PAR declarations

Units declarations:

This component has no UNITs declarations

The label file: sDe_lbl.txt

```
%% Label file for system sDe (sDe_lbl.txt)
%SUMMARY sDe Sensitivity version of Effort detector (De)
%DESCRIPTION

% %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% %% Version control history
% %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% %% $Id: sDe_lbl.txt,v 1.2 2002/04/16 11:15:08 gawthrop Exp $
% %% $Log: sDe_lbl.txt,v $
% %% Revision 1.2  2002/04/16 11:15:08  gawthrop
% %% Forgot to do this ..
% %%
% %% Revision 1.1  1999/07/29 04:53:34  peterg
% %% Initial revision
% %%
% %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
```

```
% Port aliases
%ALIAS in|out port_1,port_2

% Argument aliases
%ALIAS $1 external

%% Each line should be of one of the following forms:
%      a comment (ie starting with %)
%      component-name cr_name arg1,arg2,..argn
%      blank

% ---- Component labels ----

% Component type SS
[port_1] SS external,external
[port_2] SS external,external
ss_1 SS external,0
ss_2 SS external,0
```

Subsystems

No subsystems.

2.1.6 sR

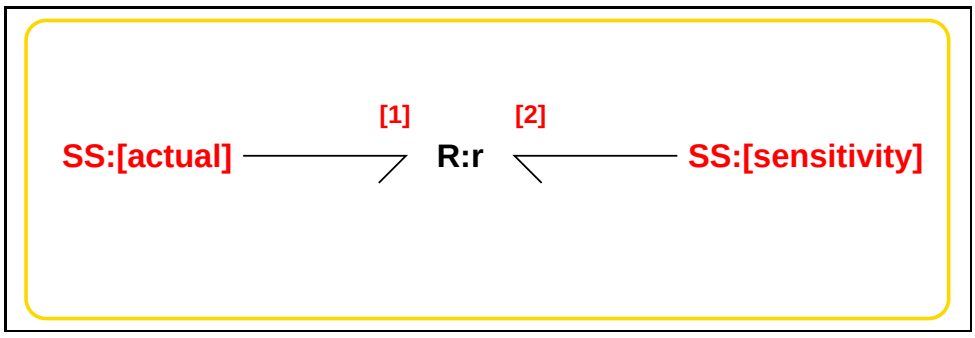

Figure 2.5: System **sR**: acausal bond graph

The acausal bond graph of system **sR** is displayed in Figure 2.5 (on page 36) and

its label file is listed in Section 2.1.6 (on page 37). The subsystems are listed in Section 2.1.6 (on page 38).

Summary information

System sR:Sensitivity R component

Interface information:

Parameter $1 represents actual parameter **flow,r**

Parameter $1 represents actual parameter **slin**

Parameter $2 represents actual parameter **rs**

Port in represents actual port **actual,sensitivity**

Variable declarations:

This component has no PAR declarations

Units declarations:

This component has no UNITs declarations

The label file: sR_lbl.txt

```
%% Label file for system sR (sR_lbl.txt)
%SUMMARY sR Sensitivity R component
%DESCRIPTION

% %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% %% Version control history
% %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% %% $Id: sR_lbl.txt,v 1.2 2001/04/24 16:41:54 gawthrop Exp $
% %% $Log: sR_lbl.txt,v $
% %% Revision 1.2  2001/04/24 16:41:54  gawthrop
% %% New 2-port sensitivity components
% %%
% %% Revision 1.1  2001/04/05 12:00:18  gawthrop
% %% Identification example
% %%
% %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
```

```
% Port aliases
%ALIAS in actual,sensitivity

% Argument aliases
%ALIAS $1 flow,r
%ALIAS $2 rs

%CR alias
%ALIAS $1 slin

%% Each line should be of one of the following forms:
%      a comment (ie starting with %)
%      component-name cr_name arg1,arg2,..argn
%      blank

% ---- Component labels ----
r slin  flow,r;rs

% Component type SS
[actual] SS external,external
[sensitivity] SS external,external
```

Subsystems

No subsystems.

2.1.7 sSe

The acausal bond graph of system **sSe** is displayed in Figure 2.6 (on page 39) and its label file is listed in Section 2.1.7 (on page 38). The subsystems are listed in Section 2.1.7 (on page 40).

Summary information

System sSe:Sensitivity version of effort source (Se)

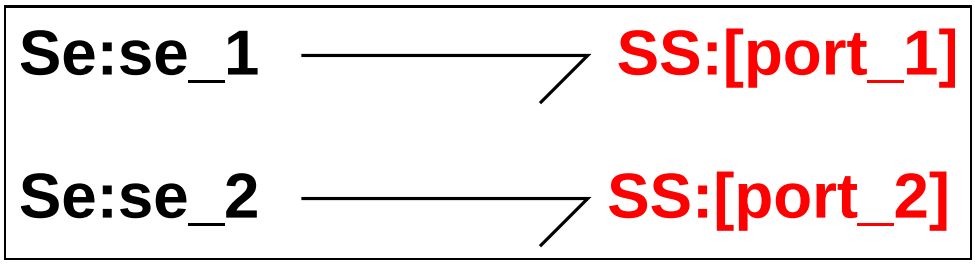

Figure 2.6: System **sSe**: acausal bond graph

Interface information:

Parameter $1 represents actual parameter **e_s**

Parameter $2 represents actual parameter **k_s**

Port in represents actual port **port_1,port_2**

Port out represents actual port **port_1,port_2**

Variable declarations:

This component has no PAR declarations

Units declarations:

This component has no UNITs declarations

The label file: sSe_lbl.txt

```
%% Label file for system sSe (sSe_lbl.txt)
%SUMMARY sSe Sensitivity version of effort source (Se)
%DESCRIPTION

% %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% %% Version control history
% %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% %% $Id: sSe_lbl.txt,v 1.1 2000/12/27 16:35:36 peterg Exp $
% %% $Log: sSe_lbl.txt,v $
% %% Revision 1.1  2000/12/27 16:35:36  peterg
% %% Initial revision
% %%
```

```
% %% Revision 1.1  1999/07/29 04:54:41  peterg
% %% Initial revision
% %%
% %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%


% Port aliases
%ALIAS in|out port_1,port_2

% Argument aliases
%ALIAS $1 e_s
%ALIAS $2 k_s


%% Each line should be of one of the following forms:
%       a comment (ie starting with %)
%       component-name cr_name arg1,arg2,..argn
%       blank

% ---- Component labels ----

% Component type SS
[port_1] SS external,external
[port_2] SS external,external

% Component type Se
se_1 SS e_s
se_2 SS k_s
```

Subsystems

- Se Simple effort source (2) No subsystems.

2.2 sRCr_struc.tex

MTT command:

```
mtt sRCr struc tex
```

List of inputs for system sRCr			
	Component	System	Repetition
1	u	sRCr__e1__se_1__u	1

List of outputs for system sRCr			
	Component	System	Repetition
1	ss_1	sRCr__e2__ss_1	1
2	ss_2	sRCr__e2__ss_2	1

List of states for system sRCr			
	Component	System	Repetition
1	c	sRCr__c__c	1
2	c	sRCr__c__c_2	1

2.3 sRCr_ode.tex

MTT command:

```
mtt sRCr ode tex
```

$$\begin{aligned} \dot{x}_1 &= \frac{(cu_1 - x_1)}{(cr)} \\ \dot{x}_2 &= \frac{(-cu_1 + x_1 - x_2 r)}{(cr^2)} \end{aligned} \tag{2.1}$$

$$\begin{aligned} y_1 &= \frac{x_1}{c} \\ y_2 &= \frac{x_2}{c} \end{aligned} \tag{2.2}$$

2.4 sRCr_sm.tex

MTT command:

```
mtt sRCr sm tex
```

$$A = \begin{pmatrix} \frac{(-1)}{(cr)} & 0 \\ \frac{1}{(cr^2)} & \frac{(-1)}{(cr)} \end{pmatrix} \tag{2.3}$$

$$B = \begin{pmatrix} \frac{1}{r} \\ \frac{(-1)}{r^2} \end{pmatrix} \tag{2.4}$$

$$C = \begin{pmatrix} \frac{1}{c} & 0 \\ 0 & \frac{1}{c} \end{pmatrix} \tag{2.5}$$

$$D = \begin{pmatrix} 0 \end{pmatrix} \tag{2.6}$$

2.5 sRCr_tf.tex

MTT command:

```
mtt sRCr tf tex
```

$$G = \begin{pmatrix} \frac{1}{(crs+1)} \\ \frac{(-cs)}{(c^2r^2s^2+2crs+1)} \end{pmatrix} \tag{2.7}$$

2.6 sRCr_lmfr.ps

MTT command:

```
mtt sRCr lmfr ps
```

This representation is given as Figure 2.7 (on page 43).

2.7 sRCr_odeso.ps

MTT command:

```
mtt sRCr odeso ps
```

This representation is given as Figure 2.8 (on page 43).

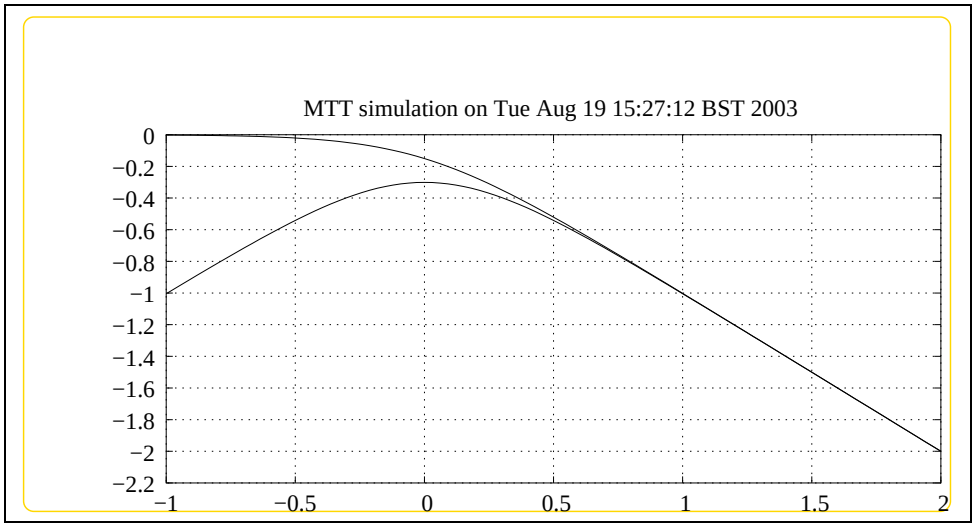

Figure 2.7: System **sRCr**, representation lmfr (-noargs)

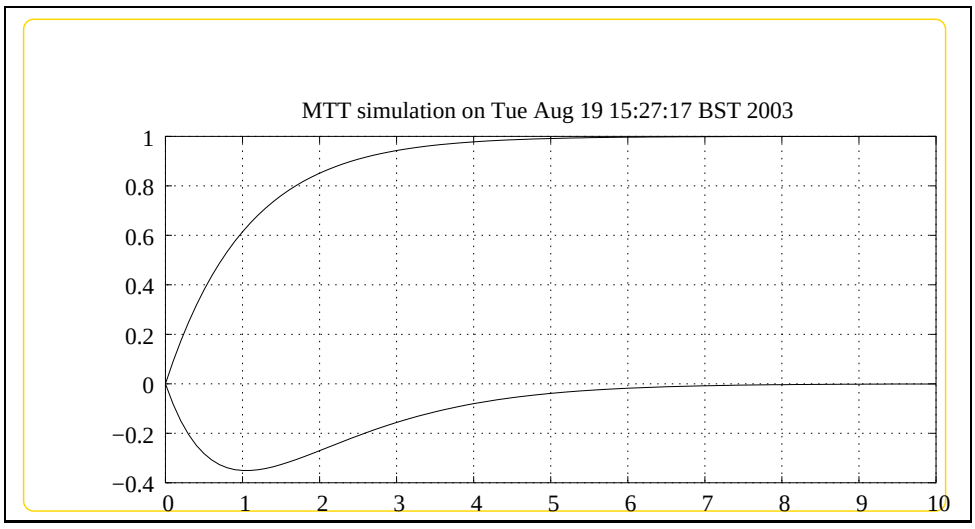

Figure 2.8: System **sRCr**, representation odeso (-noargs)

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