

# Package **deTestSet**: testset for initial value problems of differential equations in R

**Karline Soetaert**

Royal Netherlands Institute of Sea Research (RIVO)  
Yerseke, The Netherlands

**Jeff Cash**

Department of mathematics  
Imperial College London  
U.K.

**Francesca Mazzia**

Dipartimento di Matematica  
Universita' di Bari  
Italy

---

## Abstract

R package **deTestSet** contains the R-version of the ODE and DAE initial value problems test set from <http://www.dm.uniba.it/~testset> Mazzia and Magherini (2008).

If the model problem is small enough, then it is implemented in pure R . For larger models, the problem specified in FORTRAN code at the website of Jeff Cash [http://www.ma.ic.ac.uk/~jcash/IVP\\_software](http://www.ma.ic.ac.uk/~jcash/IVP_software) were used.

These implementations were compiled as DLLs, and included in the package. The code of these models can be found in the packages **inst/examples/dynload** subdirectory.

For a number of small models, we show how to implement them in R .

*Keywords:* ordinary differential equations, differential algebraic equations, initial value problems, testset, R.

---

```
> out <- andrews()
```

```
Andrews' squeezing mechanism  
Solved with mebdfi  
Using rtol = 1e-07, atol=1e-07  
Mixed error significant digits:  
1.406111
```

```
> plot(out, which = 1:9, lwd = 2, ask = FALSE)  
> mtext(outer = TRUE, side = 3, line = -1.5, "andrews", cex = 1.5)
```

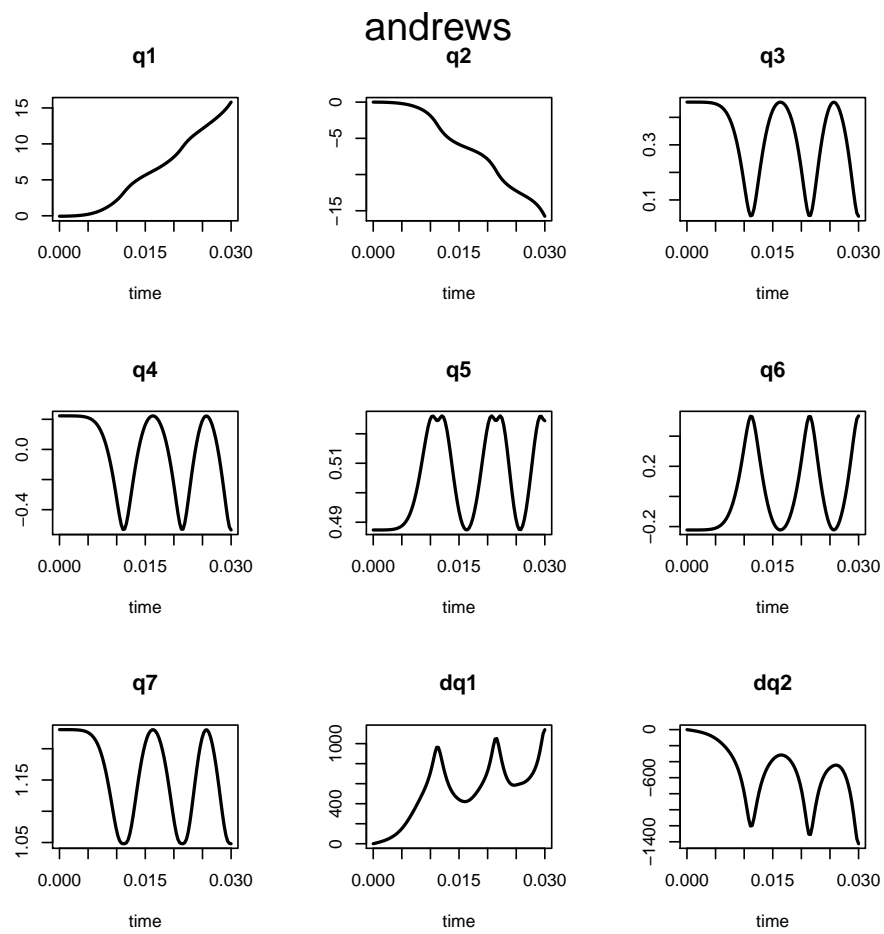


Figure 1: the andrews problem- see text for R-code

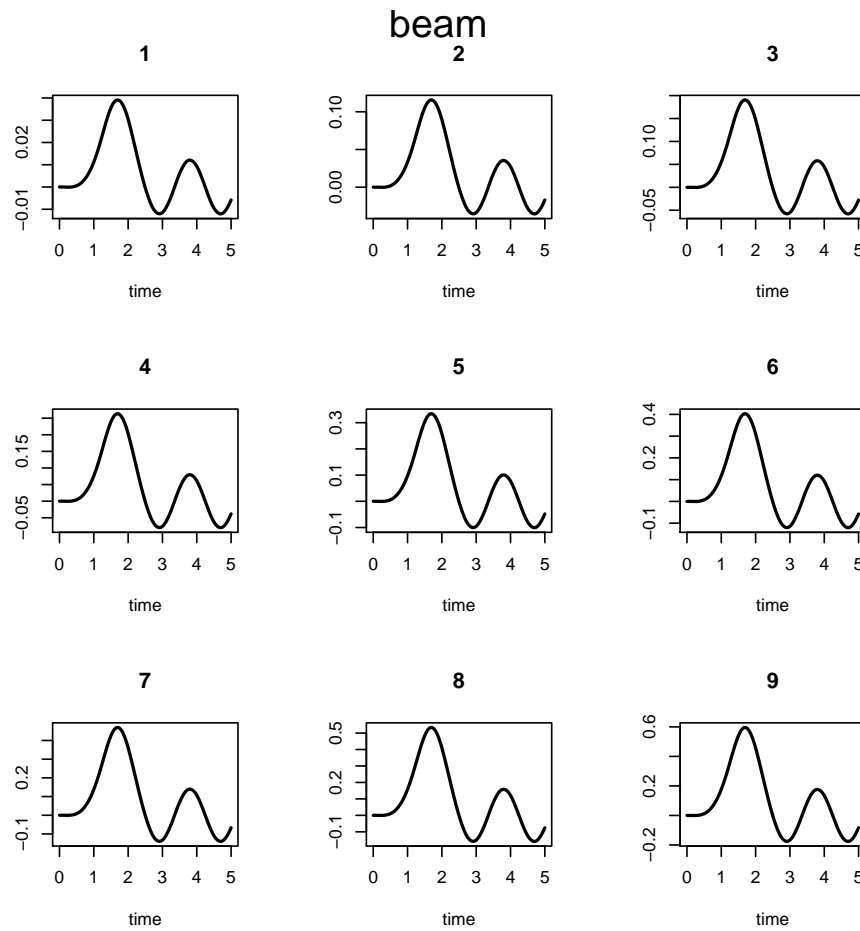


Figure 2: Solution of beam - see text for R-code

```
> out <- beam()
```

Beam

Solved with gamd

Using rtol = 1e-06, atol=1e-06

Mixed error significant digits:

4.987048

```
> plot(out, which = 1:9, lwd = 2, ask = FALSE)
```

```
> mtext(outer = TRUE, side = 3, line = -1.5, "beam", cex = 1.5)
```

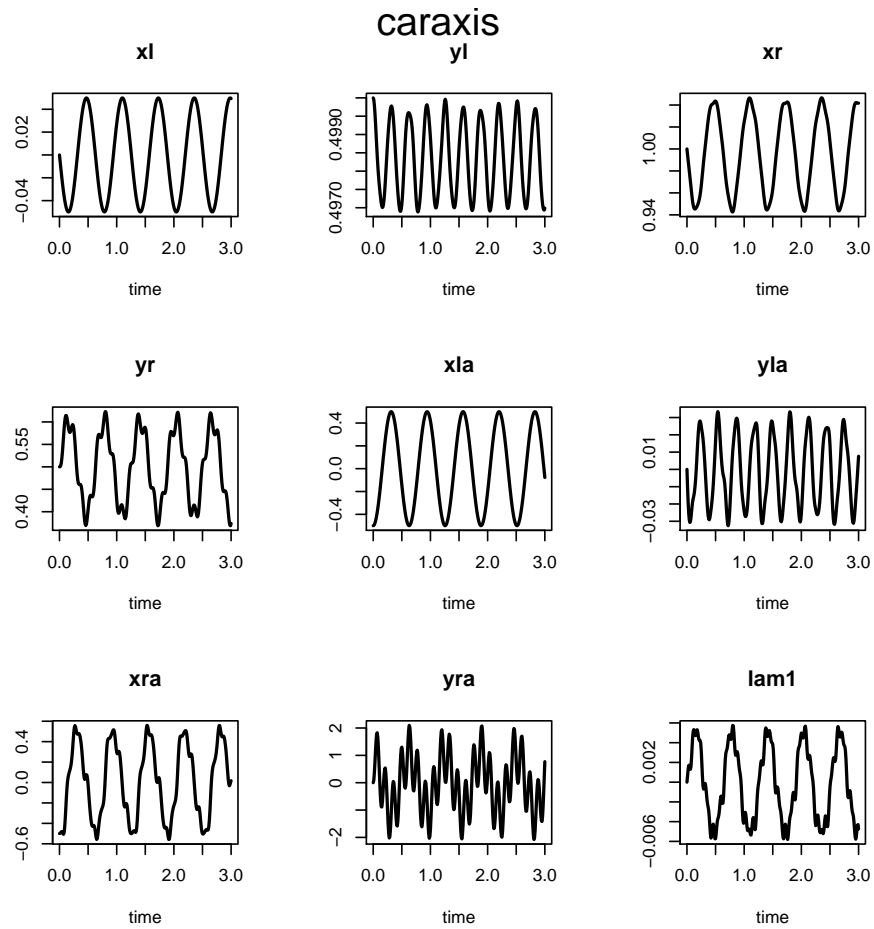


Figure 3: Solution of caraxis - see text for R-code

```
> out <- caraxis()
```

Car Axis problem

Solved with mebdfi

Using rtol = 1e-06, atol=1e-06

Mixed error significant digits:

3.331363

```
> plot(out, which = 1:9, lwd = 2, ask = FALSE)
```

```
> mtext(outer = TRUE, side = 3, line = -1.5, "caraxis", cex = 1.5)
```

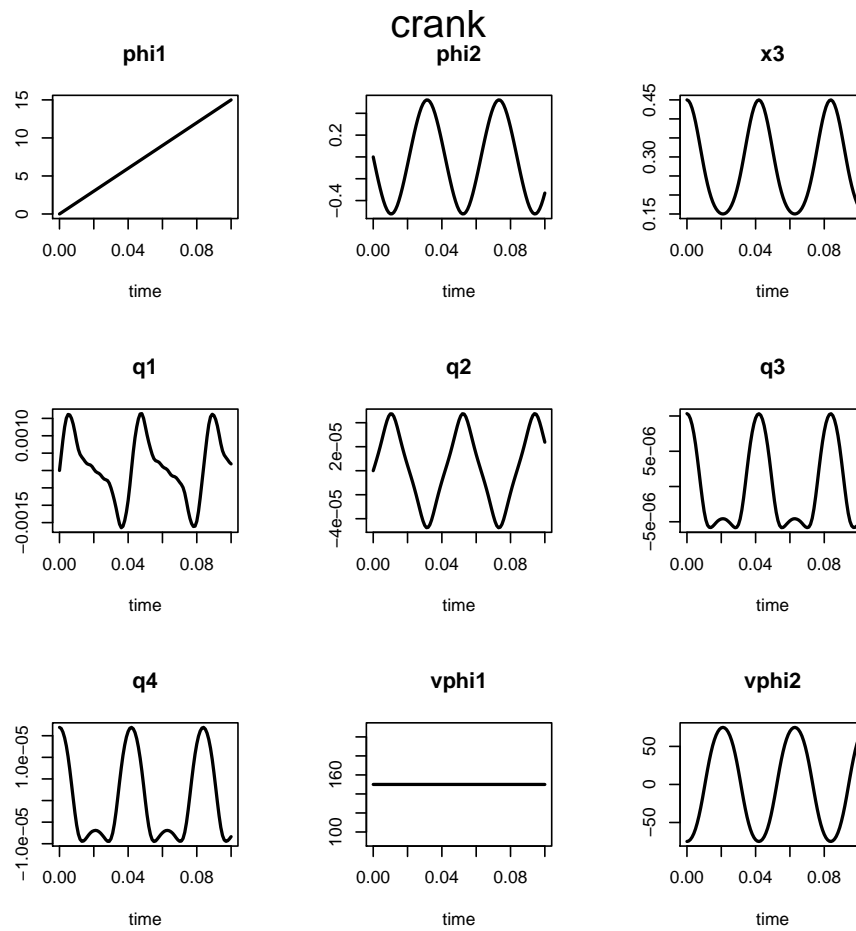


Figure 4: Solution of crank - see text for R-code

```
> out <- crank()
```

Slider Crank

Solved with mebdfi

Using rtol = 1e-06, atol=1e-06

Mixed error significant digits (first seven components):

8.428023

```
> plot(out, which = 1:9, lwd = 2, ask = FALSE)
```

```
> mtext(outer = TRUE, side = 3, line = -1.5, "crank", cex = 1.5)
```

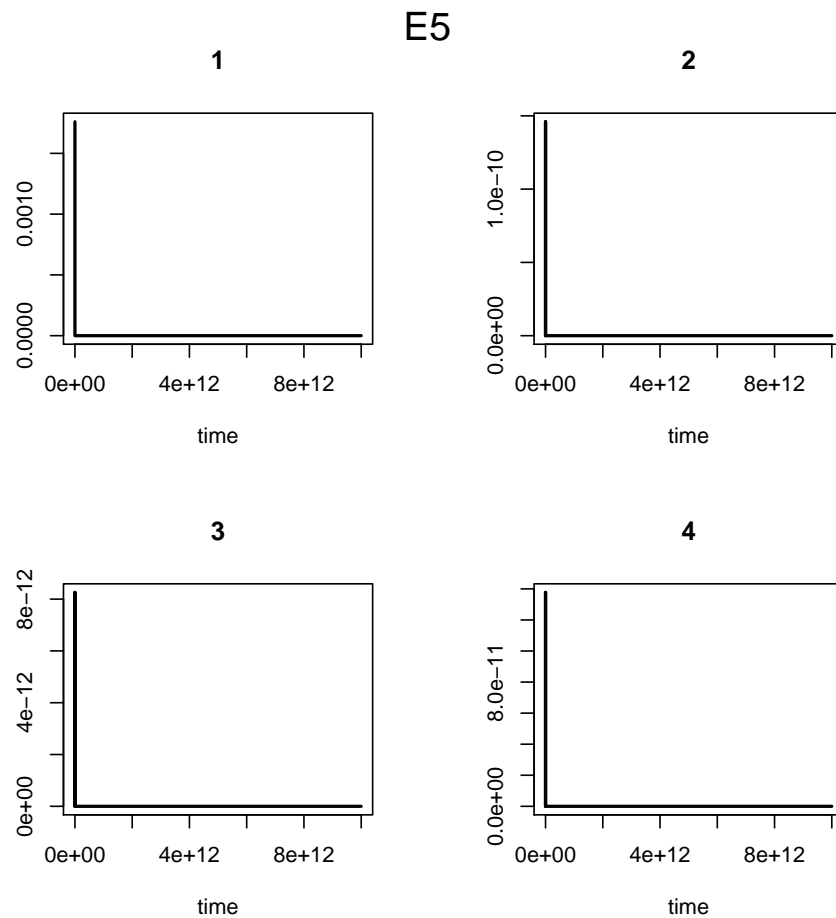


Figure 5: Solution of E5 - see text for R-code

```
> out <- E5()
```

```
Problem E5 stiff-detest
Solved with lsoda
Using rtol = 1e-06, atol=1.11e-24
Mixed error significant digits:
-0.3325057
```

```
> plot(out, lwd = 2, ask = FALSE)
> mtext(outer = TRUE, side = 3, line = -1.5, "E5", cex = 1.5)
```

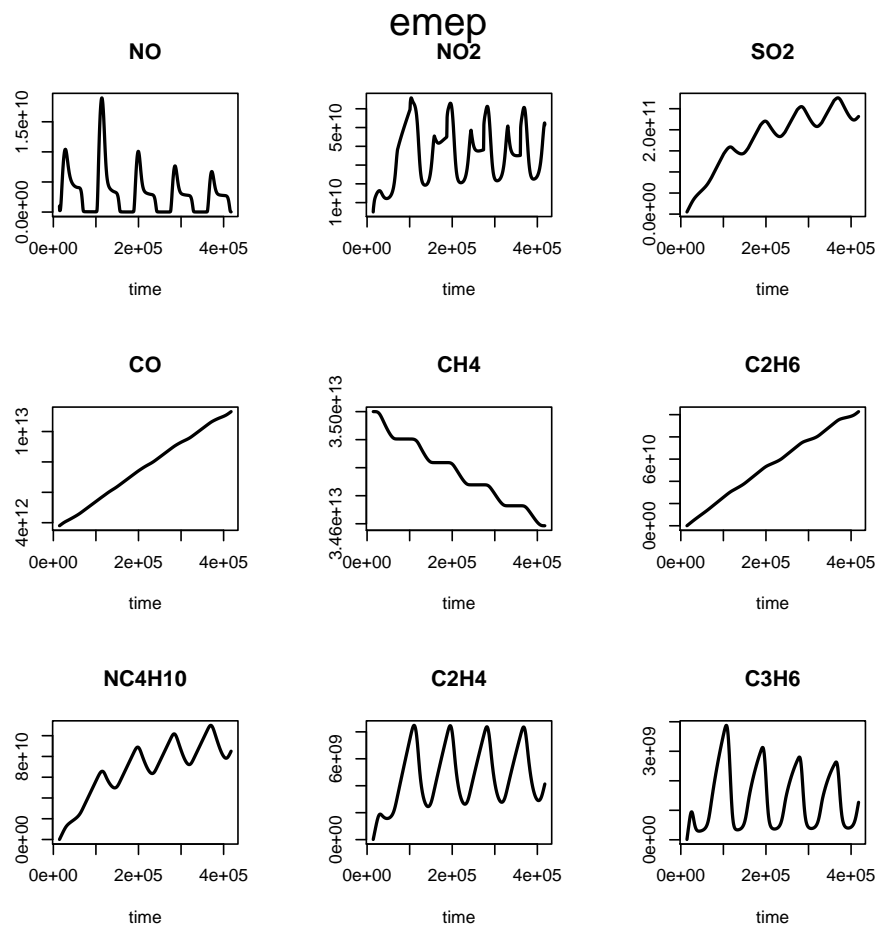


Figure 6: Solution of emep - see text for R-code

```
> out <- emep()
```

```
EMEP problem
```

```
Solved with bimd
```

```
Using rtol = 1e-05, atol=0.1
```

```
Mixed error significant digits:
```

```
3.578722
```

```
> plot(out, which = 1:9, lwd = 2, ask = FALSE)
```

```
> mtext(outer = TRUE, side = 3, line = -1.5, "emep", cex = 1.5)
```

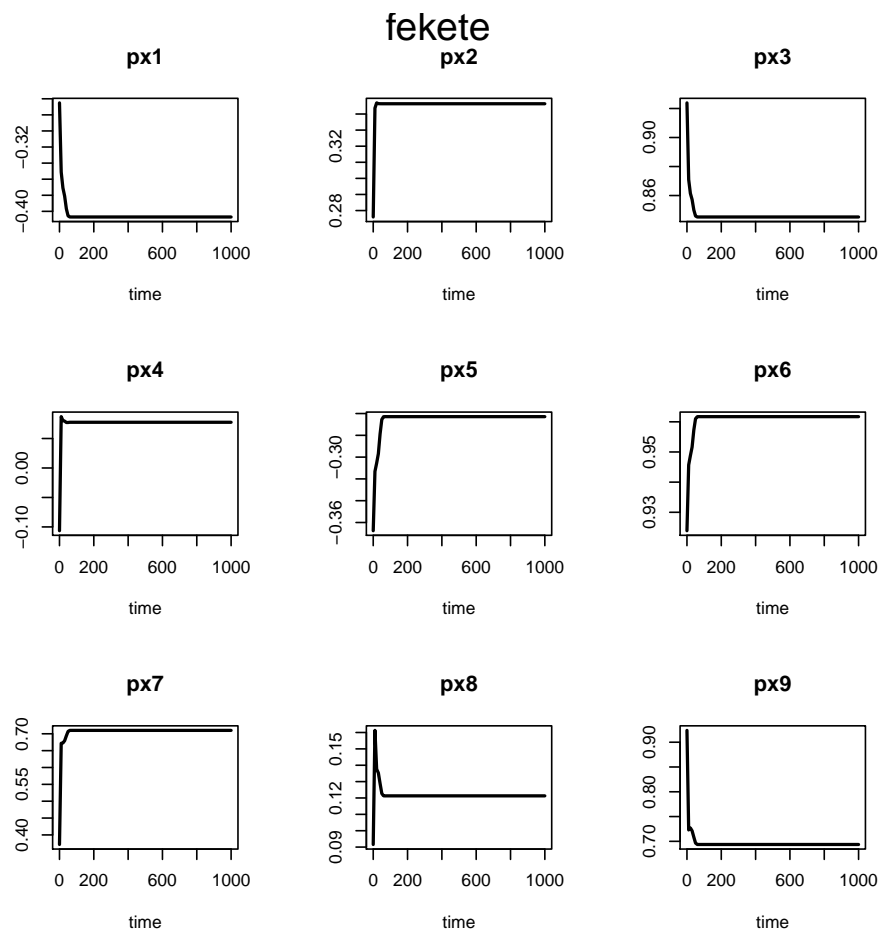


Figure 7: Solution of fekete - see text for R-code

```
> out <- fekete()
```

Fekete problem

Solved with mebdfi

Using rtol = 1e-06, atol=1e-06

Mixed error significant digits:

7.580798

```
> plot(out, which = 1:9, lwd = 2, ask = FALSE)
```

```
> mtext(outer = TRUE, side = 3, line = -1.5, "fekete", cex = 1.5)
```



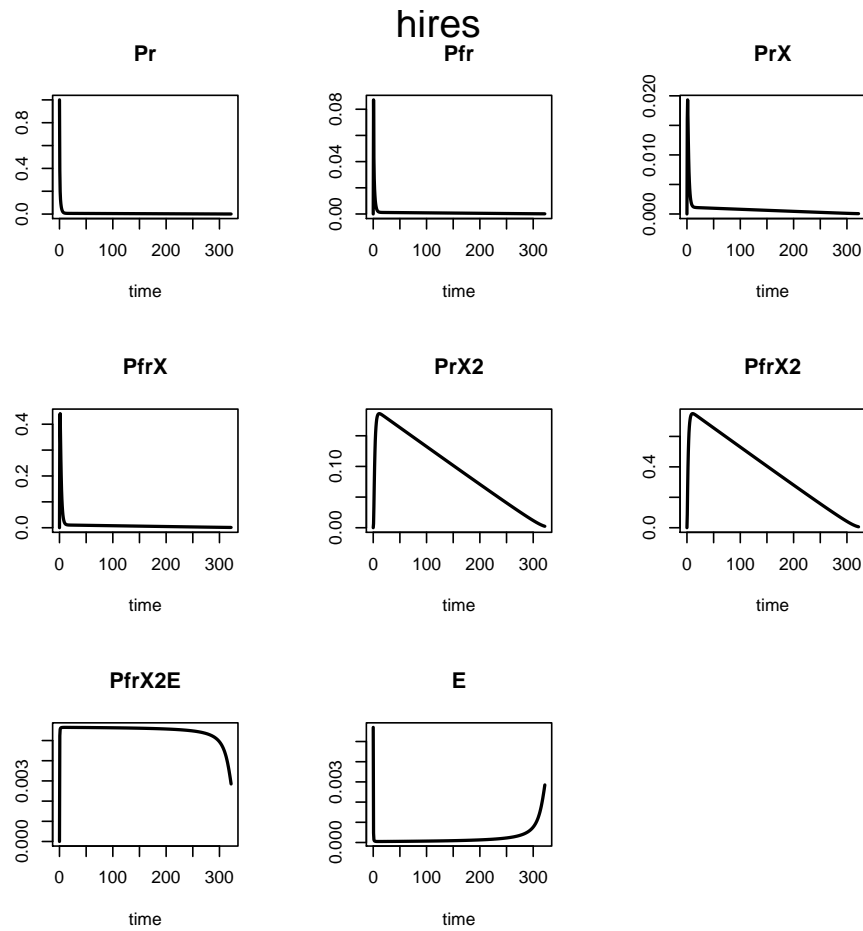


Figure 8: Solution of hires - see text for R-code

```
> out <- hires()
```

Problem HIRES

Solved with mebdfi

Using rtol = 1e-06, atol=1e-06

Mixed error significant digits:

5.567281

```
> plot(out, lwd = 2, ask = FALSE)
```

```
> mtext(outer = TRUE, side = 3, line = -1.5, "hires", cex = 1.5)
```

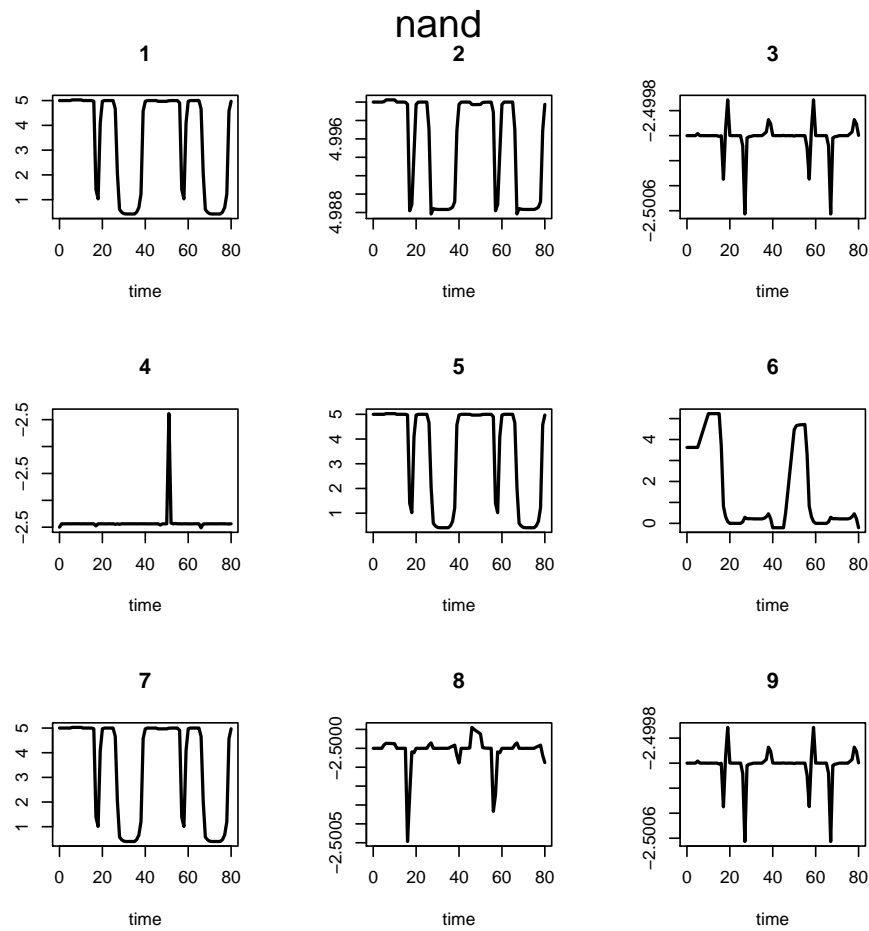


Figure 9: Solution of nand - see text for R-code

The nand problem is most efficiently solved with `daspk`

```
> out <- nand(method = daspk)
```

```
NAND gate
Solved with daspk
Using rtol = 1e-06, atol=1e-06
Mixed error significant digits:
5.008149
```

```
> plot(out, which = 1:9, lwd = 2, ask = FALSE)
> mtext(outer = TRUE, side = 3, line = -1.5, "nand", cex = 1.5)
```

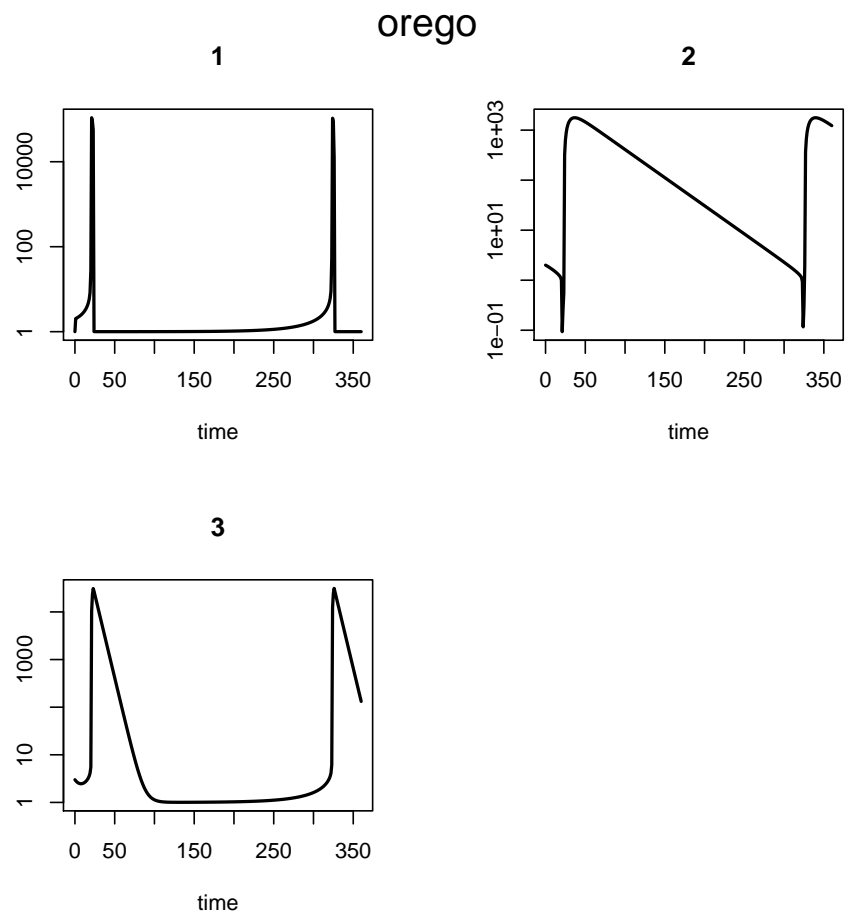


Figure 10: Solution of orego - see text for R-code

```
> out <- orego()
```

Problem OREGONATOR

Solved with lsoda

Using rtol = 1e-06, atol=1e-06

Mixed error significant digits:

4.768192

```
> plot(out, lwd = 2, ask = FALSE, log = "y")
```

```
> mtext(outer = TRUE, side = 3, line = -1.5, "orego", cex = 1.5)
```

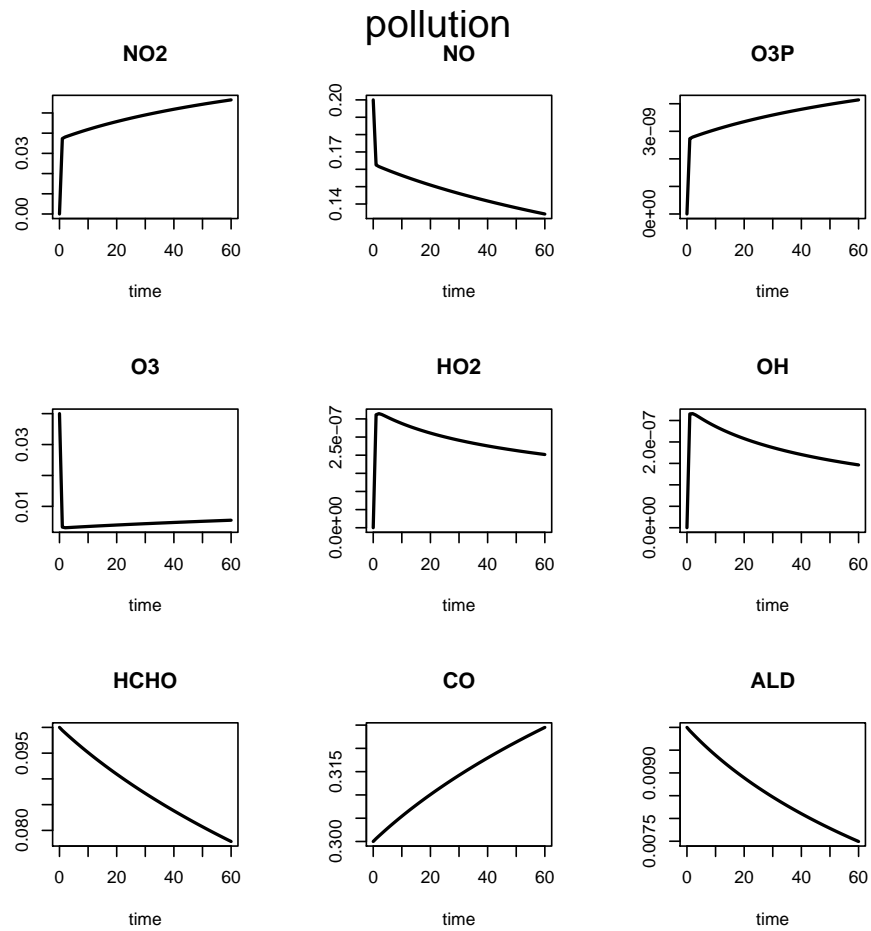


Figure 11: Solution of pollution - see text for R-code

```
> out <- pollution()
```

```
Pollution problem
Solved with mebdfi
Using rtol = 1e-06, atol=1e-06
Mixed error significant digits:
6.733499
```

```
> plot(out, which = 1:9, lwd = 2, ask = FALSE)
> mtext(outer = TRUE, side = 3, line = -1.5, "pollution", cex = 1.5)
```

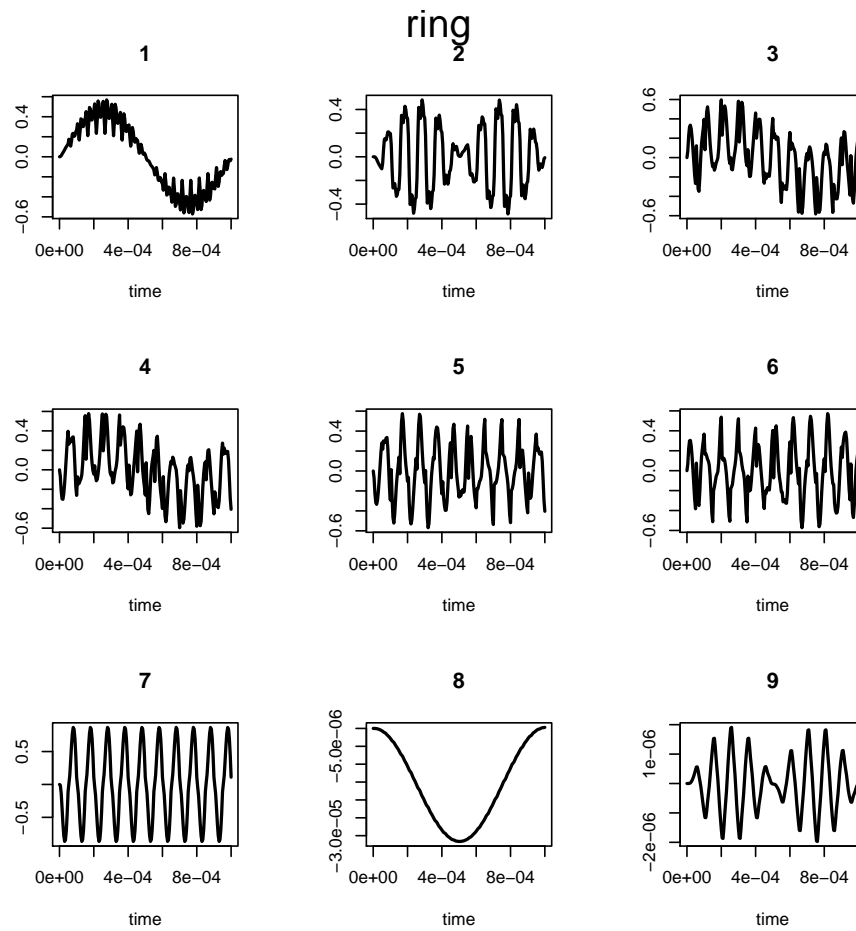


Figure 12: Solution of ring - see text for R-code

```
> out <- ring()
```

Ring Modulator

Solved with mebdfi

Using rtol = 1e-08, atol=1e-08

Mixed error significant digits:

6.285804

```
> plot(out, which = 1:9, lwd = 2, ask = FALSE)
```

```
> mtext(outer = TRUE, side = 3, line = -1.5, "ring", cex = 1.5)
```

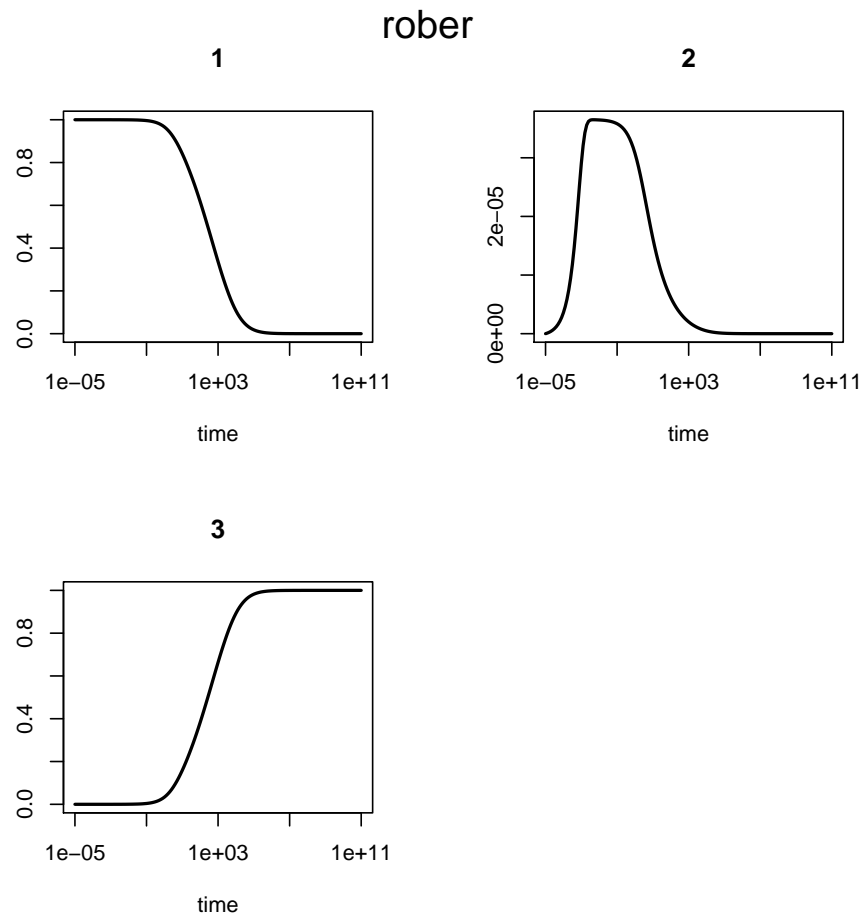


Figure 13: Solution of rober - see text for R-code

```
> out <- rober()
```

```
Problem ROBERTSON
Solved with lsoda
Using rtol = 1e-10, atol=1e-14
Mixed error significant digits:
9.304309
```

```
> plot(out, lwd = 2, ask = FALSE, log = "x", xlim = c(1e-5,1e11))
> mtext(outer = TRUE, side = 3, line = -1.5, "rober", cex = 1.5)
```

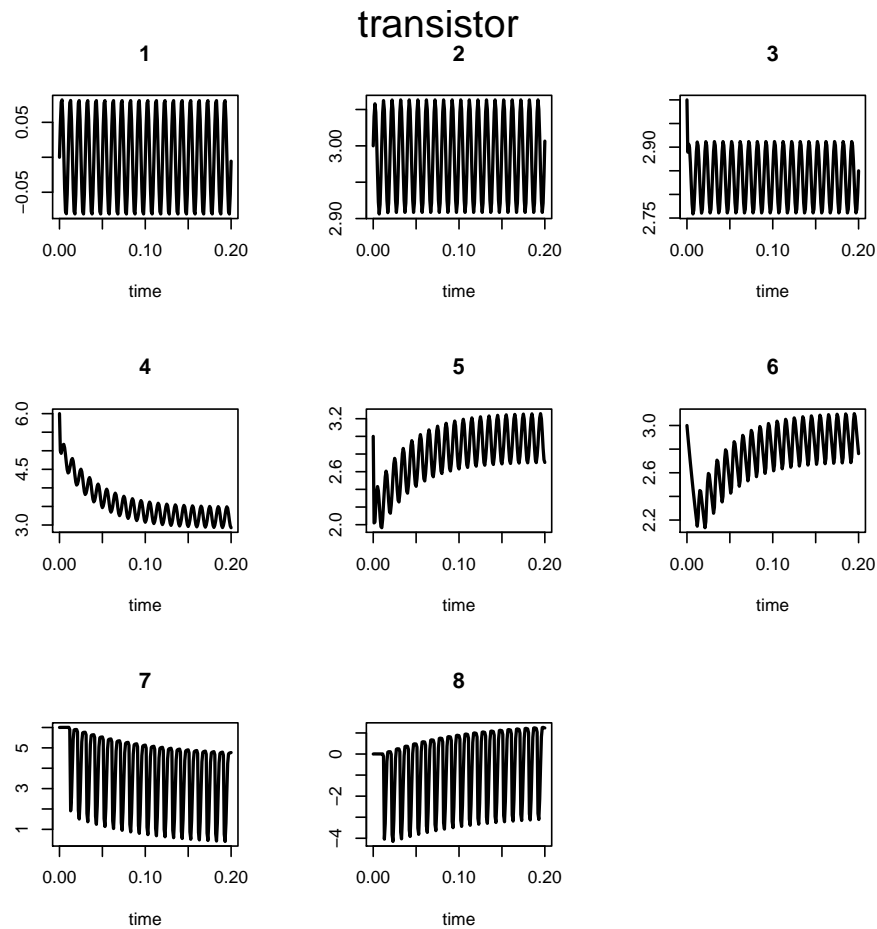


Figure 14: Solution of transistor - see text for R-code

```
> out <- transistor()
```

```
Transistor Amplifier
Solved with mebdfi
Using rtol = 1e-06, atol=1e-06
Mixed error significant digits:
6.719922
```

```
> plot(out, lwd = 2, ask = FALSE)
> mtext(outer = TRUE, side = 3, line = -1.5, "transistor", cex = 1.5)
```

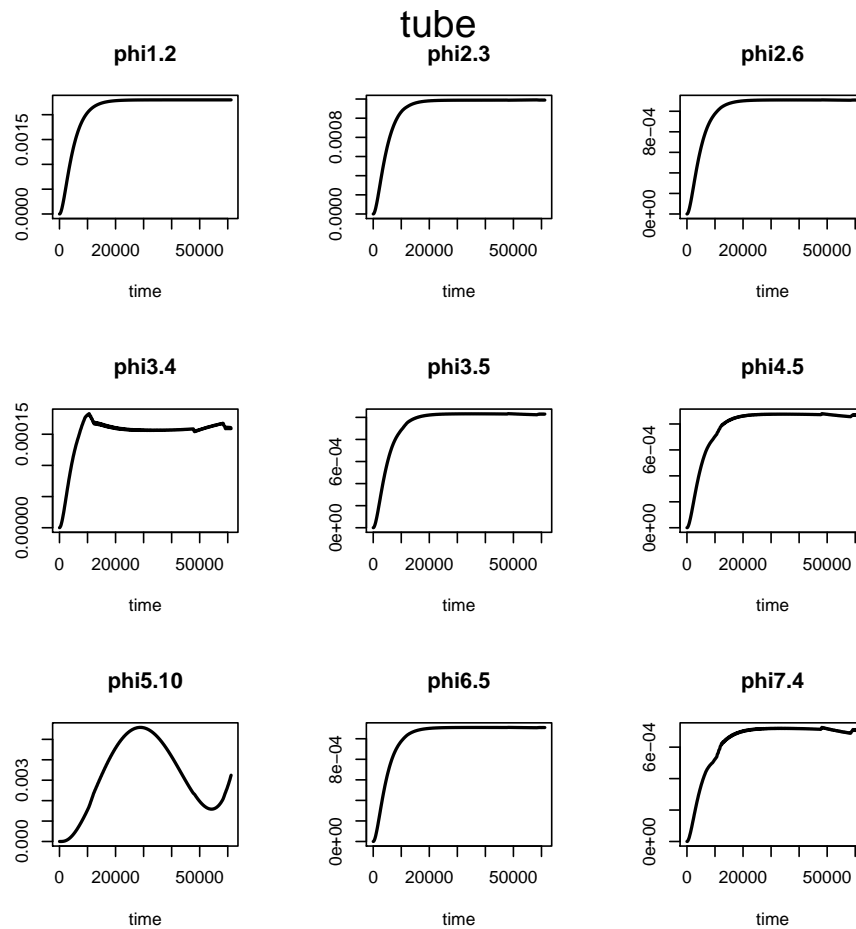


Figure 15: Solution of tube - see text for R-code

```
> out <- tube()
```

```
Water tube system
Solved with radau5
Using rtol = 1e-06, atol=1e-06
Mixed error significant digits:
5.482282
```

```
> plot(out, which = 1:9, lwd = 2, ask = FALSE)
> mtext(outer = TRUE, side = 3, line = -1.5, "tube", cex = 1.5)
```



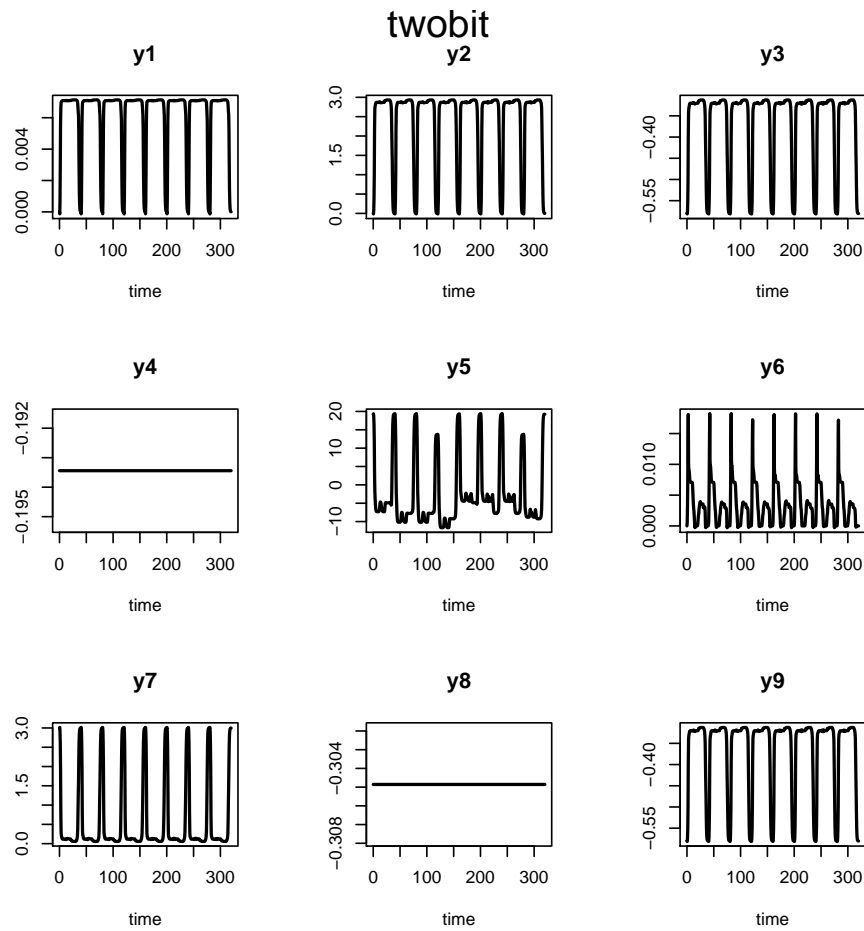


Figure 16: Solution of twobit - see text for R-code

```
> out <- twobit()
```

Two bit adding unit

Solved with radau5

Using rtol = 1e-04, atol=1e-04

Mixed error significant digits:

5.018491

```
> plot(out, which = 1:9, lwd = 2, ask = FALSE)
```

```
> mtext(outer = TRUE, side = 3, line = -1.5, "twobit", cex = 1.5)
```

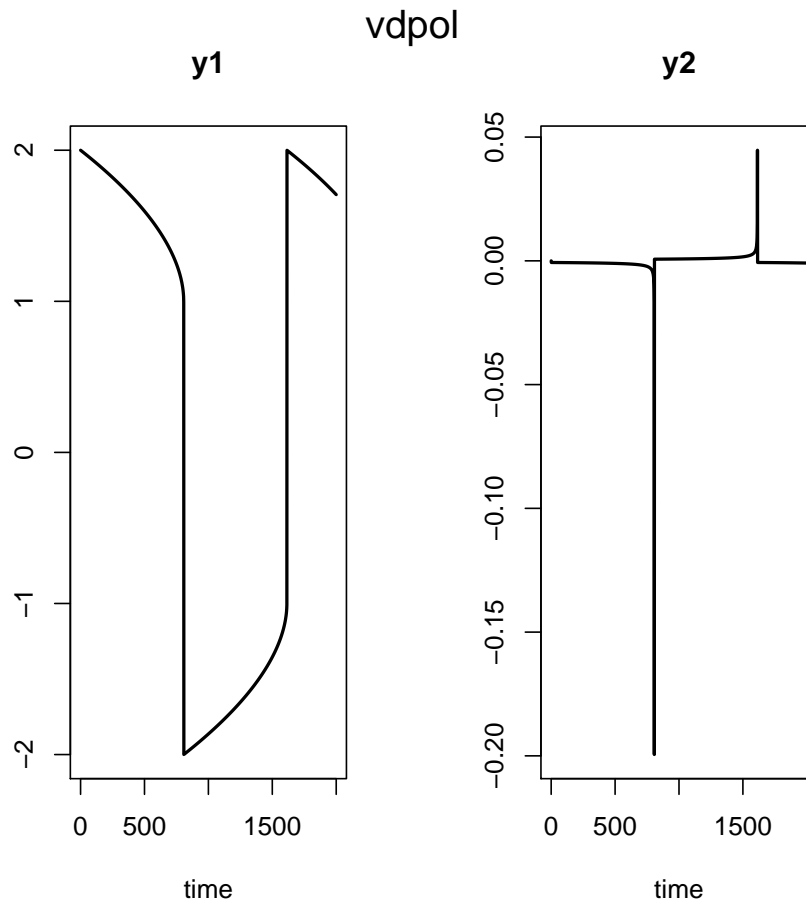


Figure 17: Solution of vdpol - see text for R-code

```
> out <- vdpol()
```

```
Problem VANDERPOL
Solved with lsoda
Using rtol = 1e-06, atol=1e-06
Mixed error significant digits:
6.051236
```

```
> plot(out, lwd = 2, ask = FALSE)
> mtext(outer = TRUE, side = 3, line = -1.5, "vdpol", cex = 1.5)
```

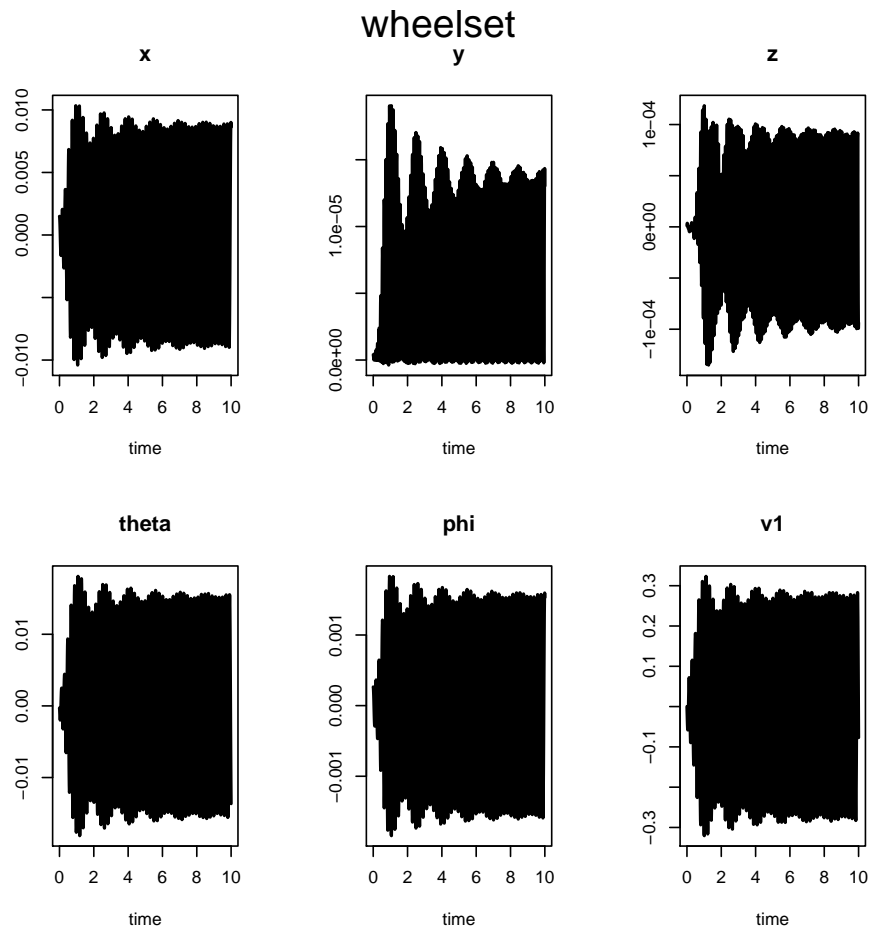


Figure 18: Solution of wheelset an implicit differential equation model - index 2, dimension 17 - see text for R-code

```
> out <- wheelset()
```

Wheelset

Solved with mebdfi

Using rtol = 1e-06, atol=1e-06

Mixed error significant digits:

3.791485

```
> plot(out, which = 1:6, lwd = 2, ask = FALSE)
```

```
> mtext(outer = TRUE, side = 3, line = -1.5, "wheelset", cex = 1.5)
```

## References

Mazzia F, Magherini C (2008). *Test Set for Initial Value Problem Solvers, release 2.4*.  
Department of Mathematics, University of Bari, Italy. Report 4/2008, URL <http://pitagora.dm.uniba.it/~testset>.

### Affiliation:

Karline Soetaert  
Royal Netherlands Institute of Sea Research (NIOZ)  
4401 NT Yerseke, Netherlands  
E-mail: [karline.soetaert@nioz.nl](mailto:karline.soetaert@nioz.nl)  
URL: <http://www.nioz.nl>

Jeff Cash  
Imperial College London  
South Kensington Campus  
London SW7 2AZ, U.K.  
E-mail: [j.cash@imperial.ac.uk](mailto:j.cash@imperial.ac.uk)  
URL: <http://www.ma.ic.ac.uk/~jcash>

Francesca Mazzia  
Dipartimento di Matematica  
Universita' di Bari  
Via Orabona 4,  
70125 BARI  
Italy E-mail: [mazzia@dm.uniba.it](mailto:mazzia@dm.uniba.it)  
URL: <http://pitagora.dm.uniba.it/~mazzia>