

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

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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 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:
```

```
1.406245
```

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

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

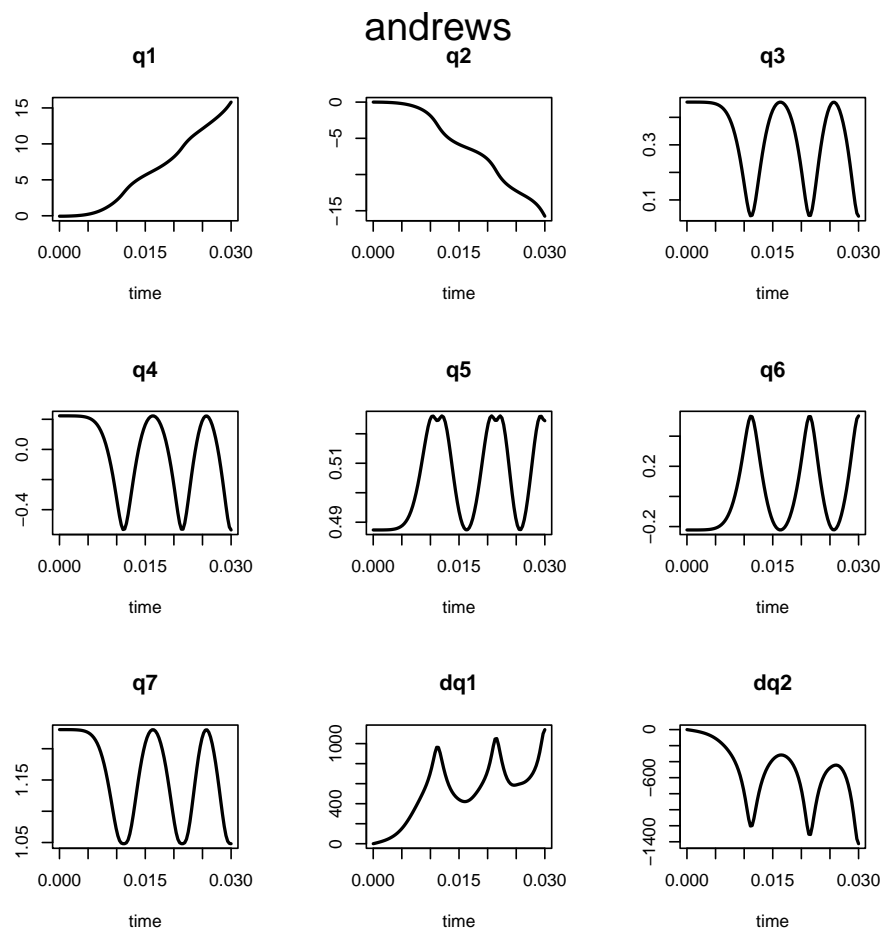


Figure 1: the andrews problem- see text for R-code

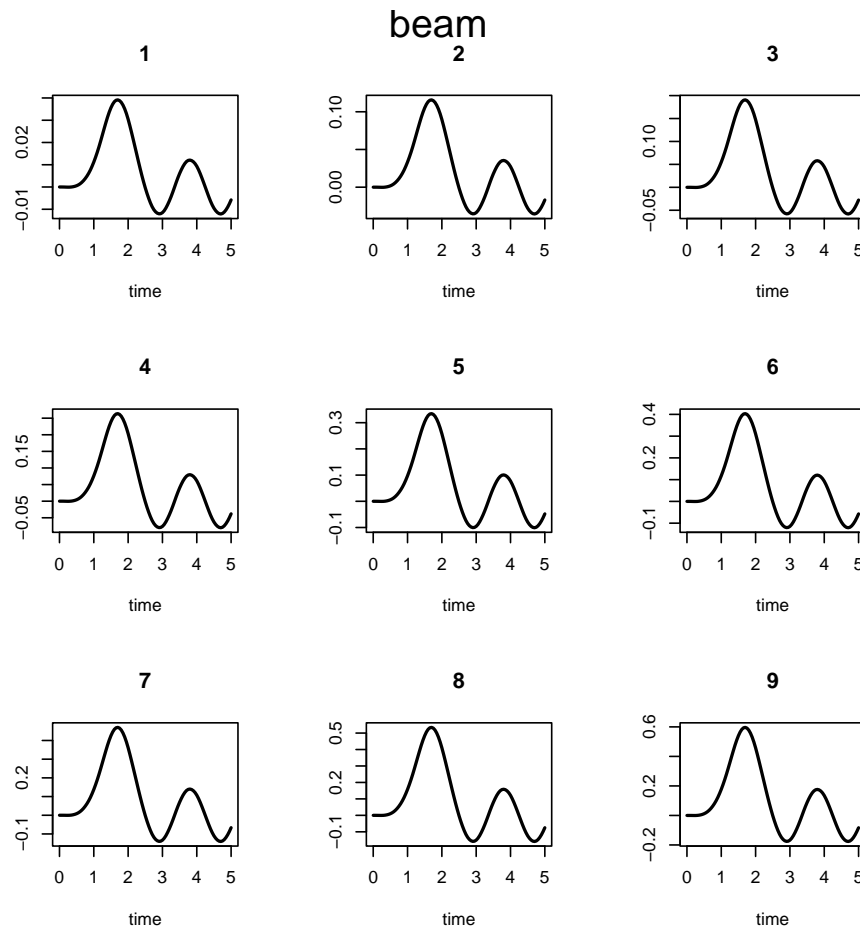


Figure 2: Solution of beam - see text for R-code

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

Beam

Solved with gamd

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

Mixed error significant digits:

4.98705

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

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

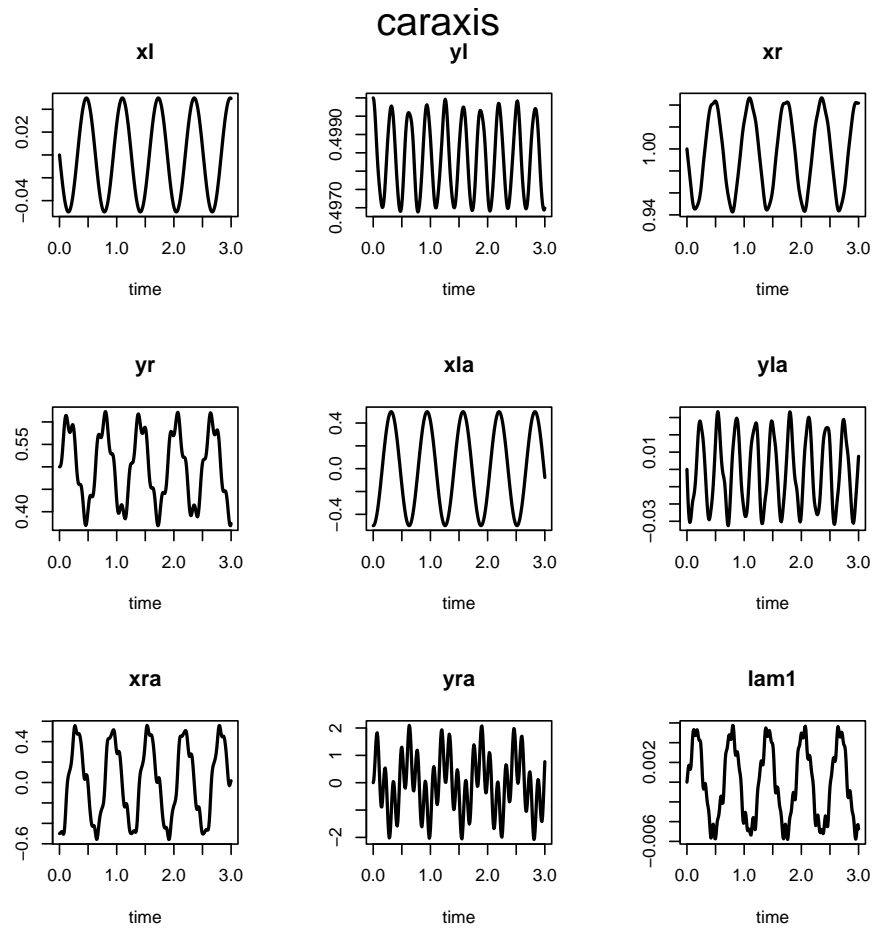


Figure 3: Solution of caraxis - see text for R-code

```
> 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)
```

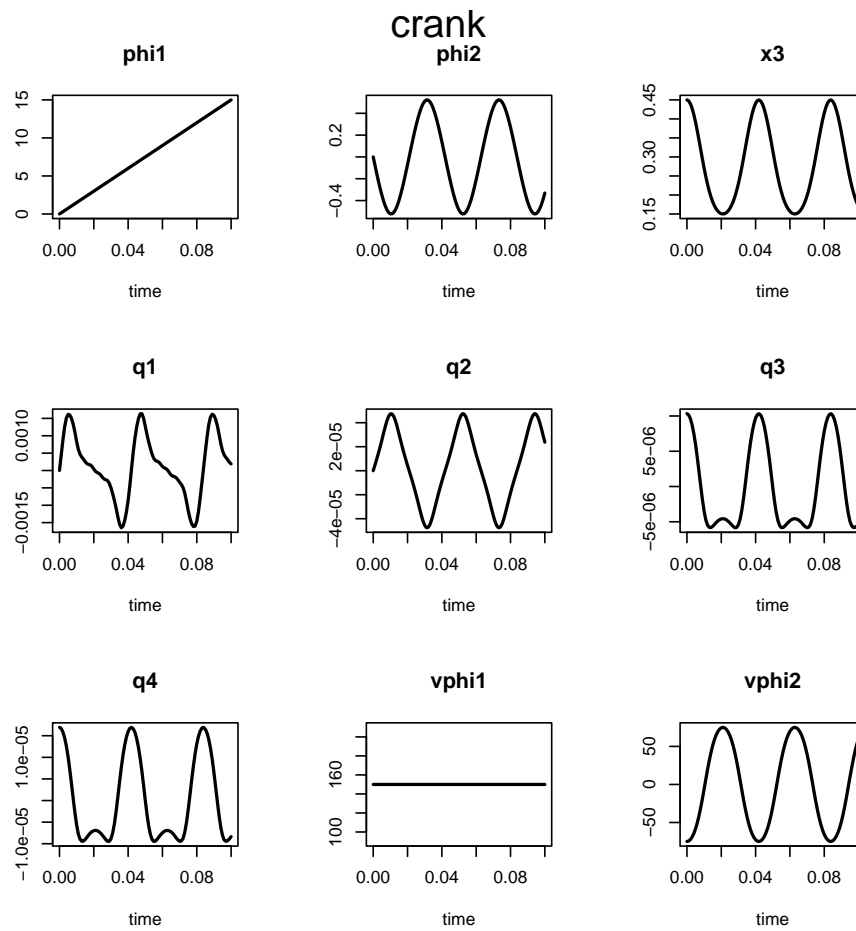


Figure 4: Solution of crank - see text for R-code

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

Slider Crank

Solved with mebdfi

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

Mixed error significant digits (first seven components):

8.456184

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

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

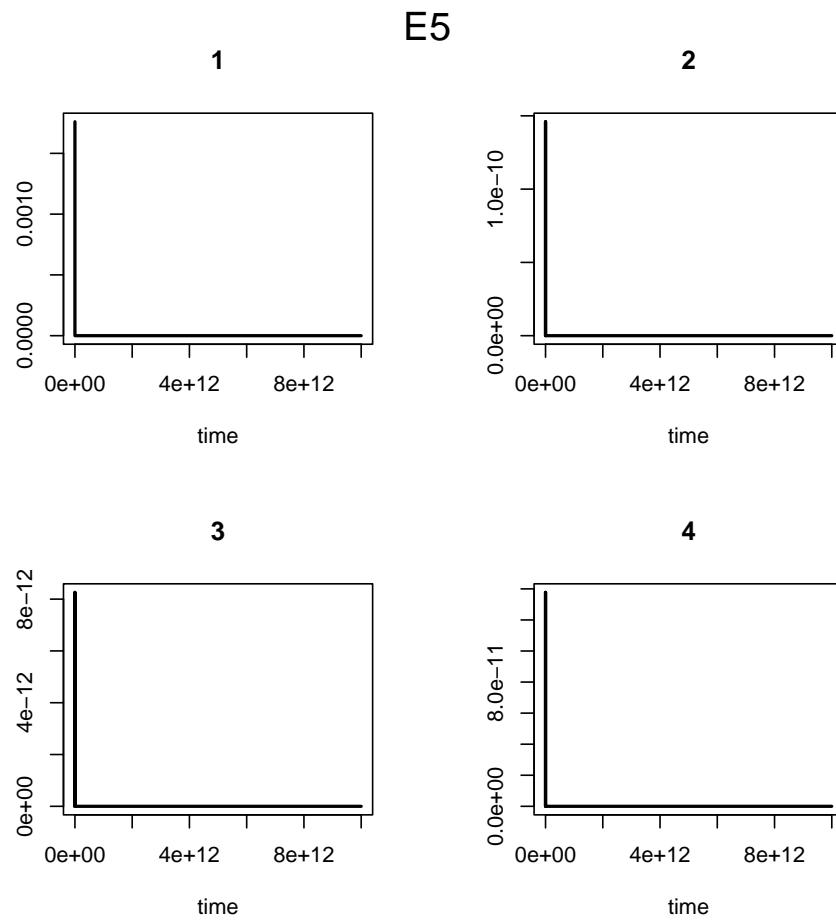


Figure 5: Solution of E5 - see text for R-code

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

```
Problem E5 stiff-detest
Solved with lsoda
Using rtol = 1e-06, atol=1.11e-24
Mixed error significant digits:
-0.332505
```

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

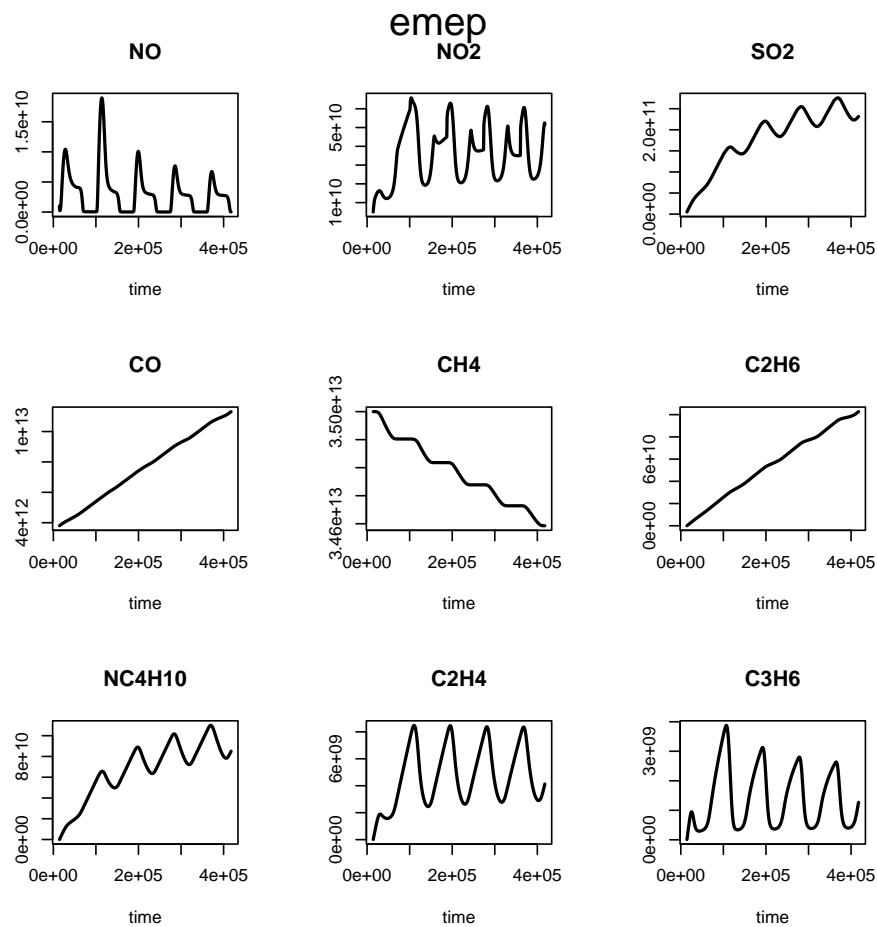


Figure 6: Solution of emep - see text for R-code

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

```
EMEP problem
```

```
Solved with bimd
```

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

```
Mixed error significant digits:
```

```
3.57872
```

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

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

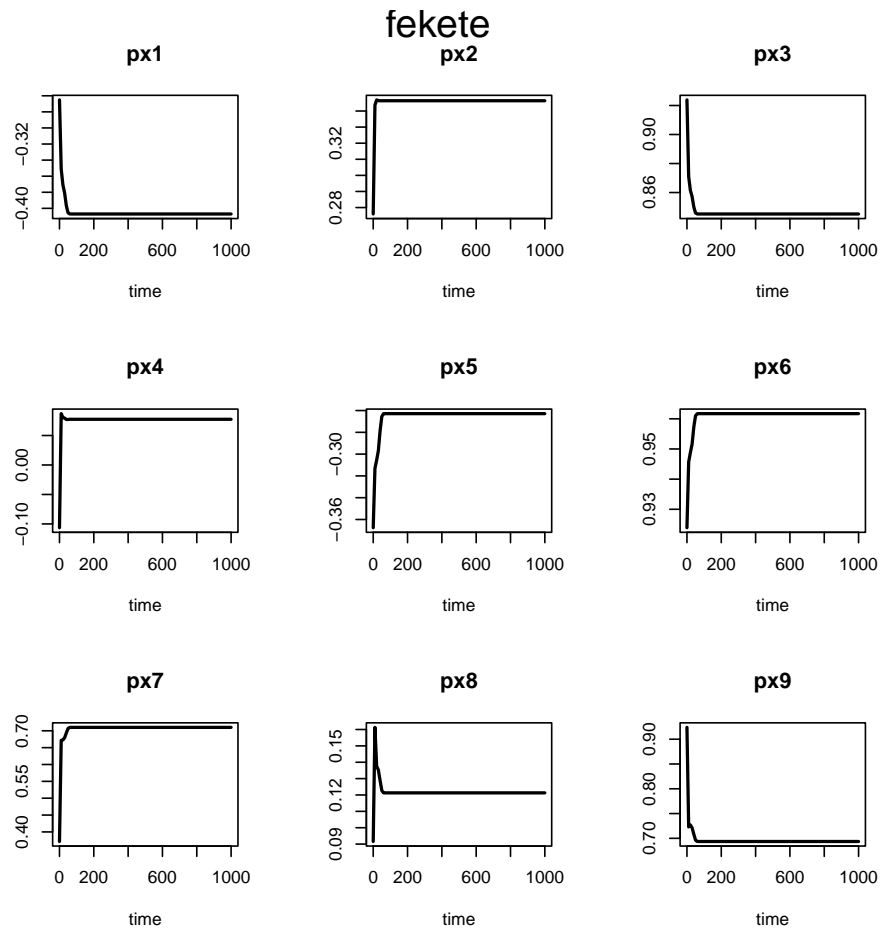


Figure 7: Solution of fekete - see text for R-code

```
> 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)
```

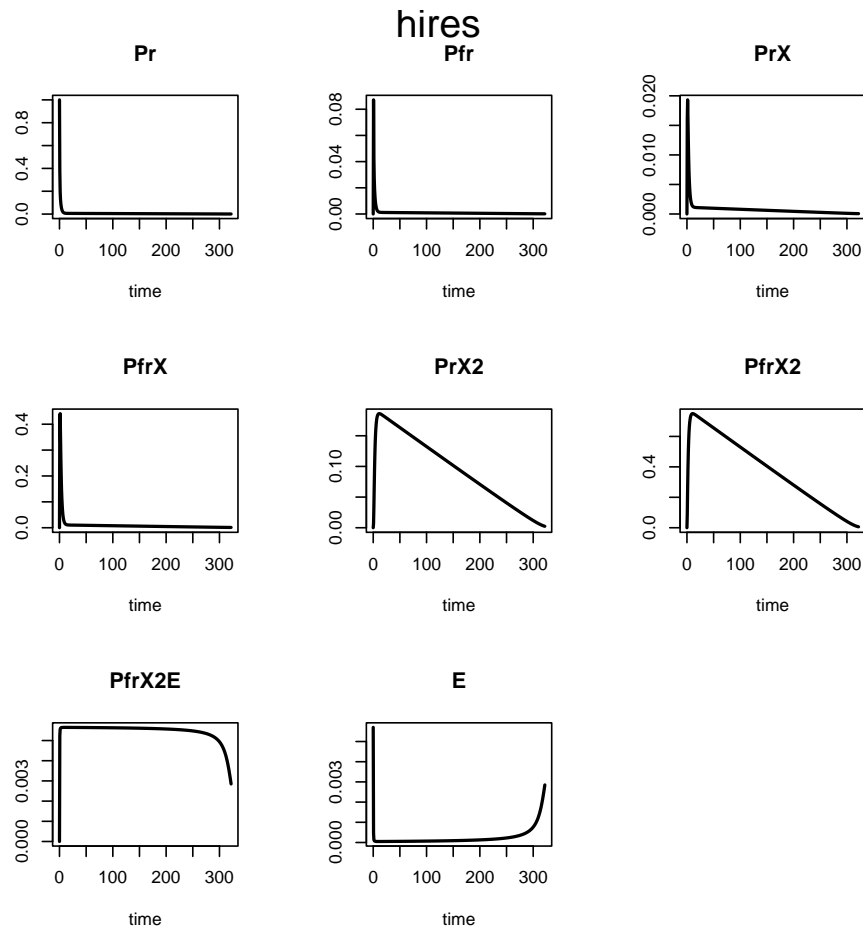



Figure 8: Solution of hires - see text for R-code

```
> 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)
```

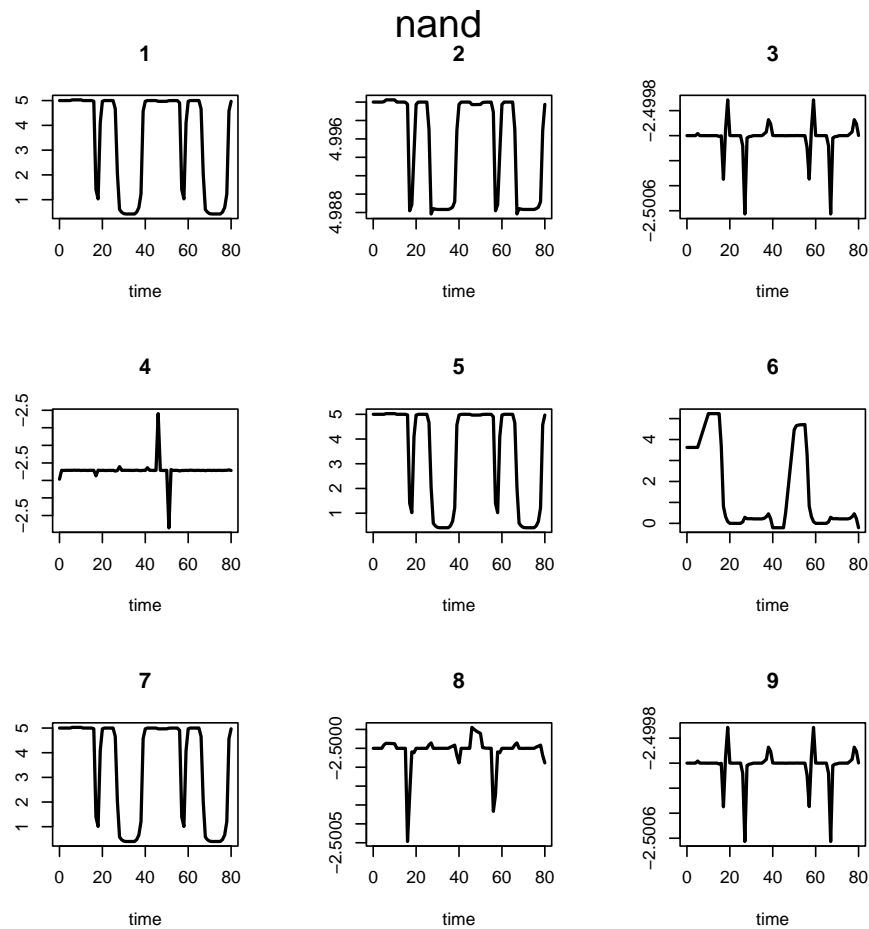


Figure 9: Solution of nand - see text for R-code

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:

5.556794

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

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

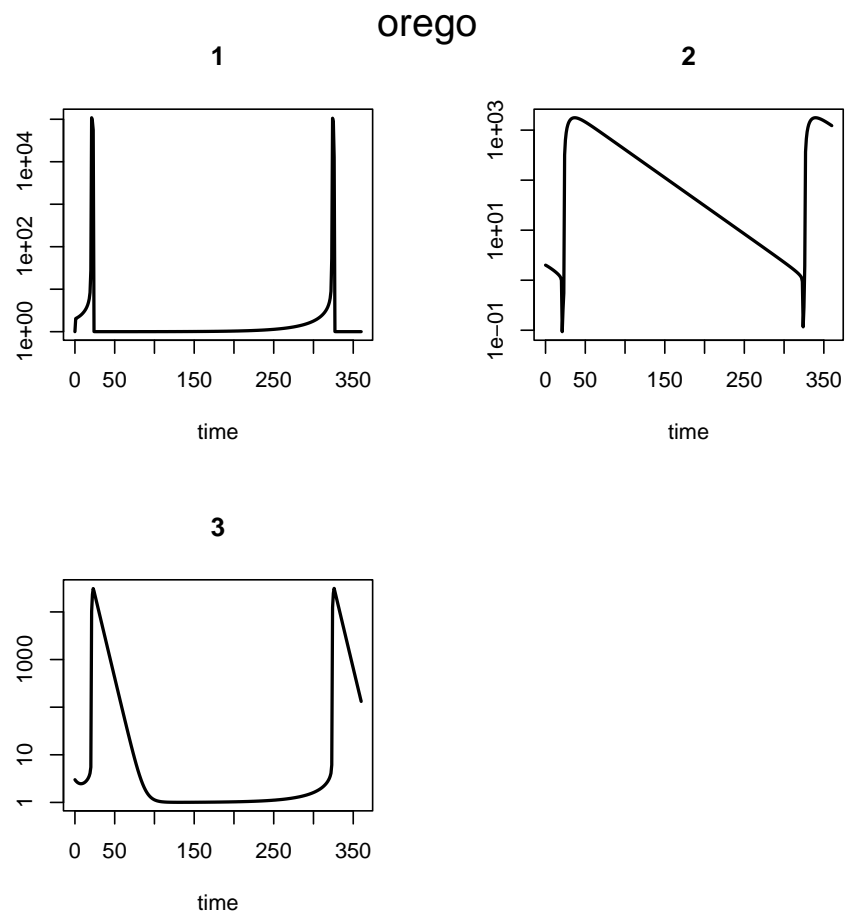


Figure 10: Solution of orego - see text for R-code

```
> 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)
```

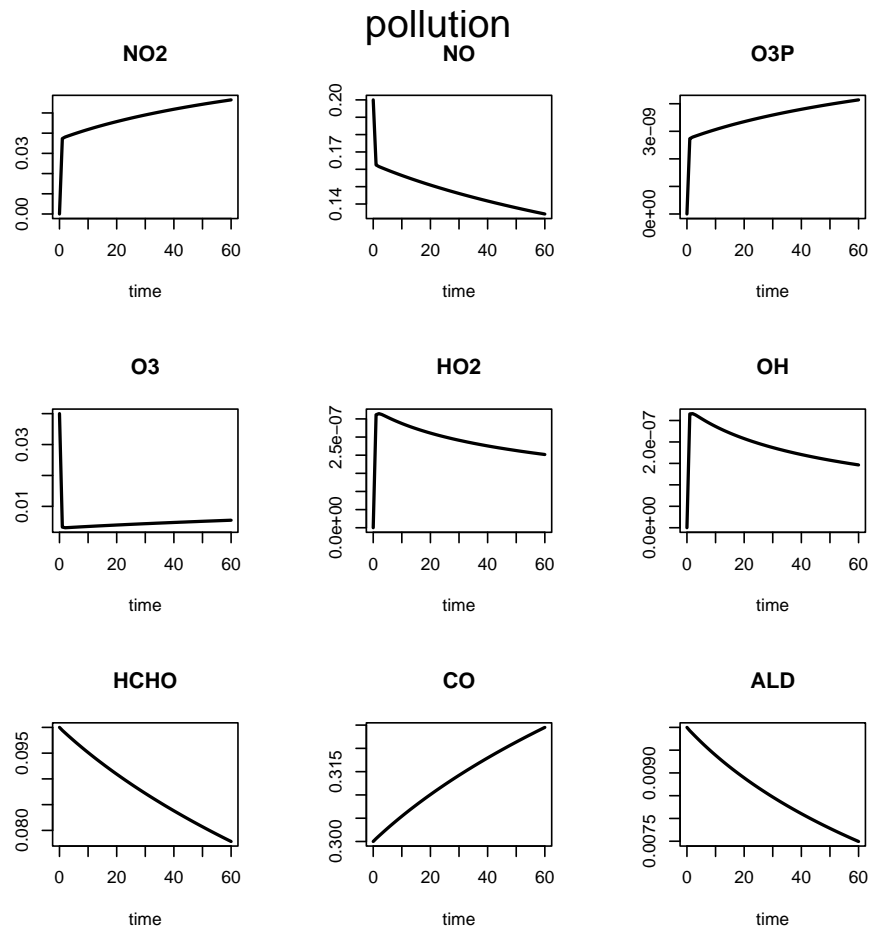


Figure 11: Solution of pollution - see text for R-code

```
> 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)
```

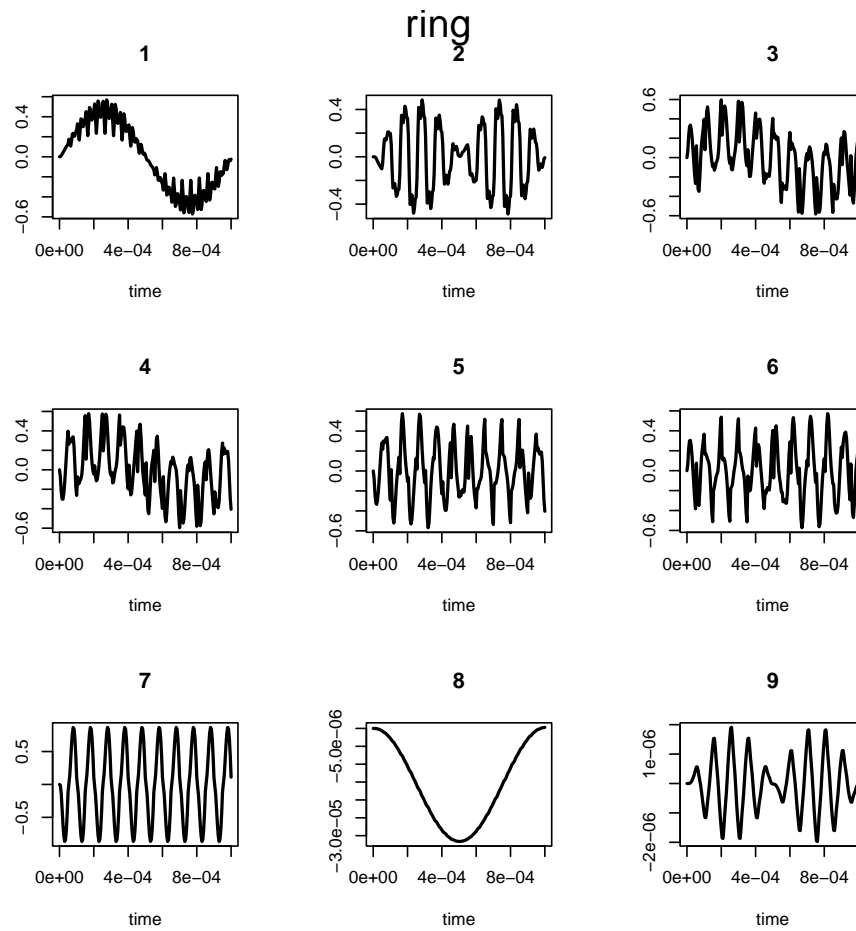


Figure 12: Solution of ring - see text for R-code

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

Ring Modulator

Solved with mebdfi

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

Mixed error significant digits:

6.308331

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

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

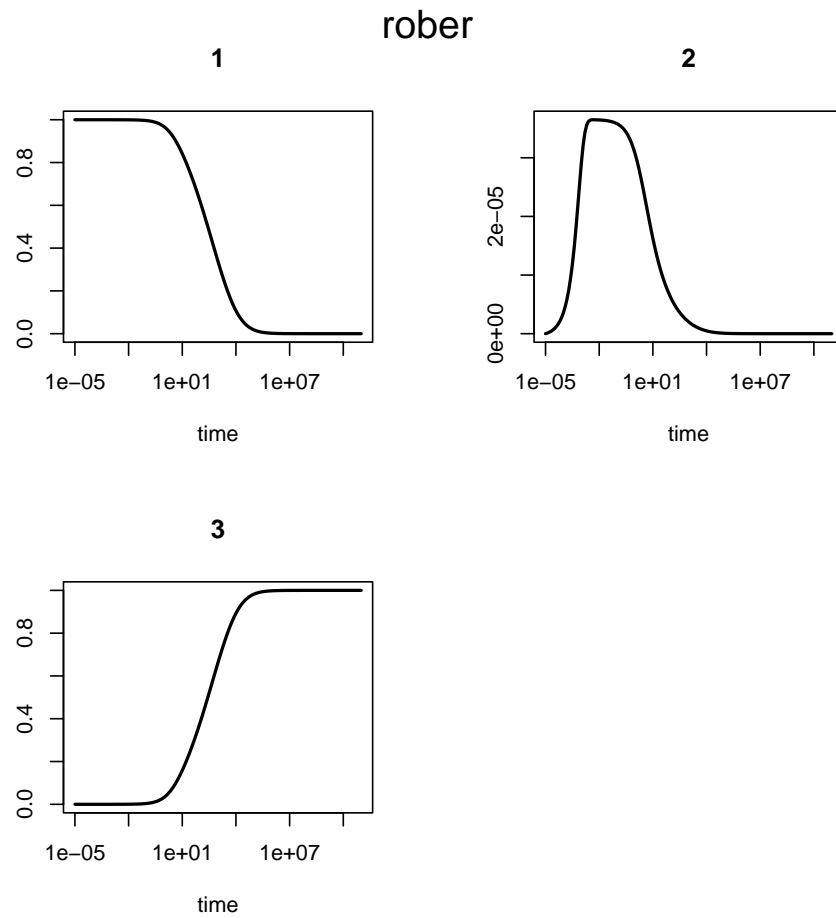


Figure 13: Solution of rober - see text for R-code

```
> 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)
```

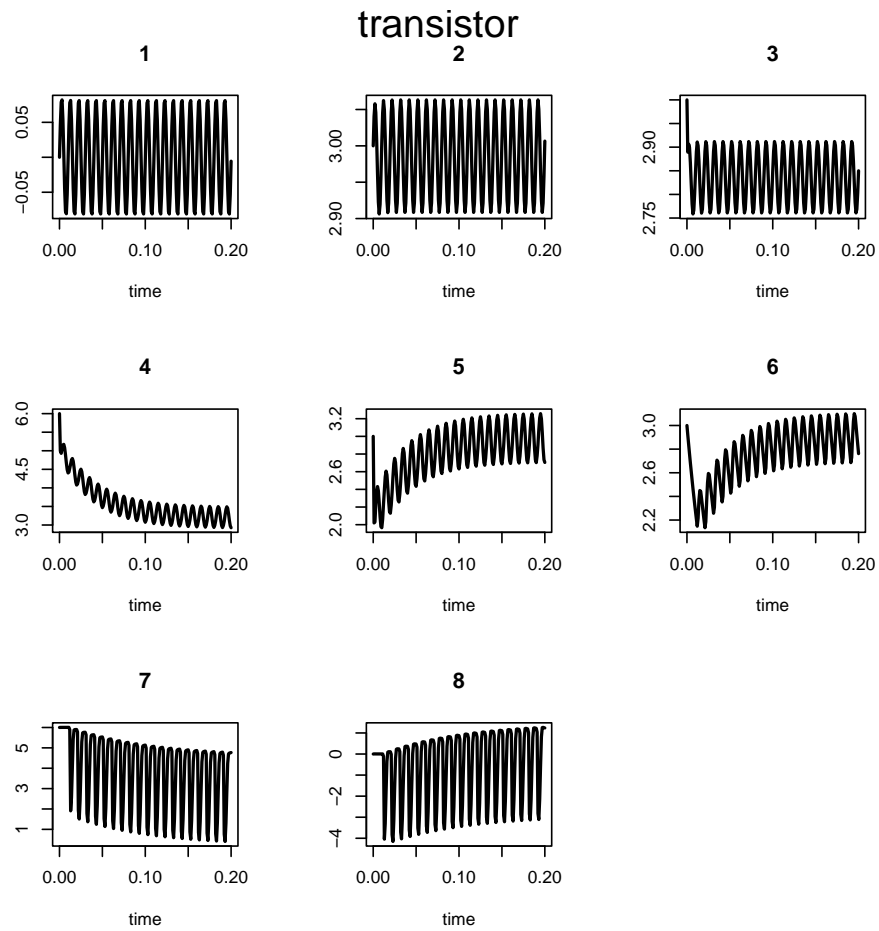


Figure 14: Solution of transistor - see text for R-code

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

```
Transistor Amplifier
Solved with mebdfi
Using rtol = 1e-06, atol=1e-06
Mixed error significant digits:
6.219765
```

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

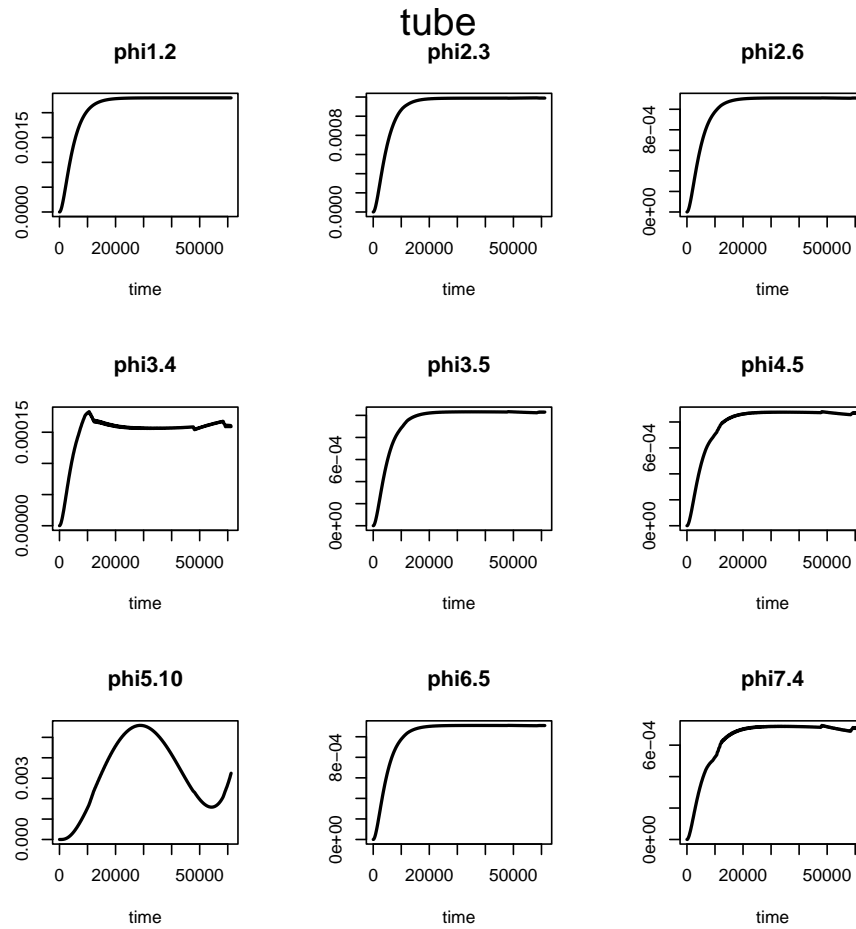


Figure 15: Solution of tube - see text for R-code

```
> 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)
```

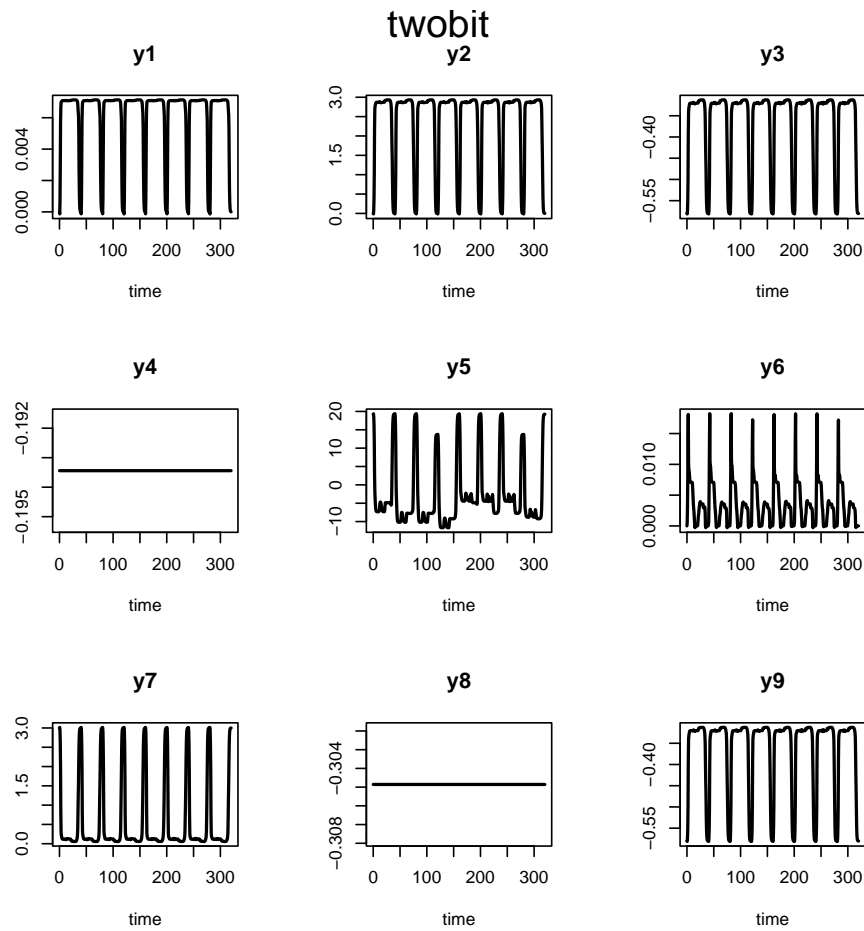



Figure 16: Solution of twobit - see text for R-code

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

Two bit adding unit

Solved with radau5

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

Mixed error significant digits:

4.924473

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

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

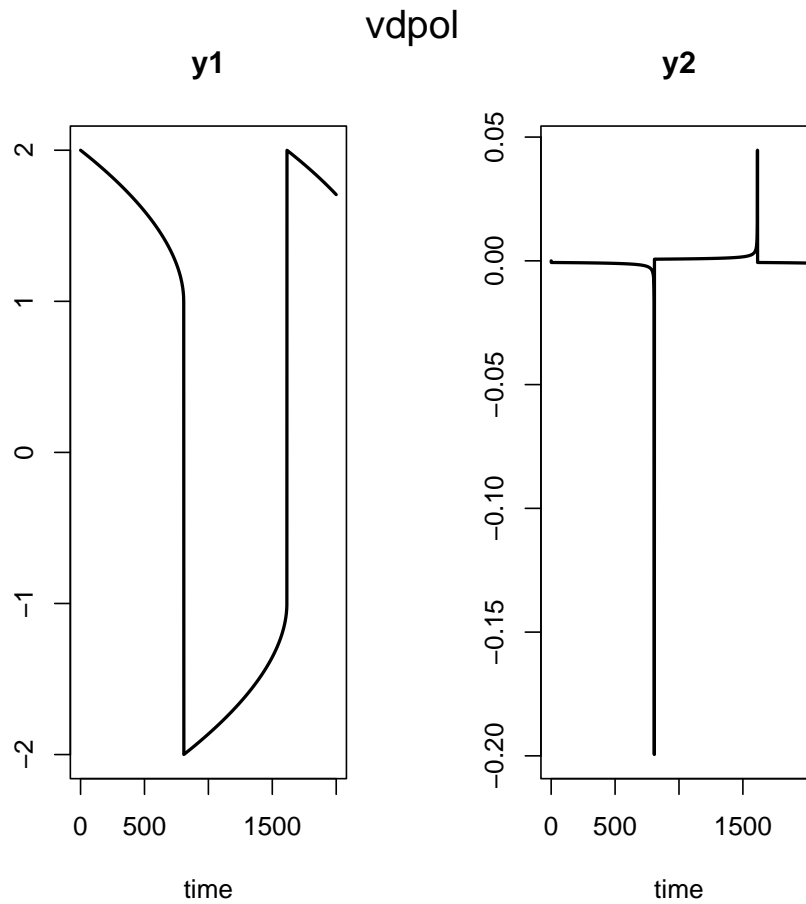


Figure 17: Solution of vdpol - see text for R-code

```
> 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)
```

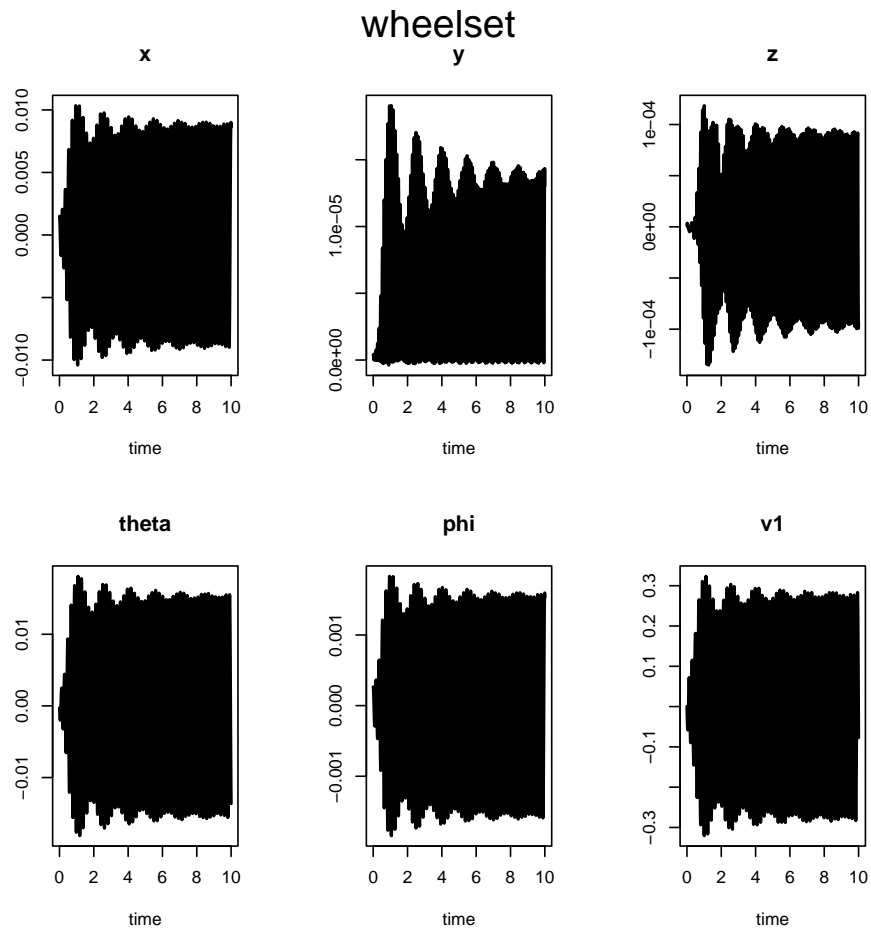


Figure 18: Solution of wheelset an implicit differential equation model - index 2, dimension 17 - see text for R-code

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

```
Wheelset
```

```
Solved with mebdfi
```

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

```
Mixed error significant digits:
```

```
3.636501
```

```
> 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>.

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