INSTRUCTIONS TO USE DAISY

Version 1.9 (Updated 2014/06/25)

(Differential Algebra for Identifiability of SYstems)

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with version CSL of REDUCE for Windows 2011-04-14 (9.1 MB)

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Brief Description

DAISY [1] is written in REDUCE and can be made available on any system running Windows or comparable operating systems.

DAISY checks structural identifiability of models described by first order differential equations as

$$\dot{x}(t) = f(x(t), u(t), p)$$
$$y(t) = h(x(t), u(t), p)$$

where x is the n-dimension state variable vector; u the m-dimension input vector of differentiable functions; y the r-dimension output; p the constant unknown parameter vector; f, g, h are vectors of polynomial or rational functions in x (note that some non polynomial functions, as exponential or logarithmic functions, after suitable manipulations, can be rendered in polynomial form).

The dependence on p may be rational.

Equality constraints between parameters are allowed.

Algebraic equations of the form:

$$g(x(t), u(t), p) = 0$$

where *g* is a vector of polynomial (or rational) functions, may be also present.

Under specific assumptions, whenever all or some of the initial conditions are given, the identifiability test can include these known initial conditions [2].

DAISY automatically provides also a check of an additional structural property of the model: the algebraic observability [2].

Some journal articles providing a more extensive description of DAISY are provided in the directory Papers Ident of DAISY.ZIP.

To download REDUCE and DAISY:

Extract from the directory DAISY2014 of DAISY.ZIP the two files reduce.exe and reduce.img (the Reduce License is provided in the file Reduce-License.pdf)

It is convenient to create on C:\ (or wherever the user prefers) two directories:
1. one directory with the above two files, for example called DAISY,
2. one directory to store the input files for the models to be studied[1], for example called MOD.

The input file of DAISY should be created following the template described in the file InputFile.pdf.

Call this file e.g. EXAMPLE.TXT and save it in C:\MOD\.

To run DAISY:

1. Open REDUCE and write the following instruction in order to activate all the procedures:

   LOAD DAISY$

   Please note that this instruction is necessary only the first time that REDUCE is called.

2. Once the input file is saved in C:\MOD\, e.g. the EXAMPLE.TXT file described above, write the following instruction:

   IN "C:\MOD\EXAMPLE.TXT"$

   Results will be only displayed on the screen but not saved to file.

   Please note: In order to save results in a file, e.g. EXAMPLERES.TXT, the user must write OUT "C:\MOD\ EXAMPLERES.TXT"$ before to call the input file with the instruction "IN". The complete instruction is:
   OUT "C:\MOD\EXAMPLERES.TXT"$

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[1] Now in the directory, available to the user, there are some examples of input files together with their corresponding output files.

IN "C:\MOD\EXAMPLE.TXT"$

Once the calculations are finished, close the output file with the following instruction:

SHUT "C:\MOD\EXAMPLERES.TXT"$

3. Please note that the user should repeat the check of the same model, with a different seed, to check that the random initial estimates of p were generic. In order to do this, it is sufficient to recall the same model with the instruction "IN" or simply by typing the ↑ bottom.

4. Whether the user want to continue with another model, proceed as follows:

> If instructions such as LET have been used on the parameters, e.g.
> **LET p12=p21, km=p21$,** use instructions such as CLEAR, e.g.:
>
> **CLEAR p12, km$**
>
> repeat point 2 above, by replacing the names EXAMPLE.TXT and EXAMPLERES.TXT with the names of the new input and output files, respectively.

5. Lastly, in order to exit REDUCE, write the instruction

BYE$
or
QUIT$

Please note:

1. If initial conditions have been inserted and the model is globally identifiable with no initial conditions, the program gives the following message:

        INITIAL CONDITION(S) NOT NECESSARY

2. For computational complexity it can happen that the program does not finish.

REFERENCES

1. Bellu, G, Saccomani, M.P., Audoly, S., D'Angiò, L. DAISY: a new software tool to test global identifiability of biological and physiological systems. Computer Methods and Programs in Biomedicine, 88(1):52-61, 2007. DOI:10.1016/j.cmpb.2007.07.002

2. Saccomani, M.P., Audoly S., D'Angiò L. Parameter identifiability of nonlinear systems: the role of initial conditions. Automatica, 39(4):619-632, 2003. DOI:10.1016/S0005-1098(02)00302-3.