ARGESIM Comparison C5 'Two State Model' Numerically Solved by MATRIXx

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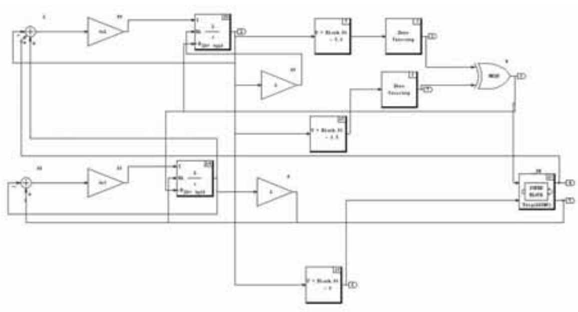
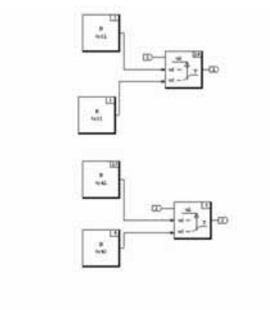
Simulator. MATRIXx is a so-called CNS – a Computer Numeric System, as MATLAB is (and as CONTRL_C has been). The structure is very similar to MATLAB: it consists of an environment called XMath, and a graphical simulation tool called SystemBuild.

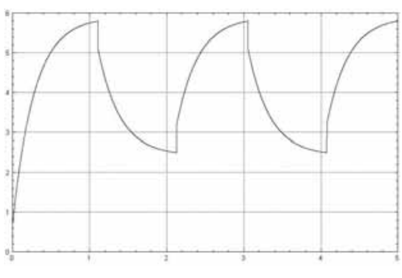
Model. SystemBuild was used to model this comparison. The graphical description is shown in the following two figures:





The detection of all state events is modelled by the use of two 'Zero-Crossing'-blocks. Their outputs were combined through an 'XOR'-operator which triggers the subsystem on the left side. There 'DataPathSwitch'-blocks are used to pass through the correct value of c2 and c4 (depending on y1).

Task a - Simulation of the System:



Using the 'extend' – keyword in the simulation call performs extended time calculations at every state event, giving sufficiently accurate results..

```
t = [0:0.001:5]' ; u = ones(t)
[t1, y1]=sim ("c5new",t,u,
        {ialg=9,extend,reltol = 1e-14});
```

The following table shows the results for every discontinuity and final value of y1.

Solver	DASSL	VKM
t0	0.000000	0.000000
t1	1.108306	1.108306
t2	2.129686	2.129686
t3	3.054153	3.054153
t4	4.075532	4.075532
t5	5.000000	5.000000
y1(5)	5.613722246632118	5.604149377519642

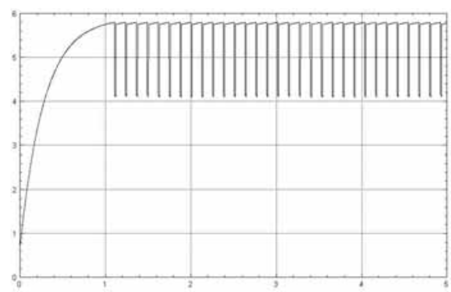
The results for these two solvers are nearly identical but VKM (variable-step Kutta-Merson method) is much slower then DASSL (suitable for stiff systems).

Task b - Time instants of discontinuities. This task consists of setting the relative accuracy to 1e-6, 1E-10 and 1E-14. Results are shown below:

solver	ODASSL	ODASSL	ODASSL
rel.	1E-06	1E-10	1E-14
t0	0.000000	0.000000	0.000000
t1	1.108307	1.108306	1.108306
t2	2.129682	2.129686	2.129686
t3	3.054150	3.054153	3.054153
t4	4.075530	4.075532	4.075532
t5	4.999994	5.000000	4.999999
y1(5)	5.800000	5.800000	5.8000000

Task c - Frequent events. The change of the parameters results in "oscillations" of the state y1. The number of discontinuities found is 62 or 63. This results in oscillation behaviour with 63 discontinuities (shown in the table and plot below).

solver	DASSL
t0	0.00000
t1	1.108306
…	
t62	4.936463
y1(5)	5.753453



C5 Classification : Fully Numerical Approach

Simulator : MATRIXx, Rel. 2004