RTDS Technologies

RTDS NEWS

RTDS Technologies at the SBSE conference in Natal, Brazil

WHAT'S NEW: JULY 2016

GE Grid Solutions develops new protection algorithms in MATLAB-Simulink and tests them in real time

RTDS Simulator featured in the UCAlug Interoperability Demonstration Booth at CIGRE Paris

Upcoming Training Courses

We are currently accepting registrations for the following courses. Please contact **christine@rtds.com** for more details.

INTRODUCTORY RTDS® SIMULATOR TRAINING

September 26-30, 2016
Winnipeg, Canada

ADVANCED TRAINING: GTNETx2 APPLICATIONS

October 3-7, 2016
Winnipeg, Canada

Upcoming Events

CIGRE Session 2016
Paris, France
August 22-26, 2016

IFAC Workshop on Control of Transmission and Distribution Smart Grids—CTDSG'16
Prague, Czech Republic
October 11-13, 2016

CIGRE Canada Conference
Vancouver, Canada
October 17-19, 2016

Don't miss our European UGM in September 2016!
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GUEST ARTICLE

Testing MATLAB-Simulink protection algorithms in real time via Simulink to RSCAD conversion tool

Anthony Perks and Ling Xiang, GE Grid Solutions

GE Grid Solutions is a leading manufacturer of protection and control equipment with a world-wide customer base. The Grid Solutions site in Stafford UK had RTDS laboratory since 1997 and its primary purpose is to test protective relays and systems for validation of products under development or for customer approvals. Since 2011 the laboratory has been accredited to IEC17025. Traditionally new product development has been split between software (for example, protection algorithms) and hardware. For the Stafford site, the preferred algorithm development tool is Simulink, which is a modelling tool underlying Matlab software. In the past the algorithms could only be tested in real time on the target hardware. In order to test the algorithms in real time before hardware is available, it was suggested to RTDS technologies that they provide an interface between Matlab Simulink models and RSCAD. The RTDS technology approach is to make use of the C code generator in Matlab Simulink to generate code in a form suitable for RSCAD C BUILDER component. The performance of the new algorithms can be compared with existing test results of existing products. The additional benefit is that the converted model could be imported as a component into existing power system protection RTDS test cases. The general process is to convert Simulink model into C code by code generation in Simulink first, then to import the C code into RSCAD and convert it to a component through C builder in RSCAD. An illustration of the conversion process is shown in Figure 1.

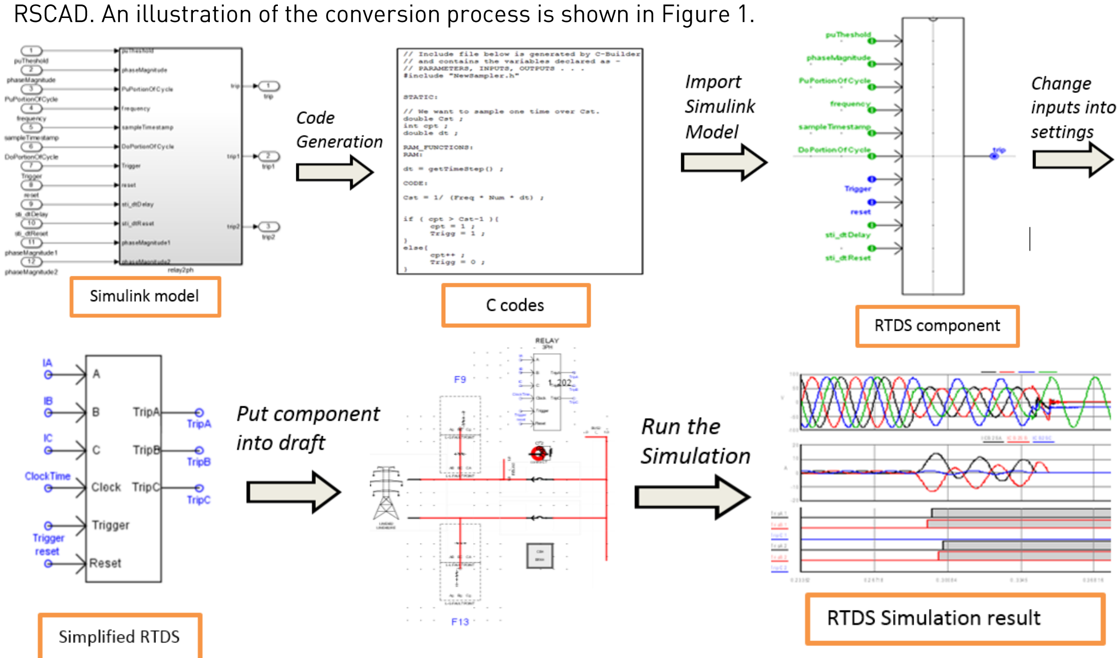

Figure 1. The conversion process

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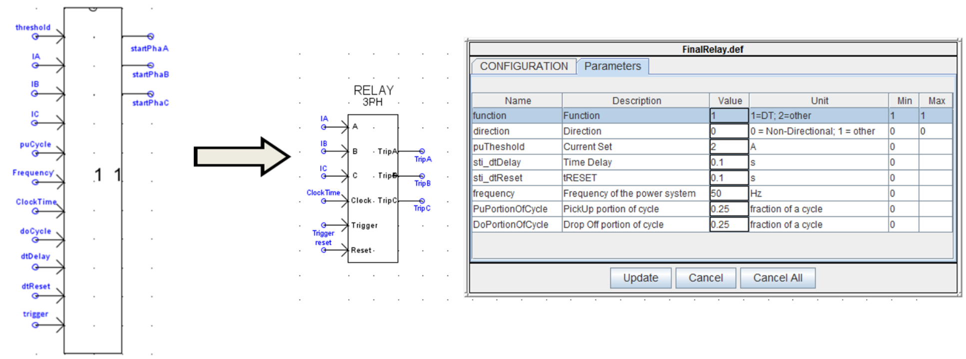
The converted component will initially have the same inputs and outputs with the Simulink model. The RTDS technology provides the facilities where model inputs can be replaced by settings in the component parameter dialog, through which a less number of inputs and a more understandable interface can be achieved. A procedure has to be followed to convert the inputs into settings. This procedure is reported below:

Step 1: New parameters have to be created under "Parameters" tab in CBuilder, at the same time the inputs have to be deleted.

Step 2: The C Code has to be changed. In the C Code, previous names (the ones of the inputs) have to be changed by the new ones (the ones of the parameters).

Step 3: Under "C file association" tab in CBuilder, move items and select the component definition file and change head file.



Name	Description	Value	Unit	Min	Max
function	Function	1	1=DT; 2=other	1	1
direction	Direction	0	0 = Non-Directional; 1 = other	0	0
puTheshold	Current Set	2	A	0	
sti_dtDelay	Time Delay	0.1	s	0	
sti_dtReset	tRESET	0.1	s	0	
frequency	Frequency of the power system	50	Hz	0	
PuPortionOfCycle	PickUp portion of cycle	0.25	fraction of a cycle	0	
DoPortionOfCycle	Drop Off portion of cycle	0.25	fraction of a cycle	0	

Figure 2. Final shape of the component

A Simulink model of overcurrent relay was used as a test case for the conversion process. The Simulink model is converted and a set of conventional CT requirements tests were performed. The results were compared with the CT requirement results of a physical protective relay. The given Simulink model is shown in Figure 3.

Following the steps above, the Simulink model can be converted to a RTDS component as in Figure 4. Following the steps above to replace some inputs with settings in dialog, RTDS component in Figure 4 is changed into component in Figure 5. The CT requirement testing system in the RTDS environment is shown in Figure 6.

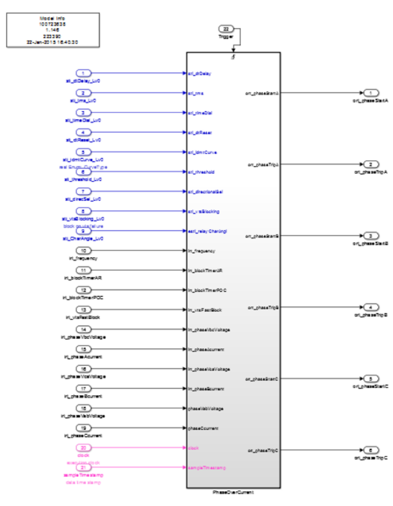


Figure 3. Simulink model

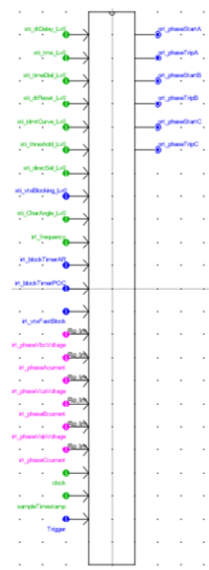


Figure 4. Converted Simulink model

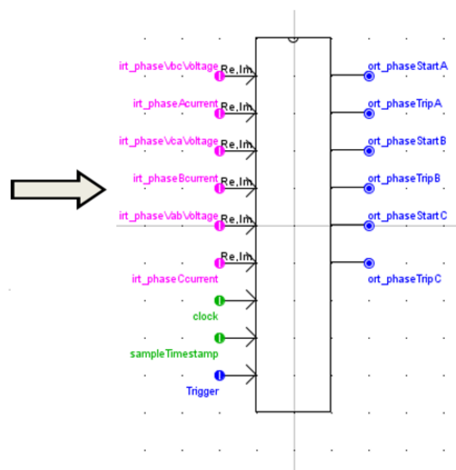


Figure 5. Converted Simulink model

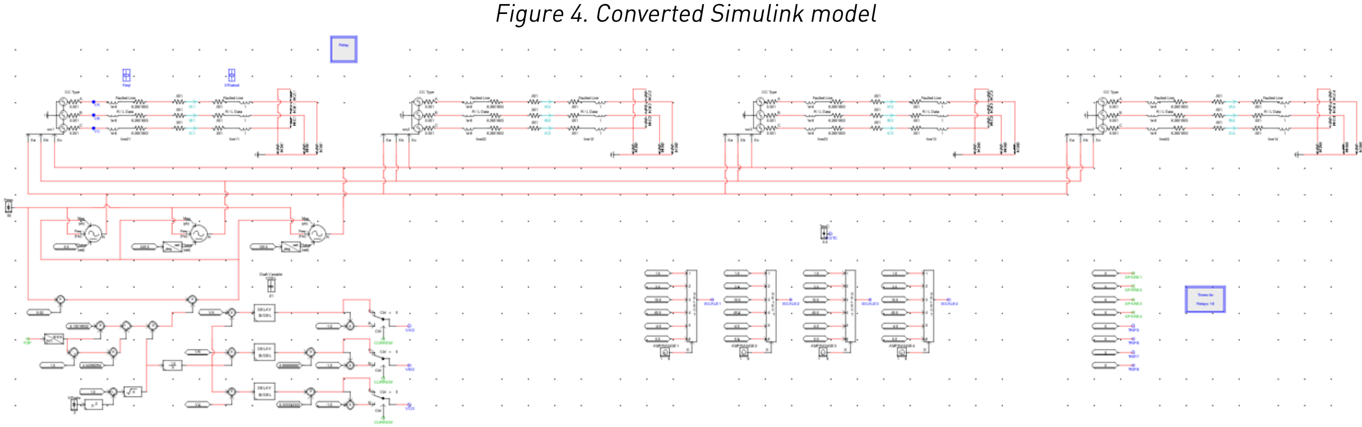


Figure 6. CT requirement testing system in RTDS environment

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RTDS Technologies

Visit us online at www.rtds.com!

Don't miss our new videos!

Power Hardware in the Loop with the RTDS Simulator

RTDS Technologies is excited to announce a new video featuring power hardware in the loop (PHIL) simulation using the RTDS Simulator. In the video, we show the development of an interface between the RTDS Simulator and an inverter connected to a solar PV panel.

Click here to watch the PHIL video

Closed-loop Protection System Testing with the RTDS Simulator

This comprehensive video provides background on RTDS Technologies, explains how the RTDS Simulator works, and demonstrates a closed-loop test of a protective relay using the Simulator. Don't miss it for an essential overview of the world standard in real time power system simulation!

Click here to watch the protection video

Figure 7 displays the final converted model in the RTDS testing system.

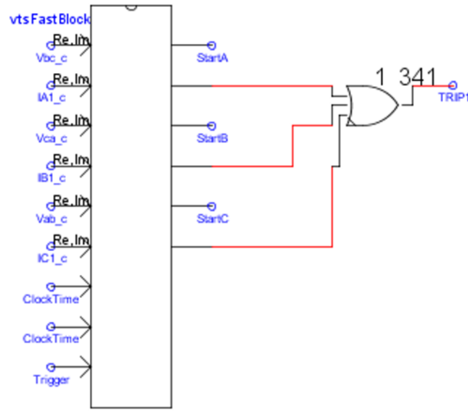

Figure 7. Converted component in testing system

The same tests were performed on a real overcurrent relay as a comparison. The results are shown in Figure 8. It displays tripping time in seconds for internal phase to ground fault for a fixed CT knee-point voltage and CT secondary lead burden varying from 0.1Ω to 13Ω. Tripping time in green is fast operation and yellow reflects normal operation. From the results we could see that the results on the real relay and scientific model follow a similar pattern. Taking account of the noise which hasn't been included in the scientific model testing, the results are really similar. The preliminary conclusion that the conversion of this scientific model is successful can be made.

Even though there are issues requiring attentions during the conversion process, the study and experiments show that if the scientific model is converted successfully, the converted component operates as expected. This means, in the future, real-time testing on scientific model can be done before the hardware is available. The integration will benefit research on new algorithm because testing on a scientific relay model is more economical and algorithm can be modified and retested again easily before manufacturing. It also means that time can be saved in the product development.

	Ftyp	XR	In	If	Shot	0.1	0.5	1	2	3	5	6	7	9	11	13
Real relay	PGF	120	1	20	1	0.1133	0.1195	0.1184	0.1148	0.1175	0.1190	0.1200	0.1177	0.1667	0.1625	0.1747
	PGF	120	1	20	2	0.1145	0.1192	0.1183	0.1145	0.1184	0.1175	0.1196	0.1166	0.1652	0.1624	0.1738
	PGF	120	1	20	3	0.1147	0.1192	0.1183	0.1148	0.1183	0.1184	0.1199	0.1267	0.1655	0.1634	0.1745
	PGF	120	1	20	4	0.1135	0.1198	0.1191	0.1164	0.1190	0.1288	0.1204	0.1163	0.1658	0.1638	0.1751
	PGF	120	1	20	5	0.1147	0.1195	0.1184	0.1155	0.1187	0.1188	0.1204	0.1156	0.1665	0.1633	0.1737
	PGF	120	1	20	6	0.1139	0.1189	0.1174	0.1157	0.1177	0.1176	0.1203	0.1170	0.1656	0.1641	0.1745
scientific model	PGF	120	1	20	1	0.1095	0.1095	0.1095	0.1095	0.1095	0.1095	0.1095	0.1095	0.1496	0.1595	0.1696
	PGF	120	1	20	2	0.1095	0.1095	0.1095	0.1095	0.1095	0.1095	0.1095	0.1095	0.1496	0.1595	0.1696
	PGF	120	1	20	3	0.1095	0.1095	0.1095	0.1095	0.1095	0.1095	0.1095	0.1095	0.1496	0.1595	0.1696
	PGF	120	1	20	4	0.1095	0.1095	0.1095	0.1095	0.1095	0.1095	0.1095	0.1095	0.1496	0.1595	0.1696
	PGF	120	1	20	5	0.1095	0.1095	0.1095	0.1095	0.1095	0.1095	0.1095	0.1095	0.1496	0.1595	0.1696
	PGF	120	1	20	6	0.1095	0.1095	0.1095	0.1095	0.1095	0.1095	0.1095	0.1095	0.1496	0.1595	0.1696

	Ftyp	XR	In	If	Shot	0.1	0.5	1	2	3	5	6	7	9	11	13
Real relay	PGF	120	1	40	1	0.1172	0.1144	0.1097	0.1139	0.1119	0.1146	0.1187	0.1190	0.1518	0.1568	0.1512
	PGF	120	1	40	2	0.1125	0.1100	0.1167	0.1097	0.1175	0.1173	0.1191	0.1178	0.1169	0.1559	0.1576
	PGF	120	1	40	3	0.1180	0.1093	0.1111	0.1165	0.1140	0.1104	0.1105	0.1169	0.1133	0.1549	0.1591
	PGF	120	1	40	4	0.1177	0.1177	0.1203	0.1146	0.1166	0.1137	0.1123	0.1170	0.1105	0.1531	0.1552
	PGF	120	1	40	5	0.1172	0.1169	0.1165	0.1130	0.1104	0.1192	0.1198	0.1109	0.1273	0.1544	0.1536
	PGF	120	1	40	6	0.1171	0.1130	0.1172	0.1130	0.1130	0.1138	0.1148	0.1190	0.1162	0.1560	0.1514
scientific model	PGF	120	1	40	1	0.1095	0.1095	0.1095	0.1095	0.1095	0.1095	0.1095	0.1095	0.1095	0.1496	0.1496
	PGF	120	1	40	2	0.1095	0.1095	0.1095	0.1095	0.1095	0.1095	0.1095	0.1095	0.1295	0.1496	0.1496
	PGF	120	1	40	3	0.1095	0.1095	0.1095	0.1095	0.1095	0.1095	0.1095	0.1095	0.1295	0.1496	0.1496
	PGF	120	1	40	4	0.1095	0.1095	0.1095	0.1095	0.1095	0.1095	0.1095	0.1095	0.1095	0.1496	0.1496
	PGF	120	1	40	5	0.1095	0.1095	0.1095	0.1095	0.1095	0.1095	0.1095	0.1095	0.1095	0.1496	0.1496
	PGF	120	1	40	6	0.1095	0.1095	0.1095	0.1095	0.1095	0.1095	0.1095	0.1095	0.1095	0.1496	0.1496

Figure 8. Performance comparison between a real relay and a scientific model

cigré 2016 — Join us in Paris!

The RTDS Simulator will be featured in two different demonstration booths at the 2016 CIGRE Session in Paris, France. Visit these booths during the technical exhibition from August 21 to 26!

UCA International Users Group — STAND 229

The IEC 61850 Users Group, an affiliate of UCAIug, will be demonstrating multi-vendor interoperability using simulation, protection, and monitoring equipment from 10 different vendors. The RTDS Simulator's new GTFPGA-based hardware for IEC 61850 Sampled Values streaming will be featured.

RTDS Technologies — STAND 313

Visit RTDS Technologies' simulation specialists for a demonstration of the MMC Support Unit and its growing capabilities for highly detailed and flexible modelling of MMC valves and associated controls.