

BOOLEAN MODULES NEWS 2016



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GRIF BOOLEAN MODULES 2016

SUMMARY (1/2)

- Ordering choices
- News laws:
 - Full periodic test with defined times;
 - Dormant exponential;
 - Undefined.
- Create curves directly in contextual menu
- Law edition table
- Quick creation of events
- Quick event insertion
- Progress bar
- Calculation before test period



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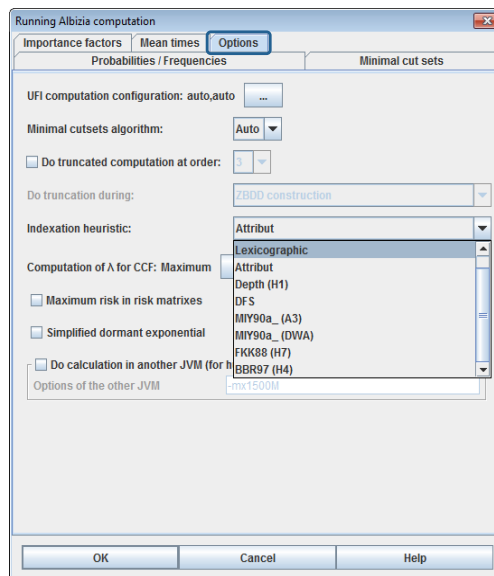
SUMMARY (2/2)

- Display mean times in results
- New results table for minimal cut sets
- Results on watched sub-tree
- Uncertainties on parameters
- Logic solver defined by a fault tree
- Better incorporation of Etree in Bool module
- Switch shortcut and its source
- Search for shortcuts
- Import/Export improvements (Open-PSA/.dag)
- Add a part of a scenario in ETree



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ORDERING CHOICES



Several choices of heuristic to order BDD construction

By default, the algorithm used is FKK88

Note: Attribut can be used only in RESEDA

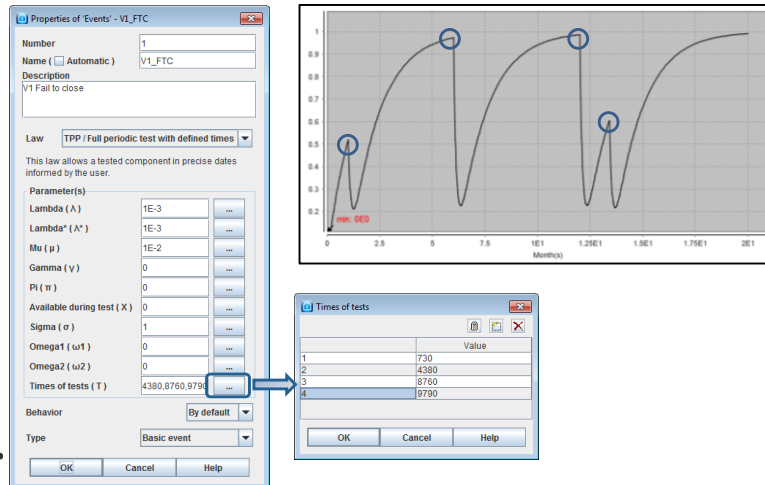


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NEWS LAWS

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- Full periodic test with defined times:



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NEWS LAWS

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- Dormant exponential:

- This law is used to model the dormant events in a more precise way than with a simple dormant law. It has three parameters: the failure rate of the component (supposed constant during the time), the test periodicity and the mission time.

This last parameter is not typed by the user. It corresponds to the last computation time asked by the user.

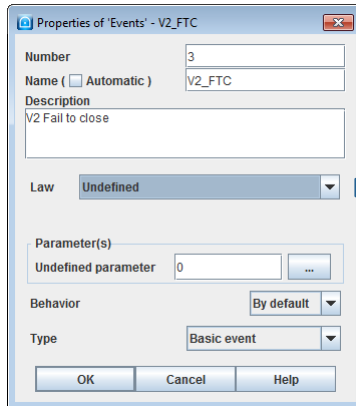
The 'Properties of Events' dialog for 'NH' shows the following configuration:

- Number: 2
- Name: ☐ Automatic (unchecked), NH
- Description: NH Fail
- Law: EXPD / Dormant exponential
- Parameter(s):
 - Lambda (A): 1E-3
 - Tau (T): 1
- Behavior: By default
- Type: Basic event

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NEWS LAWS

● Undefined:



Properties of 'Events' - V2_FTC

Number: 3

Name (☐ Automatic): V2_FTC

Description: V2 Fail to close

Law: Undefined

Parameter(s): Undefined parameter: 0

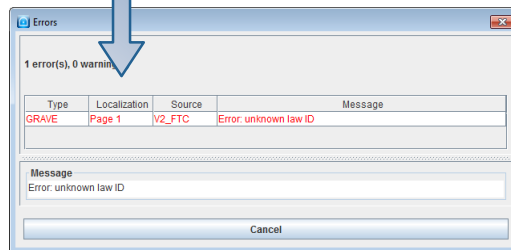
Behavior: By default

Type: Basic event

OK Cancel Help

It is not possible to run calculations with an Undefined law

Very useful when the Undefined law is defined as the default law in the option.



Errors

1 error(s), 0 warning(s)

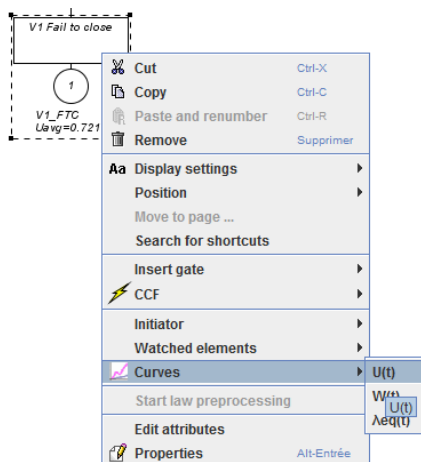
| Type | Localization | Source | Message |
|-------|--------------|--------|-----------------------|
| GRAVE | Page 1 | V2_FTC | Error: unknown law ID |


Message: Error: unknown law ID

Cancel

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CREATE CURVES DIRECTLY



Right click on the event/gates/blocs and select  curves in the menu.

The curve is drawn in the input area and updated automatically when results changed.

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LAW EDITION TABLE

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Data and Computations

- Edit Parameters
- Edit Events
- Edit Gates
- Edit CCF
- Edit laws**
- Delete unused data
- Parameters database
- Compute manager
- Invalidate the calculation cache
- Let names and IDs be unique
- Verify
- Preprocessing of Markov graphs (not computed)
- Preprocessing of Markov graphs
- Set-up and start computation
- Re-start computation
- Display last results
- Batch computations
- Start Moca
- Re-start Moca with current settings
- Compute target probability value for sub-tree

All parameters for all elements having laws are described.

Parameters can be changed in this table

With a double click, law can be changed

If the parameter is in the new law, the parameter is kept

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QUICK CREATION OF EVENTS

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Only in module Tree

- If the user has already created all the event in an another GRIF file:

Events

| Number | Name | Law | Results U(last) | Watched |
|--------|---------------|-----|-----------------|---------|
| | Import events | | | |

Import from GRIF file

- Import from .dag file
- Import from CSV
- Import events from a Tree module file
- Import from clipboard

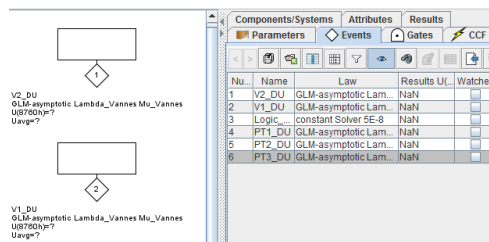
Select Tree module file

Event are created with the same law and name

0

QUICK CREATION OF EVENTS

- Only in module Tree
 - The same methods can be used to import events using a dag file;

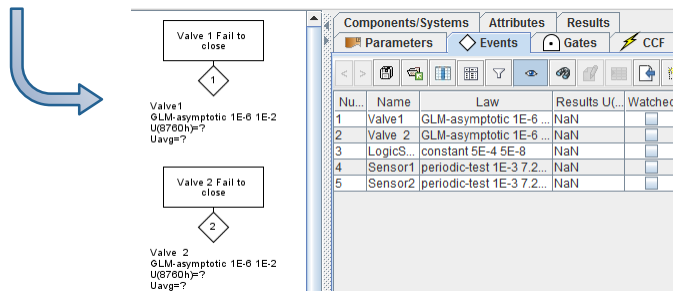


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QUICK CREATION OF EVENTS

- Only in module Tree
 - Or a CSV file.

| | A | B | C | D |
|---|----|-------------|----------------------------|--------------------------|
| 1 | ID | NOM | LOI | DESCRIPTION |
| 2 | 1 | Valve1 | GLM-asymptotic 1E-6 1E-2 | Valve 1 Fail to close |
| 3 | 2 | Valve 2 | GLM-asymptotic 1E-6 1E-2 | Valve 2 Fail to close |
| 4 | 3 | LogicSolver | constant 5E-4 5E-8 | Logic Solver SIL4 |
| 5 | 4 | Sensor1 | periodic-test 1E-3 7.2E1 0 | Sensor 1 Spurious signal |
| 6 | 5 | Sensor2 | periodic-test 1E-3 7.2E1 0 | Sensor 2 Spurious signal |



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QUICK CREATION OF EVENTS

- Only in module Tree
 - Or from clipboard.

| | A | B | C | D |
|---|----|-------------|----------------------------|--------------------------|
| | ID | NOM | LOI | DESCRIPTION |
| 1 | 1 | Valve1 | GLM-asymptotic 1E-6 1E-2 | Valve 1 Fail to close |
| 2 | 2 | Valve 2 | GLM-asymptotic 1E-6 1E-2 | Valve 2 Fail to close |
| 3 | 3 | LogicSolver | constant 5E-4 5E-8 | Logic Solver SIL4 |
| 4 | 4 | Sensor1 | periodic-test 1E-3 7.2E1 0 | Sensor 1 Spurious signal |
| 5 | 5 | Sensor2 | periodic-test 1E-3 7.2E1 0 | Sensor 2 Spurious signal |

Ctrl + C

Valve 1 Fail to close

Valve 1
GLM-asymptotic 1E-6 1E-2
U(6780h)=?
Uavg=?

Valve 2 Fail to close

Valve 2
GLM-asymptotic 1E-6 1E-2
U(6780h)=?
Uavg=?

Components/Systems | Attributes | Results

Parameters | Events | Gates | CCF

Import from GRIF file
Import from .dag file
Import from CSV file
Import from clipboard

| Nu... | Na... | ... | suits U(...) | Watched |
|-------|-----------|---------------------------|--------------|---------|
| 1 | Valve1 | | N | |
| 2 | Valve2 | | N | |
| 3 | LogicS... | constant 5E-4 5E-8 | NaN | |
| 4 | Sensor1 | periodic-test 1E-3 7.2... | NaN | |
| 5 | Sensor2 | periodic-test 1E-3 7.2... | NaN | |

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QUICK EVENT INSERTION

- Quick insertion from table

- If not linked : move the event in the current page.
- If linked : it creates a shortcut in the current page.

Components/Systems | Attributes | Results

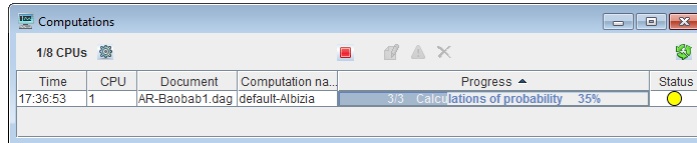
Parameters | Events | Gates

| Number | Name | Law | Results U(last) | Watched |
|--------|------|-------------------|-----------------|---------|
| 1 | Ev1 | exponential 0.001 | NaN | |
| 2 | Ev2 | exponential 0.001 | NaN | |
| 3 | Ev3 | exponential 0.001 | NaN | |
| 4 | Ev4 | exponential 0.001 | NaN | |
| 5 | Ev5 | exponential 0.001 | NaN | |
| 6 | Ev6 | exponential 0.001 | NaN | |
| 7 | Ev7 | exponential 0.001 | NaN | |
| 8 | Ev8 | exponential 0.001 | NaN | |
| 9 | Ev9 | exponential 0.001 | NaN | |
| 10 | Ev10 | exponential 0.001 | NaN | |

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PROGRESS BAR

- Progress bar for calculation



| Time | CPU | Document | Computation na... | Progress | Status |
|----------|-----|----------------|-------------------|-------------------------------------|--------|
| 17:36:53 | 1 | AR-Baobab1.dag | default-Albiza | 3/3 Calculations of probability 35% | |



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CALCULATION BEFORE TEST PERIOD

- To calculate cut sets just before a test point

Target: Top Events(s)

Options:

☒ Number of cut sets

☒ Number of cut sets per order

☒ List of cut sets

☒ Compute probability of cut sets at t= 9760

| Order | Products | Probability (products) |
|-------|------------------|------------------------|
| 2 | NH,NTH | 0 |
| 2 | NTH,V1_FTC | 0 |
| 3 | NH,V2_FTC,V3 | 0 |
| 3 | V1_FTC,V2_FTC,V3 | 0 |

Target: Top Events(s)

Options:

☒ Number of cut sets

☒ Number of cut sets per order

☒ List of cut sets

☒ Compute probability of cut sets at t= 9760

| Order | Products | Probability (products) |
|-------|------------------|------------------------|
| 2 | NH,NTH | 0.9996862554 |
| 2 | NTH,V1_FTC | 0.9873197218 |
| 3 | NH,V2_FTC,V3 | 0.9749531882 |
| 3 | V1_FTC,V2_FTC,V3 | 0.9628926129 |

Without the option

With the option



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CALCULATION BEFORE TEST PERIOD

- To calculate probability just before a test point

Computation times

☐ Automatic list of points between 0 and 17520-

☐ Iterate From 0 To 17520 Step 730-

☒ List of times 4380-8760-13140-17520-

☒ Display discontinuity points Times in Hour(s)

☐ Compute mean value and integral through [0, t]

U(t) A(t) W(t)

Type = U(t), Name = Evacuation insuffisante

| Time | Value |
|----------------------|------------------------|
| 4379.999999999999 | 0.9998431153914135 |
| 4380 | 0.9874746413789256 |
| 4380.000000000001 | 0.9874746413789256 |
| 8759.999999999998 | 0.9999980349640153 |
| 8760 | 0 |
| 8760.000000000002 | 3.5527136788004978E-15 |
| 1.3139999999999998E4 | 0.9998431153914135 |
| 1.314E4 | 0.9874746413789256 |
| 1.3140000000000002E4 | 0.9874746413789256 |
| 1.7519999999999996E4 | 0.9999980349640153 |



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DISPLAY MEAN TIMES IN RESULTS

Running Albizia computation

Importance factors Mean times Options

Probabilities / Frequencies Minimal cut sets

☒ Computation of mean times (MTTF, MUT, ...)

The set of mean times values (MTTF, MUT, MDT, MTBF) and number of failures will be computed. Unavailability, UFI and CFI computation will be activated

OK Cancel Help

Probability Products Mean times Results Info

| System | MTTF | MDT | MUT | MTBF | Number of failures | Total up time (h) | Total down time |
|-------------------------|--------|---------|--------|---------|--------------------|-------------------|-----------------|
| V1 non commandée | 1000 | 7759.18 | 1000 | 8759.18 | 2 | 2000.19 | 1.55E4 |
| Rmk7 | 1000 | 7759.18 | 1000 | 8759.18 | 2 | 2000.19 | 1.55E4 |
| NTH | 1000 | 7759.18 | 1000 | 8759.18 | 2 | 2000.19 | 1.55E4 |
| Evacuation insuffisante | 500 | 8148.18 | 500 | 8648.18 | 2.03 | 1012.93 | 1.65E4 |
| ER | 546.9 | 7690.34 | 860.19 | 8550.53 | 2.05 | 1762.53 | 1.58E4 |
| Rmk8 | 1000 | 7759.18 | 1000 | 8759.18 | 2 | 2000.19 | 1.55E4 |
| V1_FTC | 1000 | 3434.49 | 1000 | 4434.49 | 3.95 | 3950.85 | 1.36E4 |
| Alim | 520.81 | 7807.3 | 744.42 | 8551.72 | 2.05 | 1525.11 | 1.6E4 |
| V2_Ouverte | 500 | 8148.18 | 500 | 8648.18 | 2.03 | 1012.93 | 1.65E4 |
| V3_Ouverte | 500 | 8148.18 | 500 | 8648.18 | 2.03 | 1012.93 | 1.65E4 |
| NH | 1000 | 7759.18 | 1000 | 8759.18 | 2 | 2000.19 | 1.55E4 |
| V1_Ouverte | 500 | 8148.18 | 500 | 8648.18 | 2.03 | 1012.93 | 1.65E4 |
| V3 | 1000 | 3434.49 | 1000 | 4434.49 | 3.95 | 3950.85 | 1.36E4 |
| V2_FTC | 1000 | 3434.49 | 1000 | 4434.49 | 3.95 | 3950.85 | 1.36E4 |



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NEW RESULTS TABLE FOR MINIMAL CUT SETS

- List of products

Limit the display :
 - digital way (reveal the X first ones);
 - dominating products which represent XX % of the probability of all the cut sets.

Products

Failure modes

Products synthesis List of products Products details

Calculation target Common-Attribute-Analysis

Limit the number of products Filter the dominating products 100 %

Sort products by: Order

Order
 Order/alphanumeric
 Order/probability
 Order/probability/alphanumeric
 Probability/order
 Probability/order/alphanumeric

Different sorts can be chosen by the user

| | Products | Probability (products) |
|---|----------|------------------------|
| 2 | A,B | 4.8944E-2 |
| 3 | D,H,I | 4.1051E-3 |
| 3 | | 5.9001E-4 |
| 3 | | 4.1051E-3 |
| 3 | | 2.8562E-2 |
| 3 | | 4.1051E-3 |
| 4 | E,G,H,I | 4.1051E-3 |
| 4 | E,F,H,I | 4.9486E-5 |
| 4 | | 3.4431E-4 |

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NEW RESULTS TABLE FOR MINIMAL CUT SETS

- Products details

Same sort and display than previously

Products

Failure modes

Products synthesis List of products Products details

Calculation target Common-Attribute-Analysis

Limit the number of products Filter the dominating products 100 %

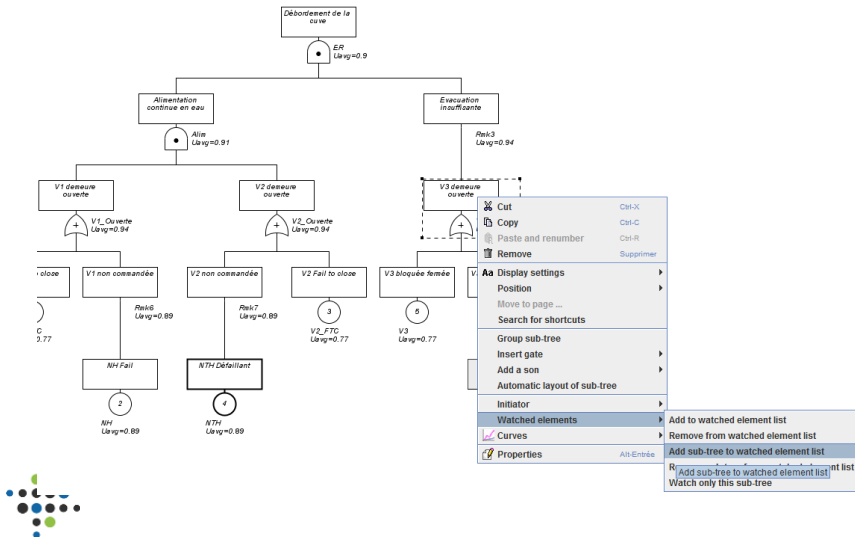
Sort products by: Order

| Order | Products | Probability (products) | Events | Law | Probability (evt) | Lambda | Zone |
|-------|----------|------------------------|--------|----------------------|-------------------|----------|----------------|
| 2 | A,B | 4.8944E-2 | A | exponential Lambda_1 | 0.5836 | Lambda_1 | Zone1 |
| | | | B | exponential Lambda_2 | 8.3873E-2 | Lambda_2 | Zone1 |
| 3 | D,H,I | 4.1051E-3 | D | exponential Lambda_1 | 0.5836 | Lambda_1 | Zone2 |
| | | | H | exponential Lambda_2 | 8.3873E-2 | Lambda_2 | Zone4 |
| | | | I | exponential Lambda_3 | 8.3873E-2 | Lambda_3 | Zone4 |
| 3 | C,H,I | 5.9001E-4 | C | exponential Lambda_2 | 8.3873E-2 | Lambda_2 | Zone2 |
| | | | H | exponential Lambda_2 | 8.3873E-2 | Lambda_2 | Zone4 |
| | | | I | exponential Lambda_3 | 8.3873E-2 | Lambda_3 | Zone4 |
| 3 | C,D,E | 4.1051E-3 | C | exponential Lambda_2 | 8.3873E-2 | Lambda_2 | Zone2 |
| | | | D | exponential Lambda_1 | 0.5836 | Lambda_1 | Zone2 |
| | | | E | exponential Lambda_2 | 8.3873E-2 | Lambda_2 | Zone3 |
| 3 | A,F,G | 2.8562E-2 | A | exponential Lambda_1 | 0.5836 | Lambda_1 | Zone1 |
| | | | F | exponential Lambda_2 | 8.3873E-2 | Lambda_2 | Zone3 |
| | | | G | exponential Lambda_3 | 8.3873E-2 | Lambda_3 | Zone3 |
| 3 | B,H,J | 4.1051E-3 | B | exponential Lambda_2 | 8.3873E-2 | Lambda_2 | Zone1 |
| | | | H | exponential Lambda_2 | 8.3873E-2 | Lambda_2 | Zone4 |
| | | | J | exponential Lambda_1 | 0.5836 | Lambda_1 | Undefined zone |
| 3 | B,F,G | 4.1051E-3 | B | exponential Lambda_2 | 8.3873E-2 | Lambda_2 | Zone1 |

More details: law, attributs, ...

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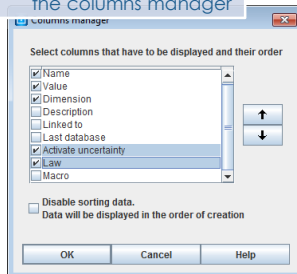
RESULTS ON WATCHED SUB-TREE



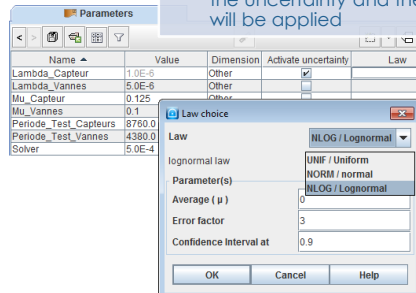
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UNCERTAINTIES ON PARAMETERS

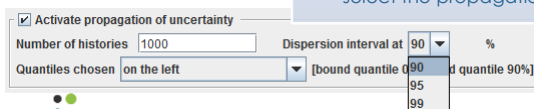
1 Select **Activate uncertainty and law** in the columns manager



2 Select parameters which the uncertainty and the law will be applied



3 In the calculation menu, select the propagation

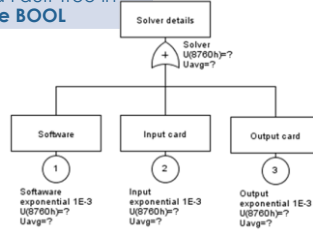


If a same parameter is used in 2 events, **the same uncertainty is considered**

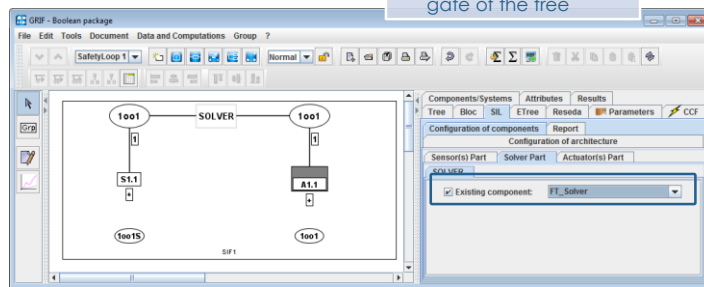
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LOGIC SOLVER DEFINED BY A FAULT TREE

1 Create the Solver using a Fault Tree in module **BOOL**



2 Create SIL loop and link the solver with the gate of the tree



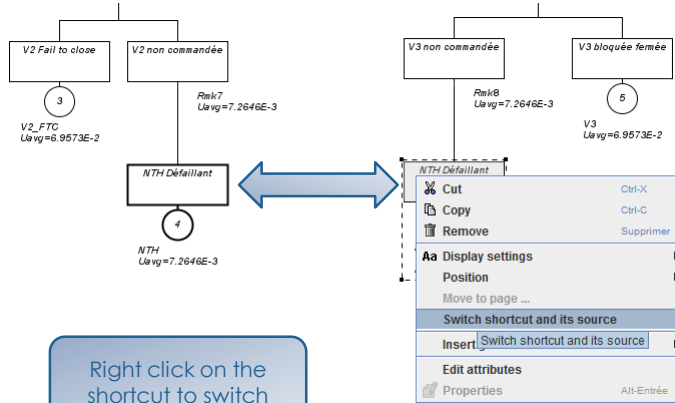
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BETTER INCORPORATION OF ETREE IN BOOL MODULE

- Common cause failures are now taken into account.
- Possibility to use an event as a reference component.
- Possibility to use a reference component to specify a barrier failure in case of specific law in the scenario.

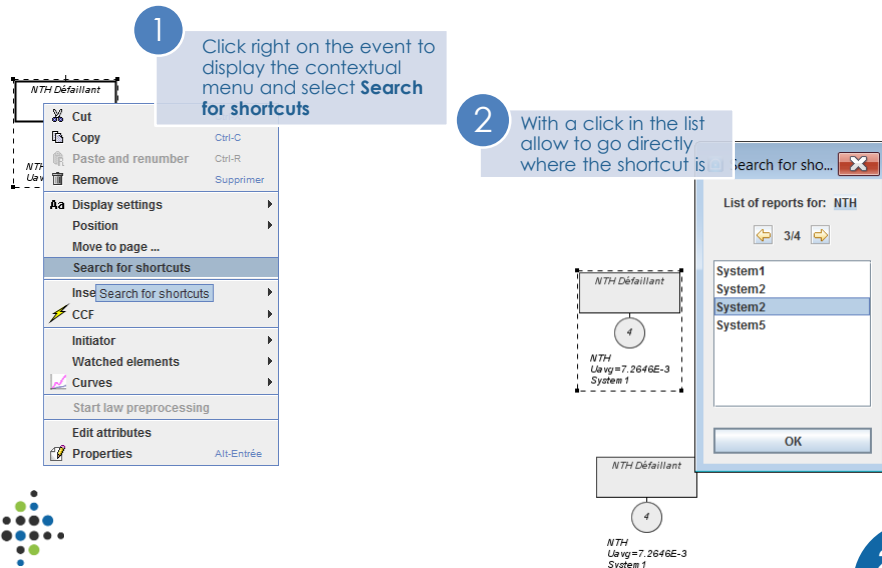
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SWITCH SHORTCUT AND ITS SOURCE



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SEARCH FOR SHORTCUTS



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IMPORT/EXPORT IMPROVEMENTS

- In the open PSA file export, the description field is now exported.
- Import/Export of .dag from Simtree has been improved to handle thing that are not in Simtree (new laws of GRIF, expression in parameters, parameter without dimension ...)



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ADD A PART OF A SCENARIO IN ETREE

- User can observe a part of a scenario (for example before adding a barrier).
- It is now possible to indicate on the link where user wants to have the results.



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THE END



SATODEV

SAFETY TOOLS DEVELOPMENT

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