
Safety and Reliability of Embedded Systems

(Sicherheit und Zuverlässigkeit eingebetteter Systeme)

Fault Tree Analysis Selected Tools

Content

- ☐ Tool Selection
- ☐ Tool Overview
 - Faulttree+
 - Relex
 - BlockSim
 - Galileo
 - UWG3 / ESSaRel
- ☐ Other Tools

Selection Criteria

- ☐ Purpose / Characteristics
 - Drawing Tool
 - Pure FT Analyzer
 - Integrated Analyzer (e.g. Markov, Event Tree Analyzer, FMEA)
- ☐ Expressiveness
 - Supported Types of Gates
 - Support of Repeated Events
- ☐ Analysis Capabilities
 - Fast Algorithm (BDD)
 - Limits (Number of Nodes etc.)
 - Useful and Justified Approximations
 - Minimal Cut-Set Listing
 - Importance Measures

Selection Criteria

- ☐ Presentation of Results
 - Exportable Tables for Numerical Results and MCS Lists
 - Report Generation
 - Graphical Highlighting of Cut Sets etc.
- ☐ Handling / Ergonomics
 - Project Explorer / Structuring / Search Capabilities
 - Positioning and Routing Aids
 - Table Input for Large Amounts of Numerical Data
 - Reuse of Trees and Partial Trees from the Same / Other Projects
- ☐ Side Conditions
 - Licensing / Prices
 - Operating Systems
 - Required Hardware

Tool Selection



Claim a (full) trial version!

Do a small example FTA that you prepared ahead.

Let the final users judge the usability!

Try some test cases (e.g. for repeated event correctness)

Tool Overview

- ☐ Faulttree+
- ☐ Relex
- ☐ BlockSim
- ☐ Galileo
- ☐ UWG3 / ESSaRel

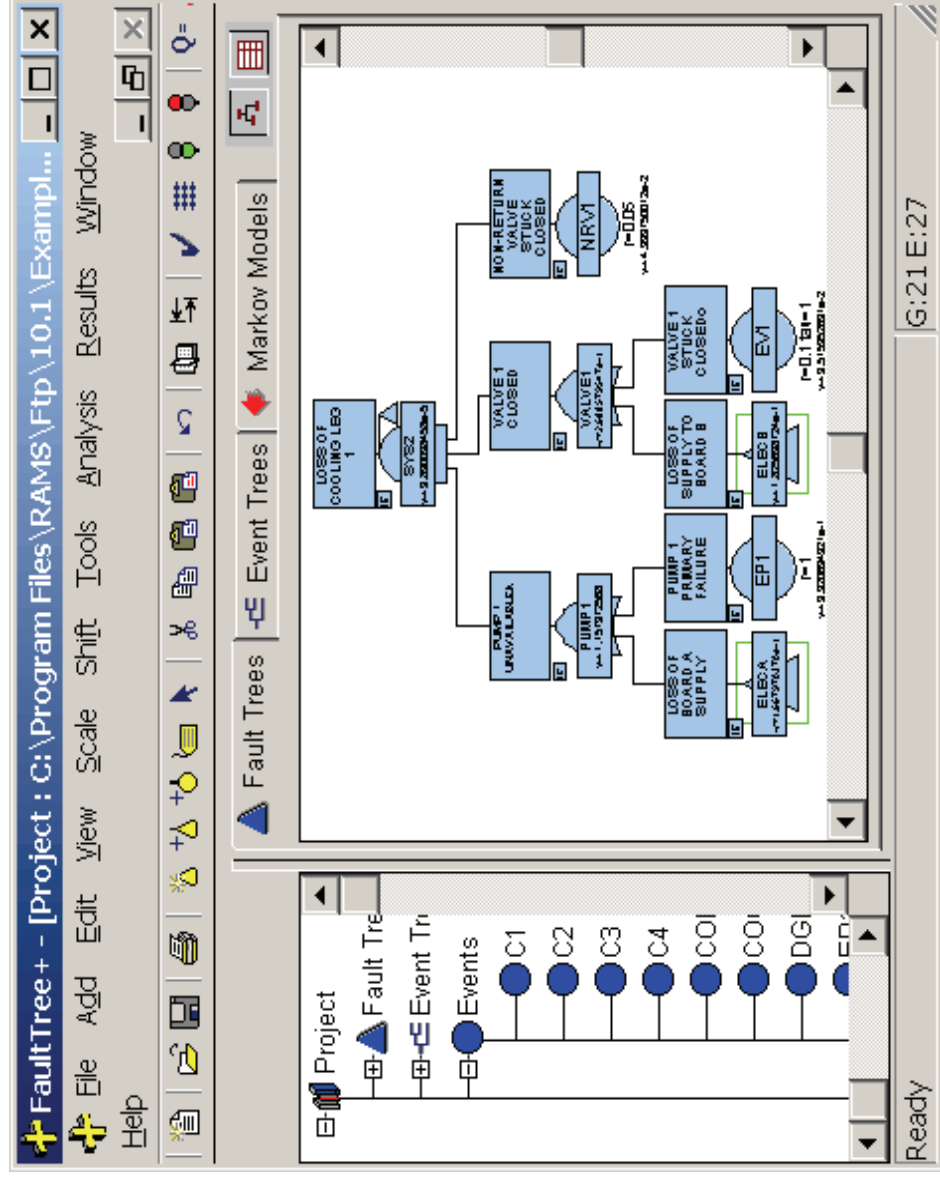
... are shown in more detail as examples.

Others are listed at the end of the presentation



The features lists are based on material supplied by the vendors!

FaultTree+

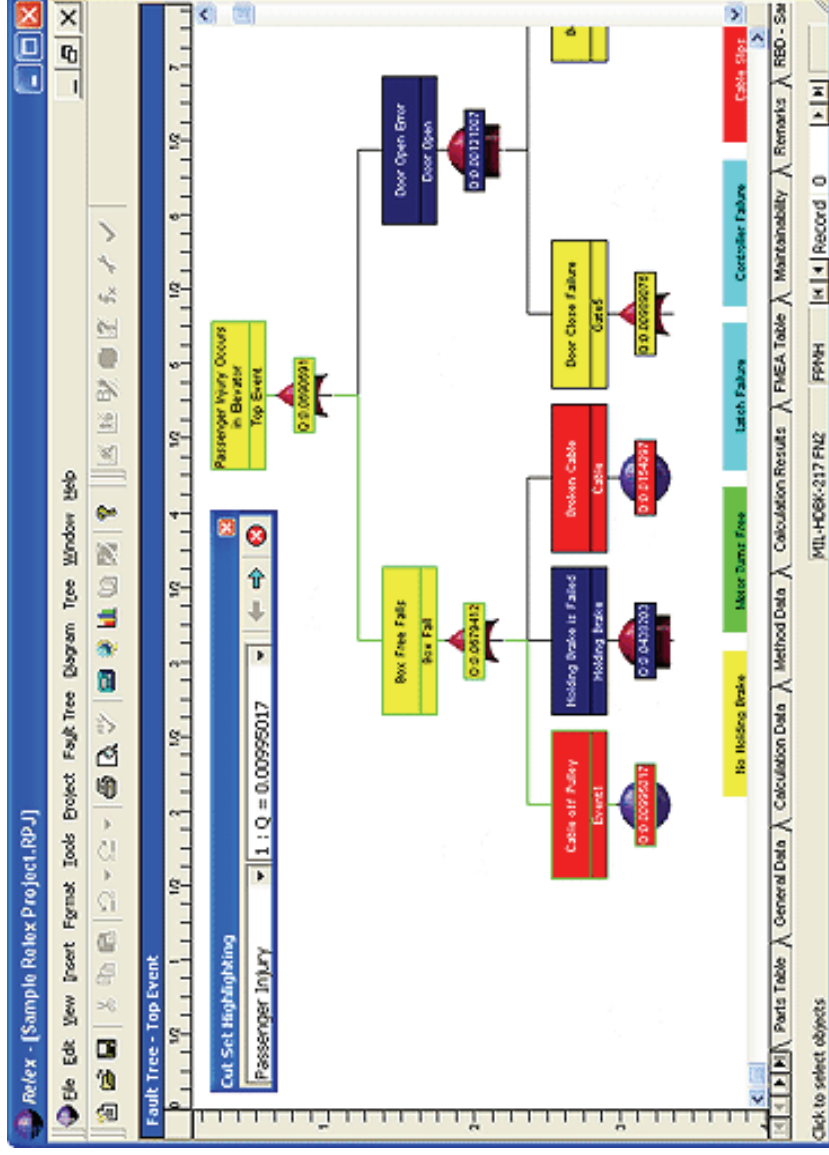


www.isograph-software.com

- ☐ By Isograph Software
- ☐ Popular Tool
- ☐ Tree Construction by Drag-and-Drop
- ☐ Includes Event Tree Analysis and Markov Analysis
- ☐ Different Failure Models
- ☐ Enabler / Initiator Events
- ☐ Common Cause Failures
- ☐ Can be integrated into a workbench

Relex

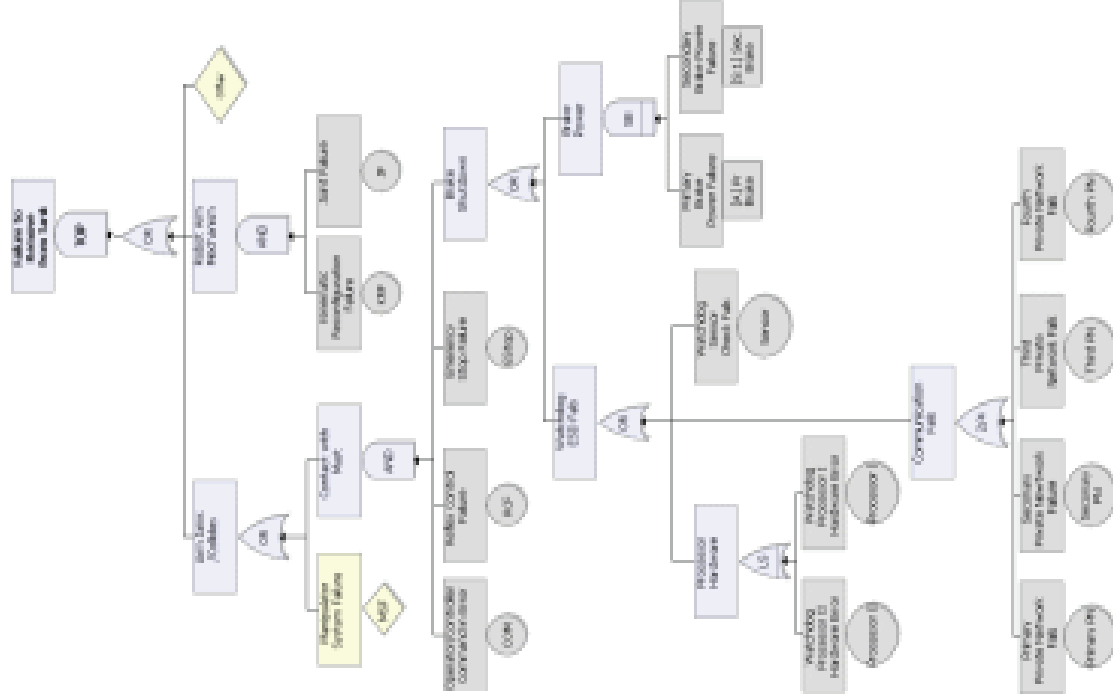
- ☐ By Relex Software
- ☐ Popular Tool
- ☐ Extended Standard Gates Set (e.g. Priority AND, Spare, Sequence Enforcing...)
- ☐ Different Analysis Algorithms
- ☐ Fast MCS Algorithm
- ☐ MCS Highlighting
- ☐ Different Common Cause Failure Models
- ☐ Also for Event Trees



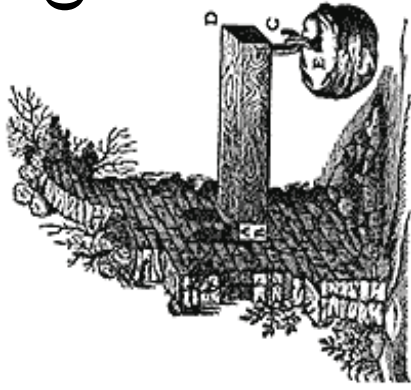
www.relexsoftware.com

BlockSim 6 FTL Edition

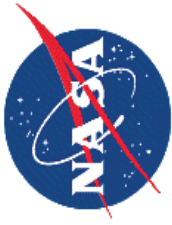
- ☐ By Reliasoft
- ☐ Recent FTA extension for an existing RBD tool
- ☐ Can convert between both models
- ☐ Specific gates (Standby, Load Sharing)



www.reliasoft.com



Galileo/ASSAP Dynamic Fault Tree Analysis Tool



Fault Trees

- ◆ Versatile mathematical reliability models
- ◆ A graphical representation of a logical function
- ◆ Can model both static or dynamic failure criteria
- ◆ Provides a logical framework for:
 - Combinations of component failures leading to system failure
 - Showing relationship between an event (failure) and its causes

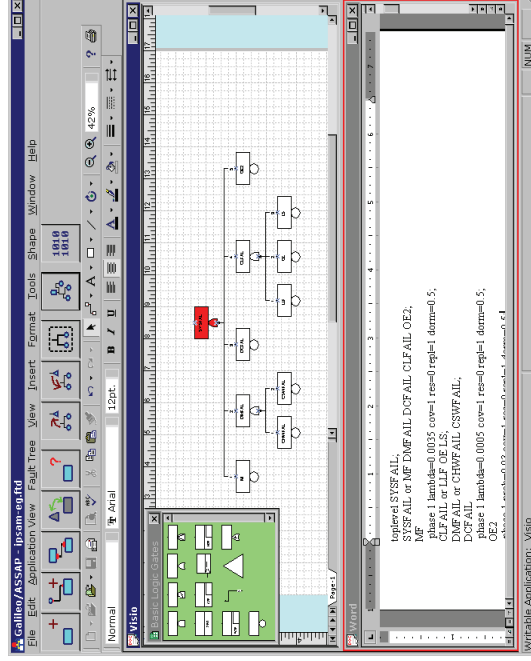
Dynamic Fault Tree Methodology

- ◆ Automatic modularization of fault trees &
- ◆ Independent solution of modules
- ◆ Efficient solution for
 - Static fault tree modules using binary decision diagrams
 - Dynamic fault tree modules using Markov-based techniques
- ◆ Multiple time-to-failure distributions
- ◆ Static and dynamic coverage modeling
- ◆ Sensitivity analysis and uncertainty analysis of basic events
- ◆ Special gates for modeling sequential behavior
 - ➡ Conversion of DFT into a Markov chain for solution
 - ➡ Modularization of complex fault trees
- ◆ Modeling and analysis of phased missions
- ◆ Diagnostic map to help determine cause of failure and optimize repair

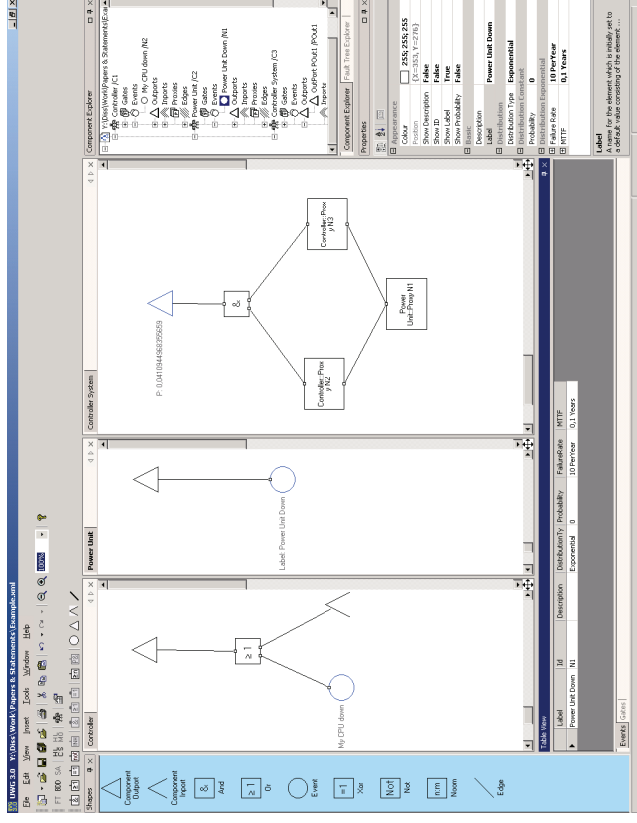
Package Oriented Programming (POP)

- ◆ COTS-based user interface *i.e.* built from widely used components
 - MS Word Editor interface
 - MS Visio Graphical interface
- ◆ Capability to edit fault tree in either textual or graphical representation
- ◆ Automatic rendering from textual view to graphical view, or vice-versa.
- ◆ Fault trees spanning multiple pages
- ◆ Enhanced graphical editing capability

www.cs.virginia.edu/~ftree/



UWG3 / ESSaRel



www.essarel.de

- Windows based GUI Tools under .NET
 - Intuitive Use (Drag&Drop, Project Explorer...)
 - XML File-Format for Collaboration and Reuse
- **UWG3**
 - Supports Component Fault Trees
 - First Version in 2003
 - Successful Evaluation in Industry Projects
- **ESSaRel** (Embedded Systems Safety and Reliability Analyser)
 - Available Spring 2005
 - Integrates State-Event-Fault-Trees, Markov Chains and State Diagrams
 - Analysis by Translation to Petri Nets (DSPNs)

Other Tools

- ☐ CAFTA
- ☐ FaulttrEASE
- ☐ CARA
- ☐ CARE
- ☐ SAPHIRE
- ☐ Item
- ☐ TTREE
- ☐ Risk Spectrum Fault Tree
- ☐ Tree Master
- ☐ Formal-FTA
- ☐ Logan



Good Overview: <http://www.enre.umd.edu/ftap.htm>