EMCoS
Consulting and Software

EMC Expert

Expert System for the Evaluation of EMC Problems

Today's automobiles are complex electronic systems containing hundred and more of microprocessors and a large number of RF transmitters and receivers. Keeping track of all possible interactions that might result in an EMC problem is a formidable task.

EMC Expert is an expert system, which provides tools for working with EMC data. The expert system tool can monitor the cable harness and electronic components while they are being designed. It can identify design features that are likely to present EMC problems and estimate the magnitude of these problems. In this way potential susceptibility, radiation, cross-talk problems can be averted before the first prototypes are built and tested.

EMC Expert detects problems according rules. The rules access several EMC calculation functions that give interesting numbers for assessing potential problems.

The underlying expert system language CLIPS is both very flexible and fast.

Powerful calculations can be done directly on arbitrary data objects using the large amount of provided operations of **EMC Expert**.

Electrical, mechanical or economical calculations on harnesses can be done flexible and fast with the help of a large set of included mathematical functions. The rule definition language CLIPS can be learned easily.

EMCoS EMC Expert is powerful program package for the evaluation and estimation of EMC problems in automotive harness industry.

The extremely user-friendly interface allows the user to view, check, search, filter, group or do further operations on data of extended cable harnesses.

Powerful analysis functions and arbitrary visualizations of selected sub data sets help to handle even extremely large cable harnesses.
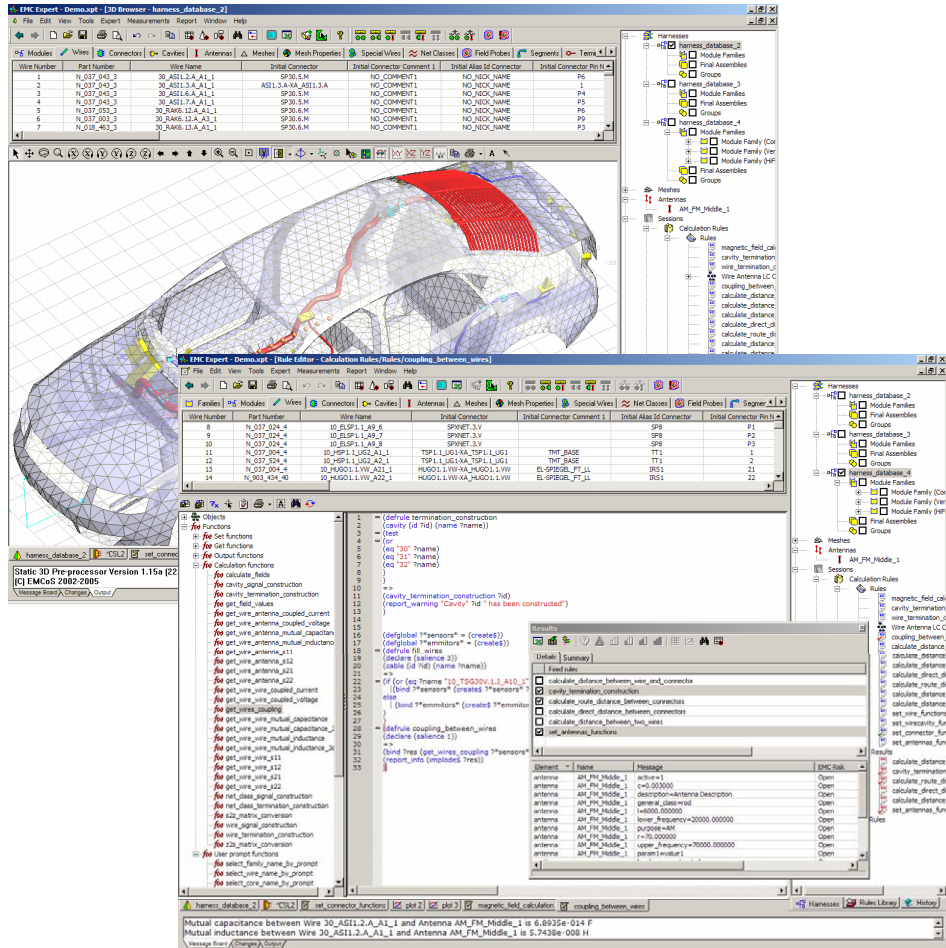
The EMC Expert user interface

EMCoS Overview

The work of EMCoS Ltd. focuses on the generation of special simulation software for electromagnetic field calculation and data visualization as well as on consultation on EM problems.

We help our customers with simulations of complex EMC problems by offering appropriate tools, or we support them with processing of, in most cases, complex data.

We see our mission in the generation of special methods and programs that are on the cutting edge of science and provide the most appropriate solution for each specific problem.

Company Background

EMCoS Ltd. was founded as a spin-off of scientists of the Laboratory of Applied Electrodynamics of the Tbilisi State University of Georgia. The Laboratory of Applied Electrodynamics has more than 20 years of experience in the field of data visualization and simulation of electromagnetic problems.

The fields of interest cover a wide range. Starting from the simulation of the non-linear arc resistance as generated by ESD or electrical switches to the calculation of field coupling, or radiation of complex cable harness systems in automobiles.

Basic Idea

The expert system is based on two ideas. First idea demands a system that judges based on rules and given data, like a human expert is doing when he just judges based on the same data. The second idea demands a system that judges like an expert that has also access to calculation routines and calculation programs. The expert is assumed that he applies all routines and programs to the complete data for the more accurate detection of EMC issues.
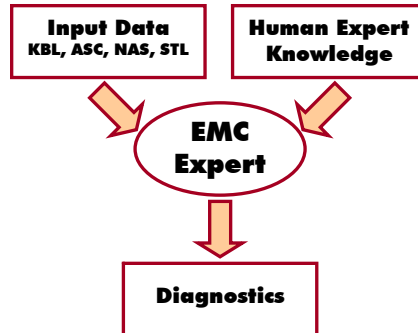

EMC Expert Workflow

EMC Expert Main Features

- Visualization of complex cable harnesses. Capability to handle even very large data sets
- Powerful creation and editing functions. Multiple comfortable ways to construct objects
- Convenient EMC Properties Editor, Rule Editor and Rules Library
- Automated rules generation from HTML file format
- Rules execution history
- Integrated functions for geometrical and electrical computations
- Supported calculation programs (TriD, Static 3D)
- Import and export of data, different file formats like STEP AP 212 (*.kbl, *.xls, *.asc) supported
- Multiple database support
- Import and visualization of surrounding geometry in NASTRAN and ASCII STL formats
- Auto routing of wires, different routing methods
- Optimization of connectors placement
- Auto merging of connectors and wires

- Table, 3D, Schematic and Cross Section View
- Linked functionality between the different views
- Comfortable navigation in any view
- Browsing functions with browsing history
- Reporting
- Powerful search and replace
- Comfortable printing and labeling functions
- Cable and signal tracing within the harness
- Convenient post processing tools
- Macro support gives to user possibility to automate frequently used sequences of actions. VBScript is used as macro language
- Conflict tables for displaying conflicts in cable harness databases
- Project Notes editor for adding comments to project
- Harness comparison functions
- Comparison Tool for System
- Component Management System
- Cable Harness Configurator
- Configurable and customizable workspace

The Modules of EMC Expert

Visualizing Engine is a database and geometry data viewer for cable harness data. 2D, 3D and schematic views are supported. The visualization engine allows direct interaction with the Table- and Tree-Views.
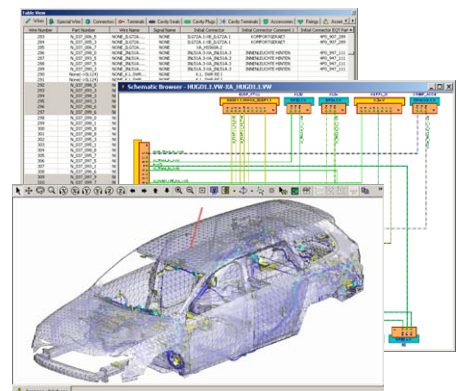
Browsers

Reporting Engine creates fast and flexible reports on a harness.

Product Features Summary

- Visualization of complex cable harnesses
- Powerful creation and editing functions. Multiple comfortable ways to construct objects
- Import and export of data, different file formats like STEP AP 212 (*.kbl, *.xls, *.asc) supported
- Import and visualization of surrounding geometry in NASTRAN and ASCII STL formats
- Import connectors and cavities data from CSV file format
- Convenient EMC Properties Editor, Rule Editor and Rules Library
- Automated rules generation from HTML file format
- Rules execution history
- Integrated functions for geometrical and electrical computations
- Supported calculation programs (TriD, Static 3D)
- SPICE file generation tools
- Multiple database support
- Table, 3D, Schematic and Cross Section View
- Linked functionality between the different views
- Auto routing of wires, different routing methods
- Optimization of connectors placement
- Auto merging of connectors and wires
- Reporting
- Powerful search functions
- Comfortable printing functions
- Labeling functions
- Browsing functions with browsing history
- Detailed information about each object and object

Search and Group Engine allows comfortable and powerful manipulation as well as filtering of the harness data.

Editor Engine gives convenient way for EMC properties editing.

Rule - Knowledge Representation Method

The method of knowledge representation in **EMC Expert** is a rule. A rule is a collection of conditions and the actions to be taken if the conditions are met. The user defines the rules, which describe how to solve a problem. Rules execute (or fire) based on the existence or non-existence of facts. Fact in this case is existence of harness object in database, like wires or connectors. Expert system provides the mechanism (the inference engine), which attempts to match the rules to the current state of the system and applies the actions.

Rules Library

EMC Expert provides convenient storage and multilevel rules grouping in Rules Library. Rules can be exported to *.clp file format, imported from *.clp files or from special HTML category files.
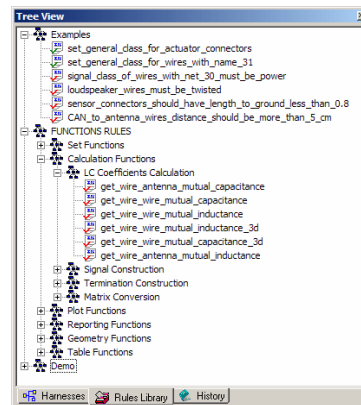
Rules Library with multilevel rules grouping

Rule Editor

EMC Expert rules are represented by CLIPS syntax and can be created or edited by using Rule Editor. Rule Editor provides convenient syntax highlighting (command words, text, numbers and properties values). Convenient Rules Assistant shows all internal functions and objects properties supported by **EMC Expert**.
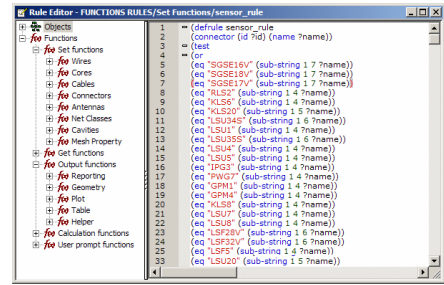
Rule Editor with Assistant

Analysis and Measurement Tools

EMC Expert provides set of convenient tools for analysis and measurement of databases. All these tools are available from rules as integrated in **EMC Expert** internal functions and also can be accessed directly from **EMC Expert** GUI.

Calculation Functions

- Wire – antenna and wire – wire mutual capacitance and inductance in 3D (using solver Static3D (option) mutual LC coefficients are calculated)
- Wire – antenna and wire – wire S11, S21, S12, S22 parameters (using solver TriD (option) S-parameters are calculated)
- Cavity, wire and net class termination construction
- S to Z and Z to S matrix conversion
- Wire – wire and wire – antenna coupled current and voltage
- Magnetic field calculation (fields in field probes are calculated considering current in specified wires)
- Wires coupling

Set Functions

Set functions give possibility to assign EMC parameters directly from the rule body.

Get Functions

Get corresponding elements functions gives possibility to manage corresponding elements directly from rule body.

Table Functions

Table functions allow adding new pages with user defined columns to the Results window.

Product Features Summary (continue...)

- Macro support
- Conflict Tables and Project Notes for making fast notes on harnesses
- Convenient post processing tools
- Comparison tools for components and harnesses
- Component Management System (CMS)
- Cable Harness Configurator
- Configurable and customizable workspace

Research Topics of EMCoS

- Specialized software for EMC calculations
- Method of Moments (MoM)
- Transmission Line Methods (MTL)
- Method of Auxiliary Sources (MAS)
- Geometry pre processing, meshing and remeshing software
- Data visualization software for complex cable harnesses
- Device modelling with behavioural models

User Prompt Functions

User prompt functions are integrated to support GUI operations (objects selection) during rule execution.

Geometry Functions
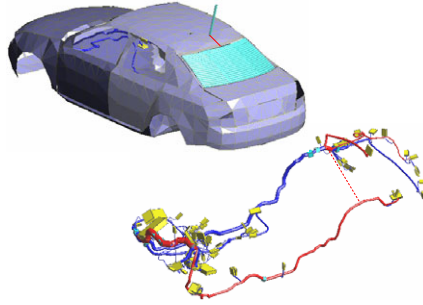
- Wire – wire distance
- Wire – connector distance
- Wire – antenna distance
- Connector – connector direct and route distance
- Connector – antenna distance
- Antenna – antenna distance
- Wires common and parallel length
- Wire – mesh property distance
- Connector – mesh property distance
- Terminal – mesh property distance
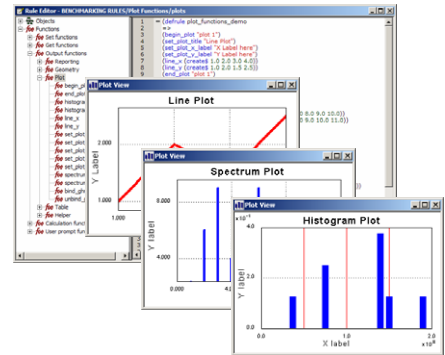
Reporting Functions

Reporting functions allow generating of detailed Excel reports directly from rule body.
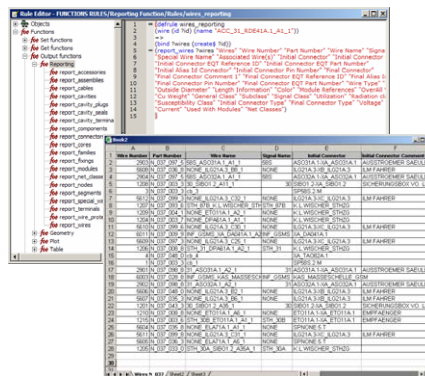
Excel report as output of rules execution

Plot Functions

Plot functions allow generating of different types of plots directly from rule body. The following types of 2D plots are supported: line plot, spectrum plot and histogram plot.

2D plots as output of rules execution

Post Processing

EMC Expert provides convenient tools for working with rules execution results:

- Search for results
- View results by priority
- EMC Risk definition for each case of rules violation
- Results exporting to Excel report

Output of the expert system on a fired rule

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