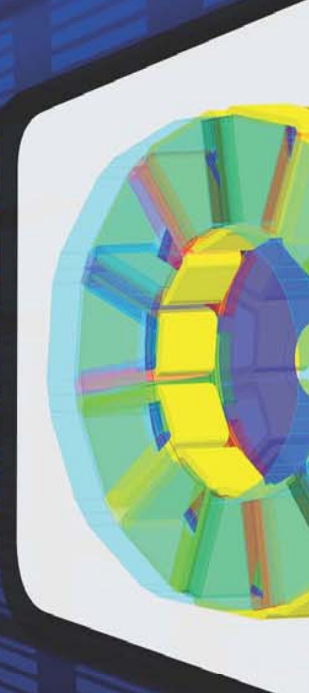
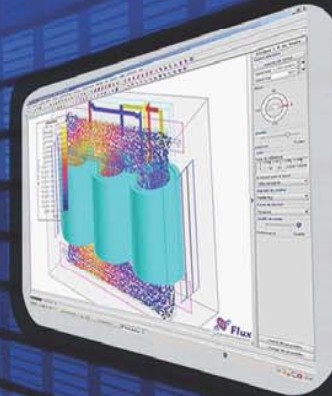
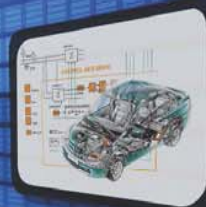
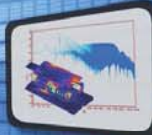
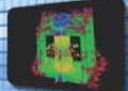


# Portunus 5.1 – New features presentation

## Mechatronic software simulator



Guitard Pascal

11/09/2012



## Portunus 5.1 Overview

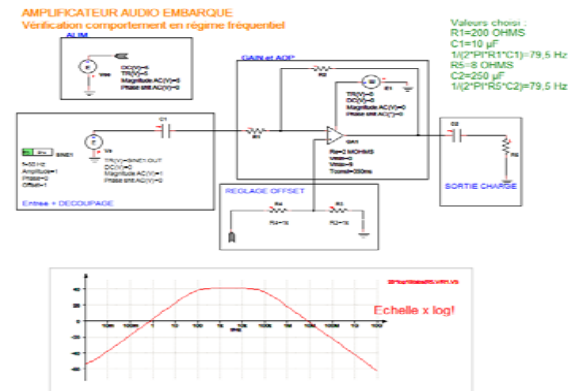
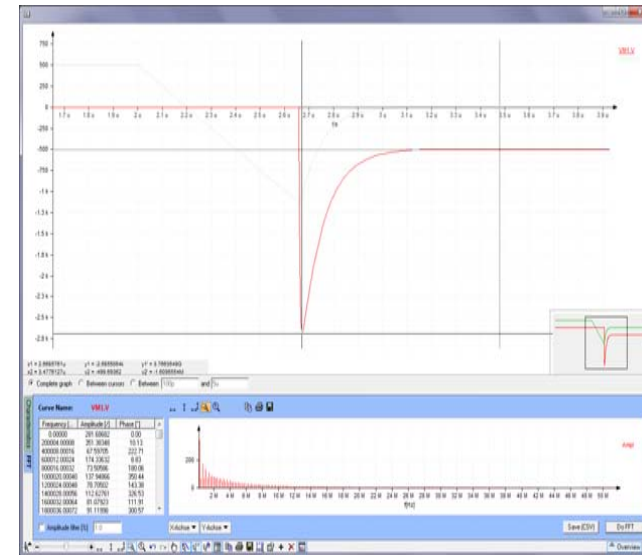
- Redesigned Display Elements
- Project Manager
- Variable Assignment Module
- Improved FFT Algorithm
- Model Extensions
- BDF Method
- User-defined animated Symbols
- HTTP Interface / HTML Creator

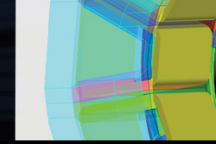
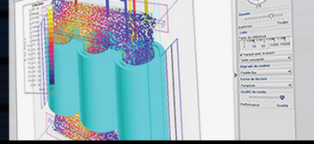
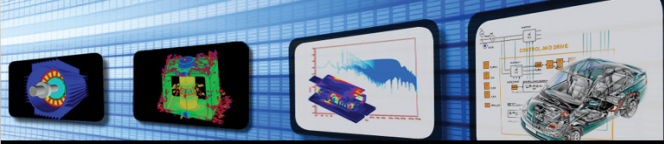
## Activities related to Portunus

- Mocosymec Project (France)
- Solar Project (Germany)
- EU Project HERRB
- German Teaching Book

# New management of curve exploitation

- A better display which is **faster** and more efficient than in the last versions
- Reorganization **more ergonomic** of the graph options and new practical features:
  - ✓ Automatic resize of the graphic in x and y-axis.
  - ✓ Undo/redo option.
  - ✓ New curve management (thinness, marker size...).
  - ✓ Export curve: copy/print/save jpeg format
  - ✓ Two cursors with characteristics table associated (with an automatic snapping cursor to data).
  - ✓ A move mode in all direction.
  - ✓ An overview mode.
  - ✓ A classical zoom in/out and a zoom area.
  - ✓ Multi y-axis option for several curves.
  - ✓ Storage of all settings
  - ✓ Logarithm scale for x and/or y axis.





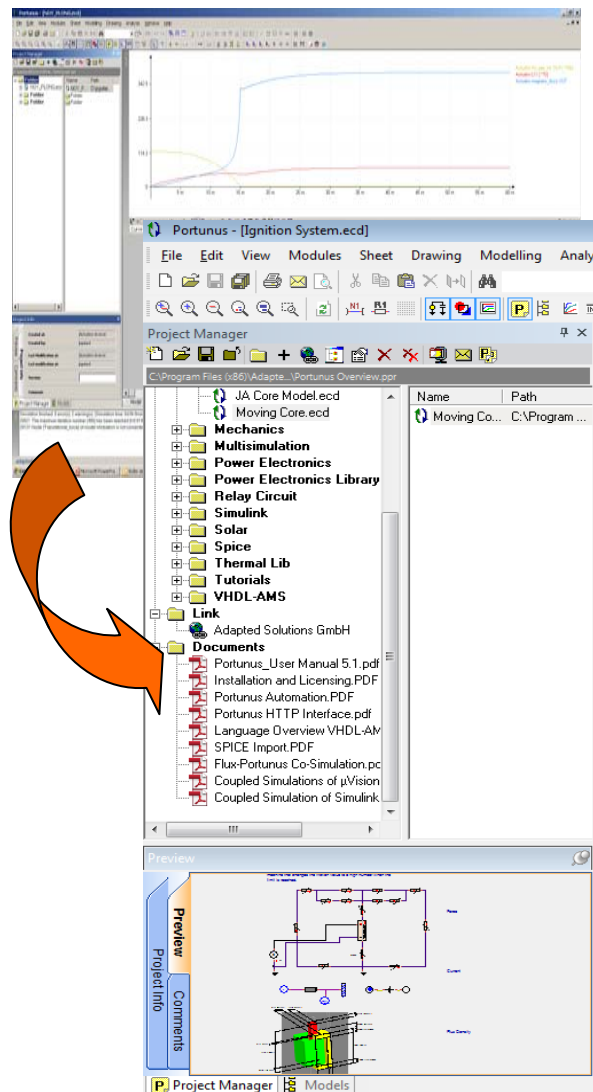
# Project Manager

## What is it?

The project manager is dedicated to **manage data** information. It is an useful option which allows to display, **gather and share** data of a project between all partners of that project.

The new opportunities that you can do with this option are:

- **Versioning** of a project
- **Tree representation** of files and links in a same file: you can gather different Portunus simulations (with schematic preview), documents, presentations, web links...
- **Explorer functions** (launching applications, showing properties)
- **Fast generation of backup** (project copy or zip file)
- Data could be send by email by one mouse-click



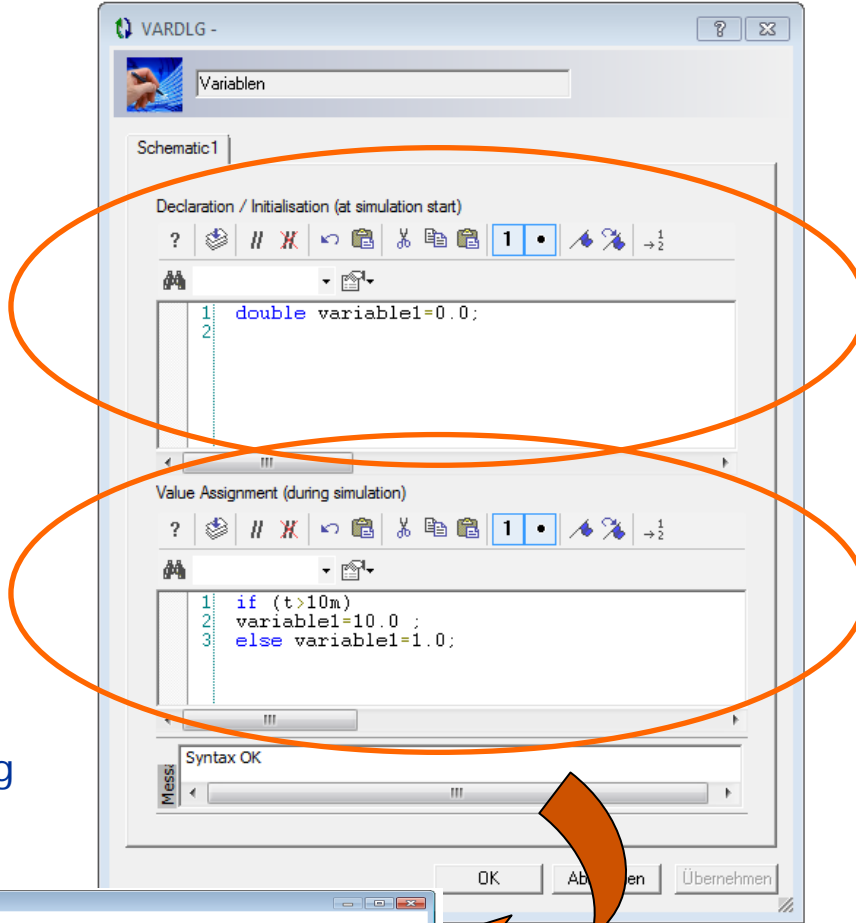
# New variables definition

- Declaration of the variables  
EX: double variable=0.0;
- Value assignment of variables during simulation  
(this module is called before the analog solver after evaluation of time function)

EX: *If (t>10m) variable=10.0;*  
Else variable=1.0;

⇒ Conditional evaluation of expressions allows to trig a variable at any time or frequency step **without time delay**

**NB:** Editor with syntax check, syntax colouring and browse function.

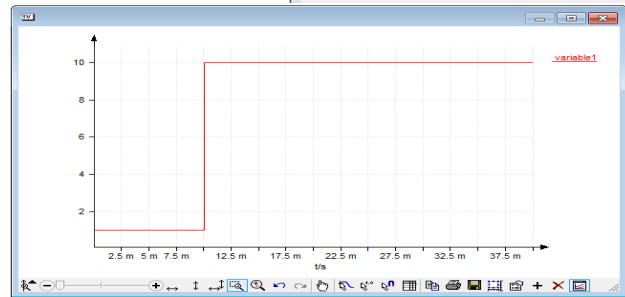


The screenshot shows the 'VARDLG - Variablen' window. It has two main sections: 'Declaration / Initialisation (at simulation start)' and 'Value Assignment (during simulation)'. Both sections have a toolbar with icons for help, undo, redo, copy, paste, and zoom. The code in the 'Value Assignment' section is:
 

```

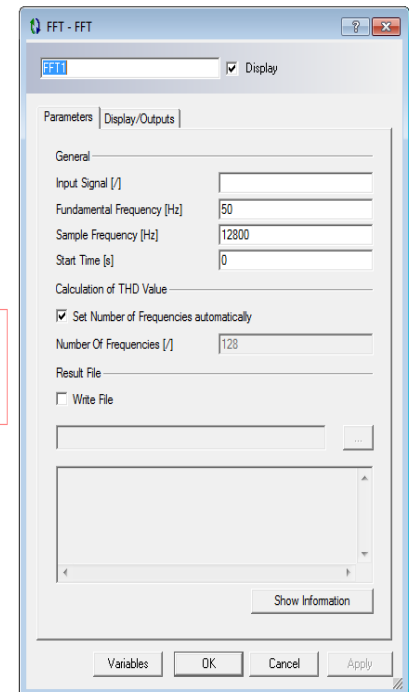
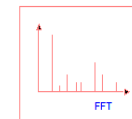
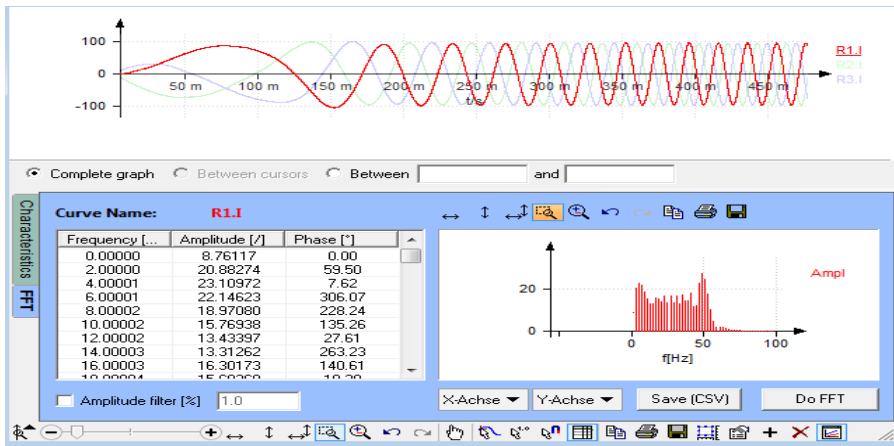
1 if (t>10m)
2   variable1=10.0 ;
3 else variable1=1.0;
```

 The status bar at the bottom indicates 'Syntax OK'.



# A better use of FFT

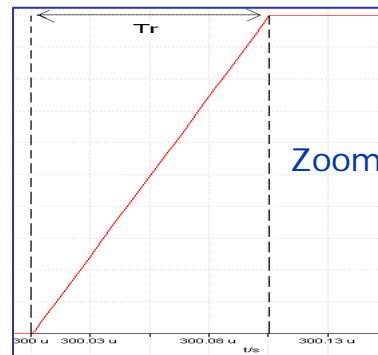
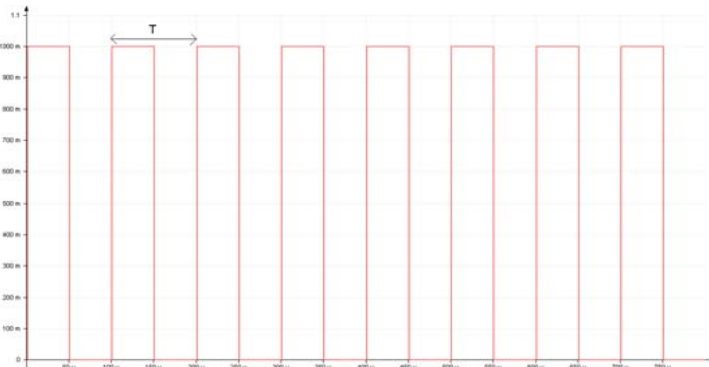
- Portunus V4.1: the number of harmonics calculation was limited to 50.
- Portunus V5.1:
  - ▶ FFT in the graphical interface: there is no limitation over the number of harmonics calculated



- ▶ FFT component in « measurement device »:
  - ✓ We define the number of harmonics
  - ✓ We can export result in a text file

# FFT example

- FFT of a trapezoidal signal:

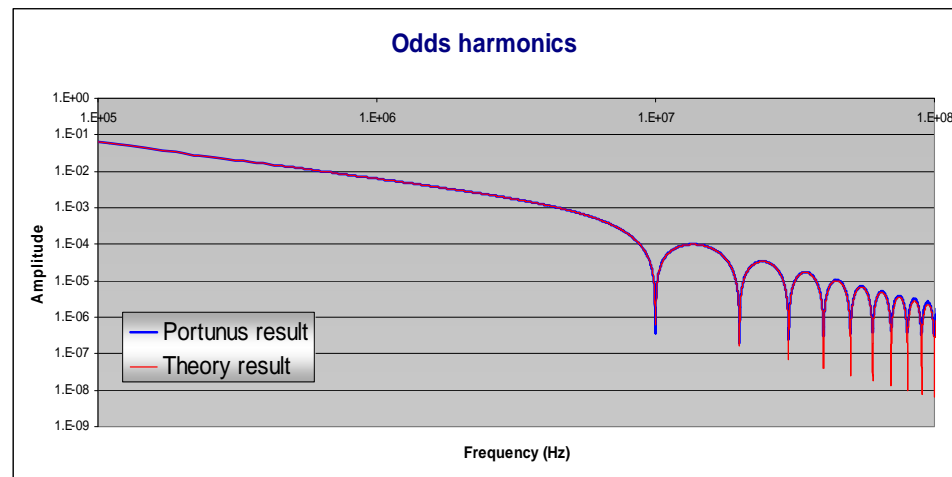


- The theory gives the amplitude of odds

$$A_n = A \times \frac{\sin(0.5 \times \pi \times n)}{0.5 \times \pi \times n} \times \frac{\sin(\pi \times n \times Tr/T)}{\pi \times n \times Tr/T}$$

- Comparison between the theory and Portunus results:

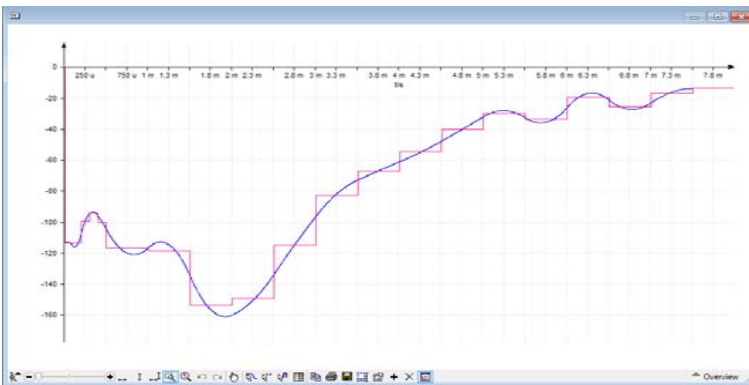
Here the number of harmonics calculated is around 8000, that gives accurate result.



# Model extension: new interpolations for look-up table

Portunus 5.1 has new interpolation algorithms which give better results for the derivatives.

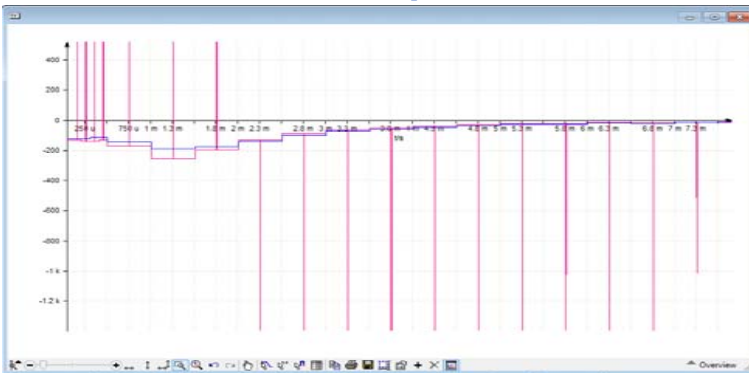
- **New spline interpolation for 2D table** => curves are  $C^2$



Here we observe the derivative after an interpolation:

- Linear interpolation
- Spline interpolation

- **New bilinear interpolation for 3D table** => curves are  $C^1$



Here we observe the derivative after an interpolation:

- Linear plane interpolation
- Bilinear interpolation
- Bi-cubic interpolation





## Model extension

- Mechanical library: “Hard stop” (Translational & rotational)
- New bloc “expression” (3 entrances)
- Semiconductor: “symmetrical FET”
- Passive component
  - ▶▶ Junction capacitance
  - ▶▶ Diffusion capacitance
- Controlled voltage & current source



# New integration method for analog solver: BDF

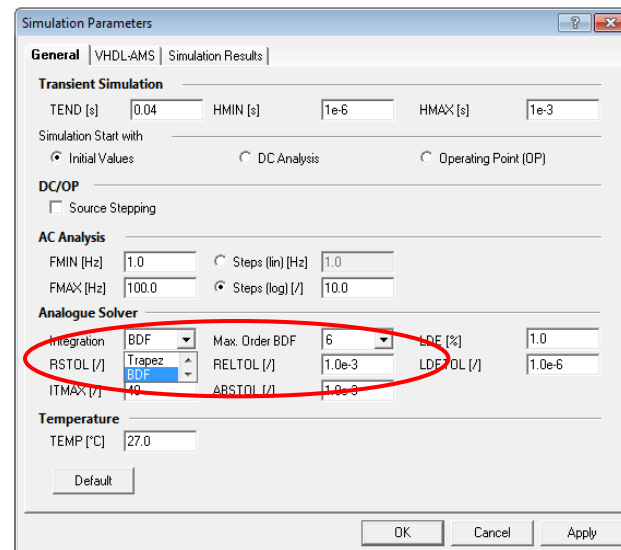
- Portunus 4.1: Euler and Trapeze methods

The Euler formula leads to shorter simulation times but damps the system. The trapezoidal formula may increase simulation time but leads to more precise results.

- Portunus 5.1: Euler, Trapeze methods + **BDF method**

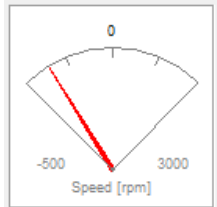
## Backward Differentiation Formulas (BDF) method:

- ▶▶ Uses up to 6 past values for next time step
- ▶▶ Prediction is improved for oscillation model
- ▶▶ Reduction of time simulation for systems without frequent operation switching

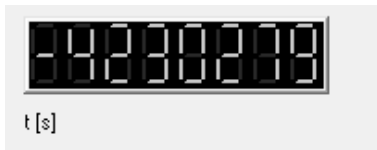


# New animated symbols

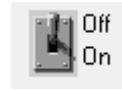
- Below are the animated symbol already present in Portunus 4.1:



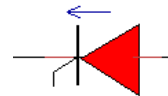
Analog display



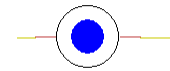
Digital display



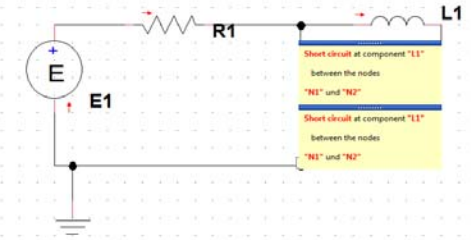
Switch manually controlled



Diode colored

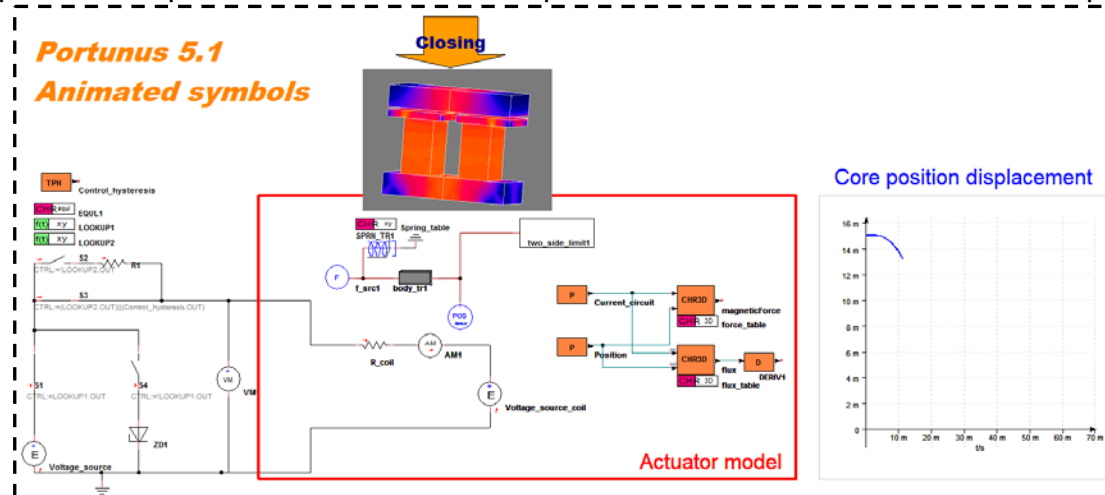


State machine



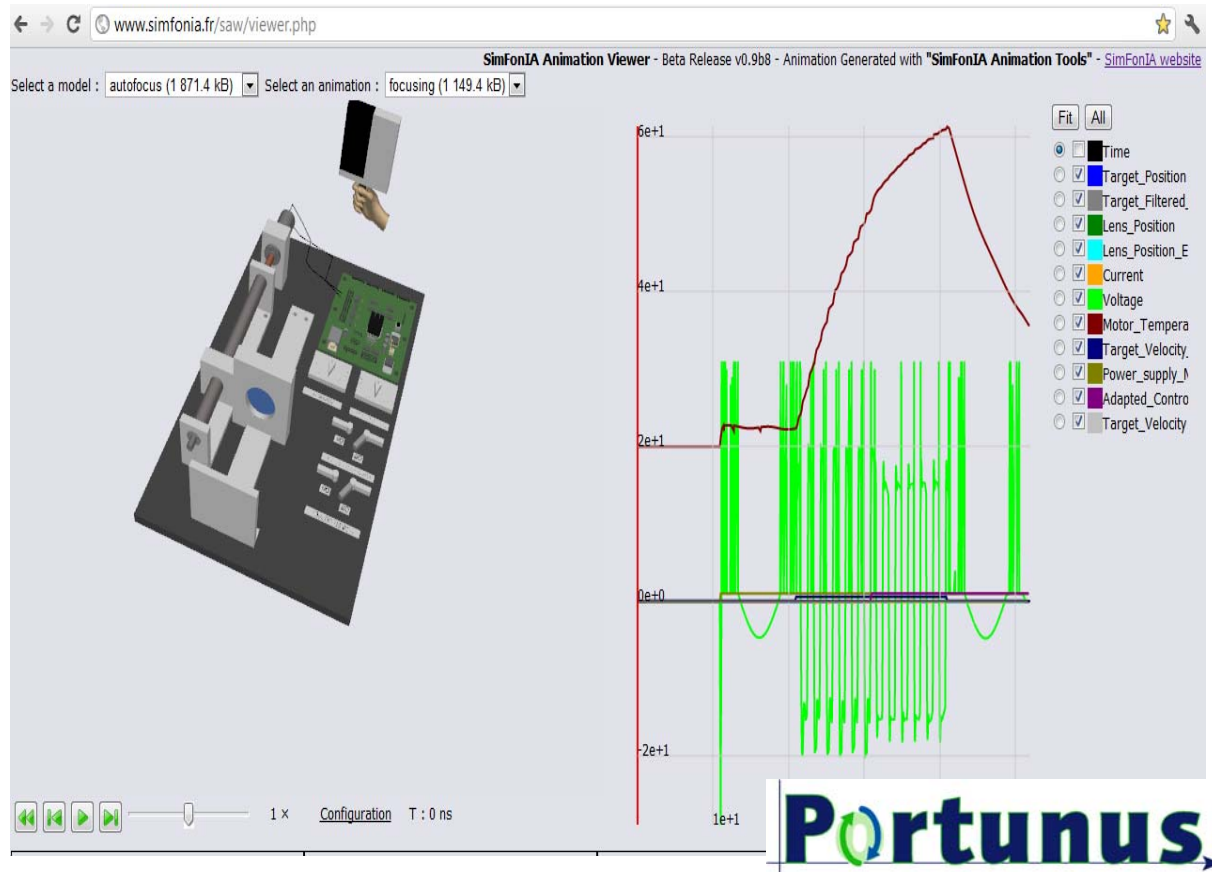
Indicator of a short-circuit

- New animated symbol customizable could be use in Portunus 5.1  
An image could appear for a precise state: for example, a linear actuator in close or open position



# SimFonIA Animation Tool

A **coupling tool** dedicated to illustrate complex result to a non technical public:

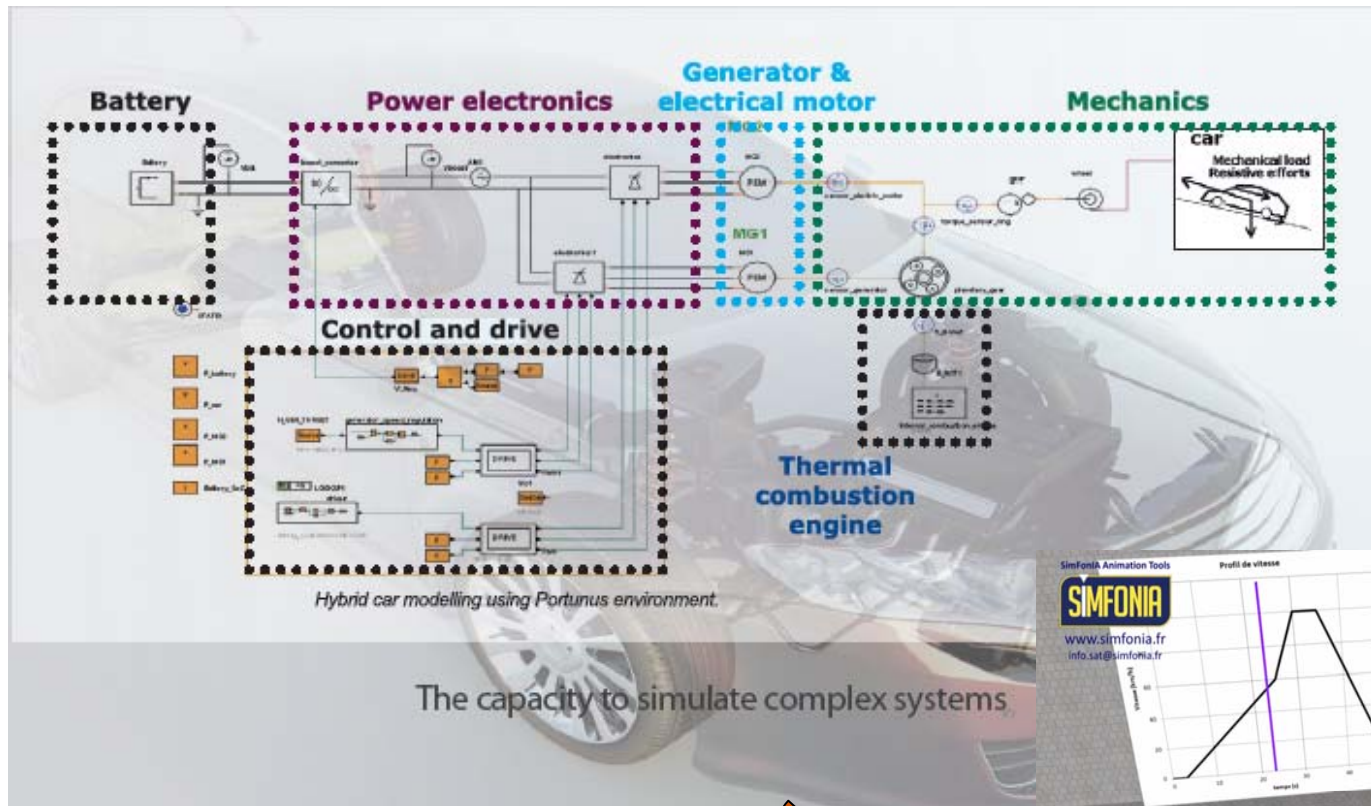


- ✓ Based on the free software **Google SketchUP**: 3D Geometry construction or import.
- ✓ Possibility to animate in **dynamic** a 3D scene via a **Portunus API** (data exchange via an HTTP server): parameter control could be insert inside the animation!
- ✓ Observation of results as mechanical moved, thermal heating, energetic transfer...
- ✓ Possibility to export the animation on the web

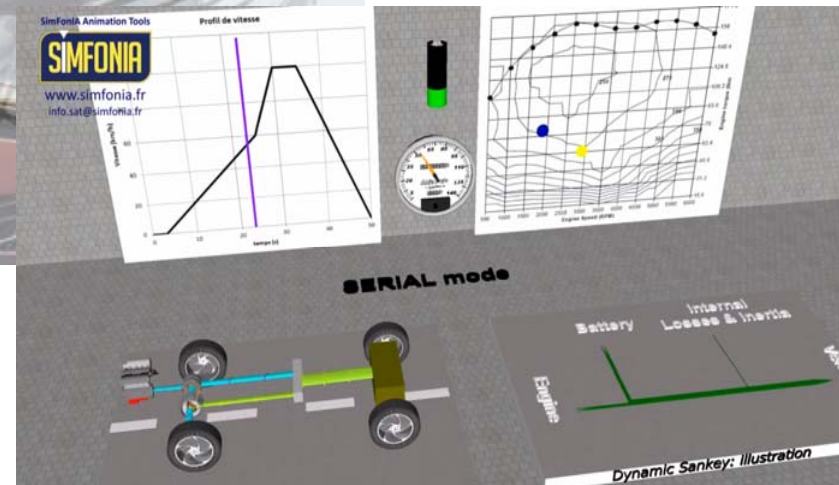




# Animation example: powertrain of the Prius car

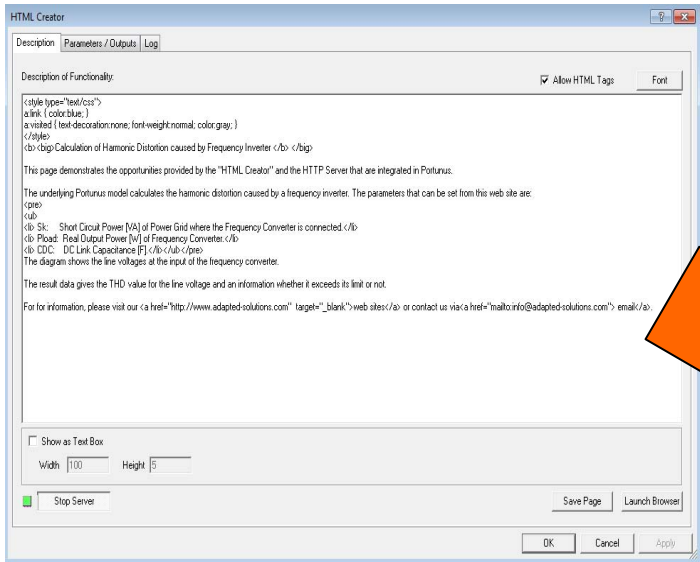


## 3D Animation Tool

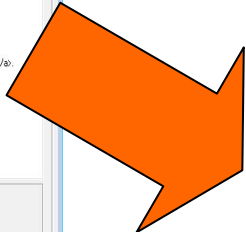
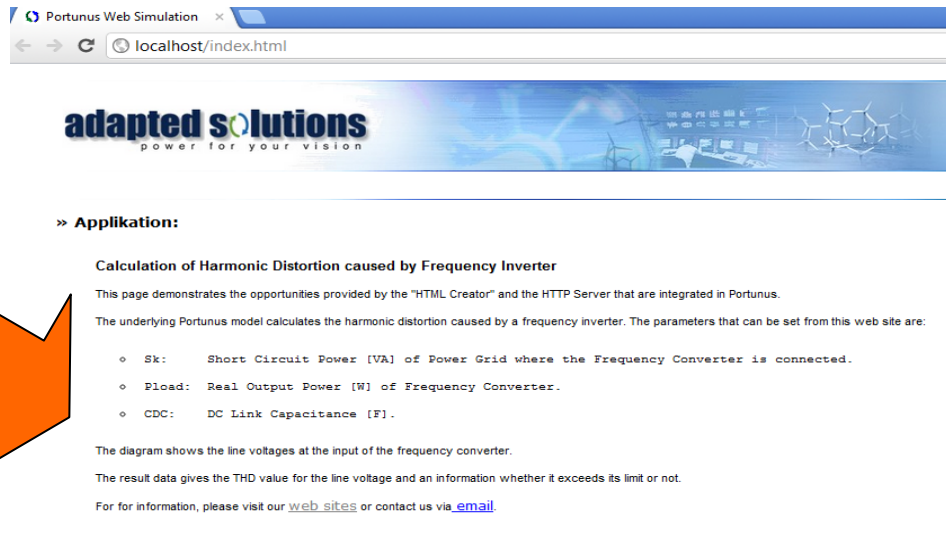


# HTML export & web simulation

## Inside Portunus: Html creator



## Web interface for Portunus simulation



- Any curves and parameters are exportable into the web
  - HTTP interface allows to set and read parameters values and to run a simulation from the web
- => **HTTP interface = Communication interface**



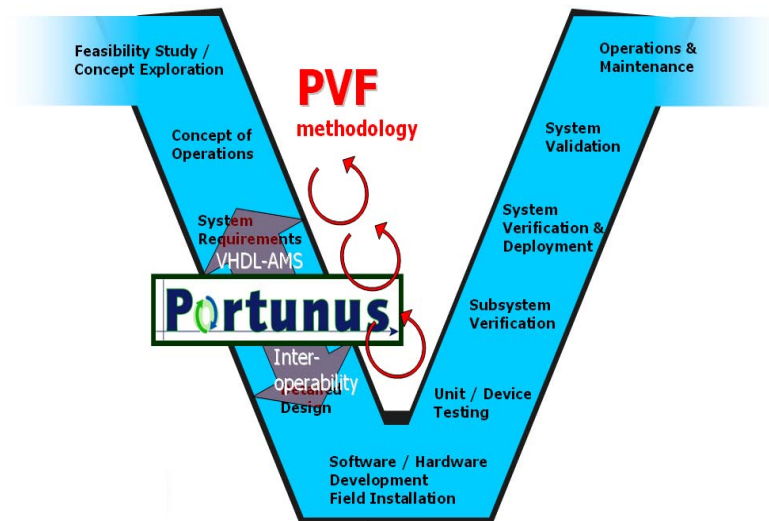
## Activities related to Portunus

- Mocosymec Project (France)
- Solar Project (Germany)
- EU Project HERRB
- German Teaching Book  
“Leistungselektronik” (Jäger / Stein)

# Mocosymec

- The *Mocosymec* project is about  
*“simulation/design tools for mechatronic systems. It aims at producing a new generation tool that satisfies the emerging requirements of designers”.*
- Through *Mocosymec* Portunus got
  - improvements in the coverage of VHDL-AMS,
  - new communication interfaces.
- One results of the project work is the usage of Portunus simulations to drive for 3D system animations .
- Some application examples may be found at  
<http://www.simfonia.fr/SAT/>

This reference could be used for Portunus marketing as our involvement is mentioned at the bottom of this page.

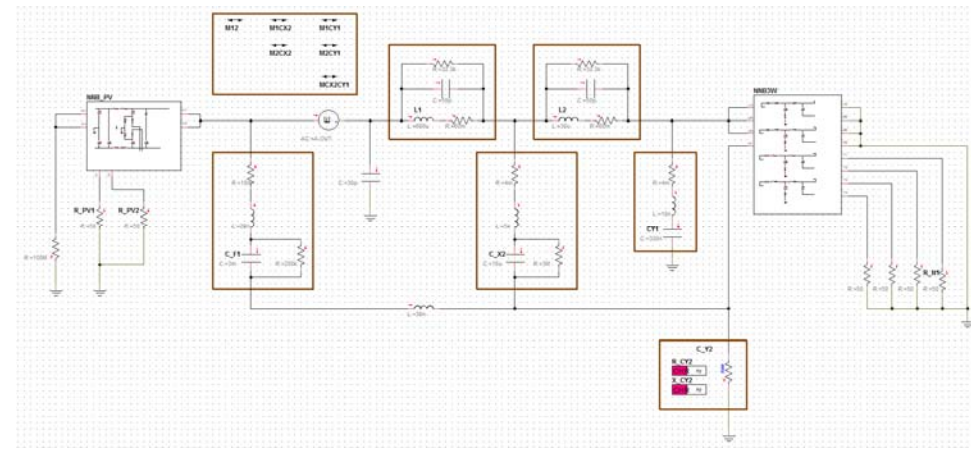
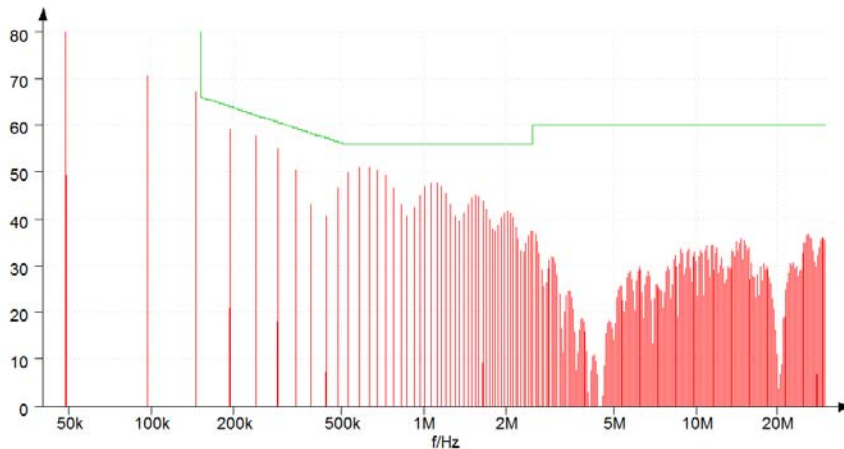






# SOLAR

- **SOLAR** is a German project lead by Bosch about *“design methodologies for power electronic systems that cover all domains involved”*.
- Within the frame of **SOLAR**, Portunus models and features are being developed for electro-thermal simulation and EMC analysis of the frequency inverter.





# HERRB

- **HERRB** is an EU project (within the frame of **Clean Sky**) dealing with the design of a **Helicopter Electric Regenerative Rotor Brake**. The proposal outlines a replacement of mechanical-hydraulic rotor brake by an electric system
- The project is lead by the University of Bristol with Motor Design Ltd. and Adapted Solutions being partners.
- Within the frame of **HERRB**, Portunus is used for the analysis of the power electronic systems regarding losses, temperatures and system efficiency.
- More information are given at   
[http://cordis.europa.eu/projects/rcn/104596\\_en.html](http://cordis.europa.eu/projects/rcn/104596_en.html)   
[www.herrbcleanskies.eu](http://www.herrbcleanskies.eu)



# Teaching Book

- **Jäger/Stein**  
**“Übungen zur Leistungselektronik”**  
**Second Edition**  
**VDE-Verlag 2012**
- First book delivered with Portunus CD.  
Previous edition used Simplorer.
- CD contains 50 power electronic example calculations covering circuit principles, switching behaviour, pulse generation, thermal aspects and system simulation.
- [www.vde-verlag.de](http://www.vde-verlag.de)





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