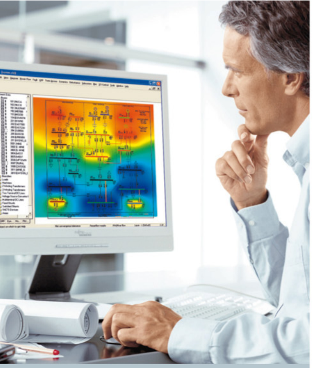

Graphical Model Builder (GMB)

Fast and accurate simulation of complex system dynamics

At a glance

Accurate power system planning requires that precise models be used in the simulation software. The software tools of the PSS® product suite (PSS®E, PSS®SINCAL, PSS®NETOMAC) are designed for dynamic modeling of complex systems. The Graphical Model Builder (GMB) is a powerful and easy to use dynamics model development tool based on graphic representations of control block diagrams. GMB allows specialized modeling by supporting both standard and non-standard dynamic models.

Advantages of the GMB include:

- Based on Microsoft® Visio® (graphical block-diagram form)
- Supports a wide range of dynamic models
- Uses common CAD functions plus large symbol library
- Model flexibility using 100+ control blocks

The challenge

Successful operation of a power system depends largely on the engineer's ability to design a system that provides safe, reliable and economic service to the customer. Advanced simulation technologies provide the means for the engineer to design and analyze power systems, and assist him in making key decisions. With powerful simulation software like the tools of the PSS® product suite, it is possible to simulate the dynamic behavior of very large power systems and to verify the performance of these complex systems in a fast and accurate manner.

However, as new technologies become available for application in the power system, it is necessary to develop dynamic models to accurately represent their behavior. New models must be developed quickly and accurately and be fully tested prior to use in the power system simulation.

Our solution

GMB is a stand-alone model builder and testing environment that can generate dynamic models for use in tools of the PSS® product suite. GMB uses Microsoft® Visio® software to easily create dynamic models (Figure 1).

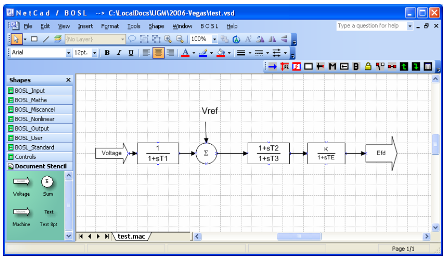

Figure 1: Visio-based Graphical Model Builder

Using Visio, the GMB becomes a drawing tool that is simple and quick for implementing, editing and documenting of dynamic models.

GMB is incorporated for, e.g.:

- Excitation systems (AVRs)
- Turbine Governors
- Power System Stabilizers
- HVDC Models
- FACTS Models
- Load Models
- Transformer Models
- New Source Models (e.g. Generic Wind Models)
- New Storage Models

Using GMB, the user can develop a wide variety of dynamic models (i.e., AVR, exciter, FACTS, wind models, etc.) which can be constructed using GMB built-in graphical block-diagrams coupled with Microsoft® Visio®. The models can be easily included as macro files without the need for compiling and linking.

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Besides familiar CAD functions, like copying, shifting, rotating, zooming, etc., the GMB system has a large symbol library which contains more than 100 basic control blocks in the form of symbols.

During model development, GMB presents a stand-alone model simulation package that allows testing of the independent model. The simulation can be driven using built-in signal generators and test points that allow simulating the response of the model over a full range of inputs.

The user develops the model based on the control block diagram that is constructed by graphically interconnecting the basic library symbols. The data is entered via masks that are object-related and have abbreviated balloon help in addition to detailed help texts. Groups of linked symbols can be saved to form independent new symbols and macro models; these can then be added to the master symbol library or the user's own library. Using hierarchical structuring based on these "subsystems", GMB allows the user to determine the level of complexity for a model. Individual components can be activated and deactivated and connected to any desired part of the system.

The symbol library "BOSL" (Block-Oriented Simulation Language) contains more than 100 different function blocks. These blocks can be combined to generate any open or closed-loop control structures or logic devices by means of the graphic interface. Besides very simple blocks, such as PID elements, also complex "blocks", such as FFT (Fast Fourier Trans-formation) are available. Parameter values can be entered and edited individually, or the default values can be used (Figure 2).

Complex open and closed-loop control and protective functions can be implemented with GMB. Besides the open and closed- loop control structure, signal processing structures can also be user-defined. External, user-defined subroutines can also be coupled (open-loop) and there is an inter-face to real-time applications (closed-loop).

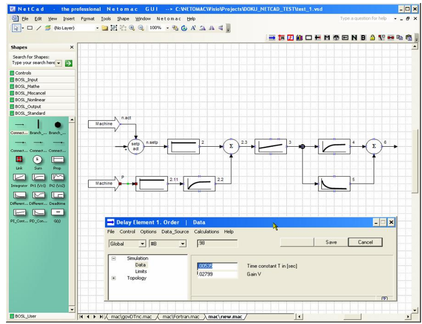

Figure 2: Data input in marks after double clicking

The block-oriented structures can be combined with FORTRAN-like terms (Figure 3), such as mathematical functions, logical terms or instructions, (e.g., IF / THEN / ELSE and GOTO / CONTINUE). Input variables are available to the controllers in all units. In addition, the variables from other closed and open-loop controllers or the evaluation structures can be used as input variables. All inputs and outputs of blocks can be printed / plotted.

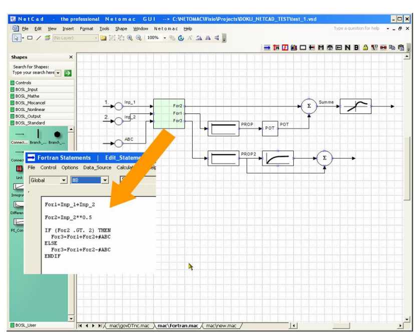

Figure 3: Special user blocks with FORTRAN statements

In working with the graphics, the user can switch between two different block styles: the European DIN symbols; and transfer function diagrams (Figure 4). GMB also offers testing and debugging functions in the stand-alone mode. A step function or a sinusoidal signal can be injected at each.

After finishing the design and testing of the model, it can be used directly as a macro file without the need for compiling and linking.

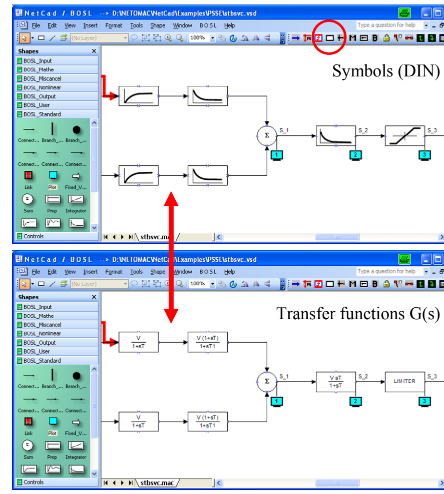

Figure 4: Switching between DIN-symbols and transfer functions

Application example

Figure 5 shows the basic voltage control of a DFIG (Doubly Fed Induction Generator) wind machine built with BOSL (example).

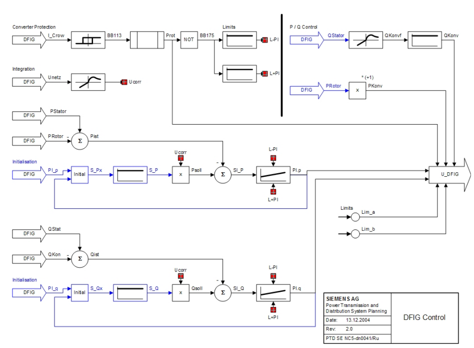

Figure 5: Example: Basic voltage control for a DFIG

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