Modelling of a Scalar Control of an Induction Machine Using Flux / Portunus Co-simulation.

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From the 10.3 version of Flux, it has been possible to export finite element models into Portunus: Cedrat's system environment that will perform co-simulation.

Taking into account the effects of system load or improving its drive is now easier thanks to Flux/Portunus co-simulation. Co-simulation works for both 2D and 3D applications within Flux 10.3 and there is virtually no limit to the parameters that can be shared between both programs.

Figure 1: Model of the scalar control in Portunus using a Flux component.

Figure 2: VHDL-AMS description of the scalar control algorithm

A user-friendly coupling interface

Thanks to the easy co-simulation interface (simple file import), control and drive as scalar control can easily be added to an accurate finite element model, to monitor the effect of a given command on the machine efficiency and performance.

The principle of this type of control is to adjust the motor speed by varying the output frequency fs such that the magnetic state of the machine is fixed, through the preservation of Φs in a constant value. This type of control is implemented in many industrial variators.

This control is composed of a Proportional Integral speed controller using the speed, a scalar control algorithm and of an inverter. All the components are described in VHDL-AMS: with VHDL-AMS, physical equations are directly entered into the VHDL-AMS editor, in a way which is close to the designer's language.
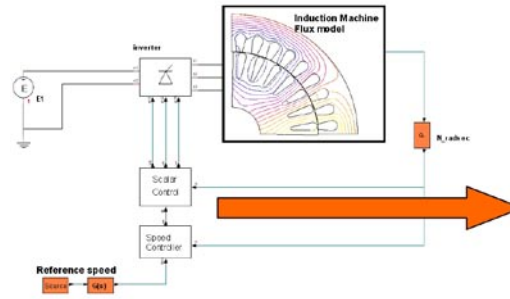
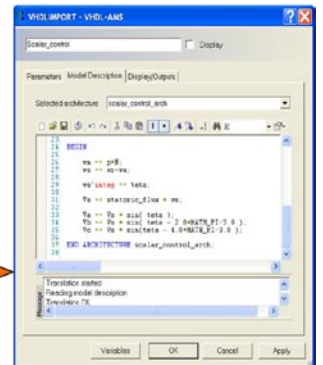Figure 1 represents the model of the scalar control in Portunus. Figure 2 represents the VHDL-AMS description of the scalar control algorithm: one can see that it only takes a few lines whereas a corresponding block diagram would have required a lot of mathematical blocks. The gain for the designer is double:
a) setting up the model is shorter and easier
b) model capitalization is more efficient because the model is directly understandable.

Due to Portunus modelling flexibility, the description of the drive is made easy.

The complete environment of Portunus system simulator allowing to use in the same simulation sheet:

- Kirchhoff representation (analogue signals),
- signal flow (block diagrams),
- digital signals (state machines, logical statements, etc…) and
- VHDL-AMS model

makes it very appreciated from the designers.

The results

Global quantities (mechanical and electrical) are prsented by Portunus: Figures 3a & 3b represents the speed and the torque of the induction motor. Figures 4a & 4b represents the voltage and the current of phase 1 for the induction motor.

Local magnetic quantities like flux density can be displayed in Flux: Figure 5 represents color-shade of flux density in the induction motor.
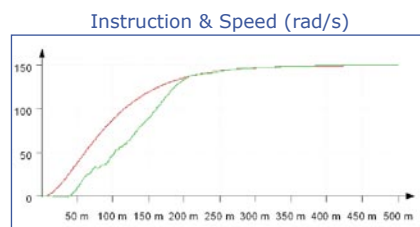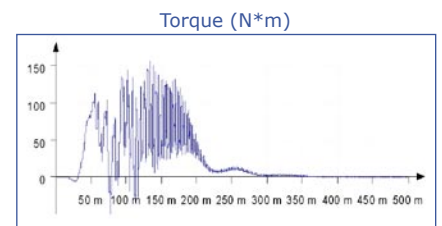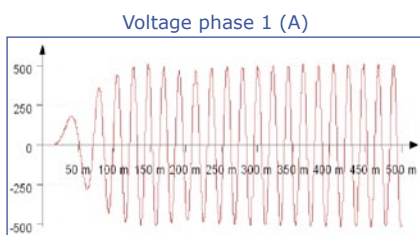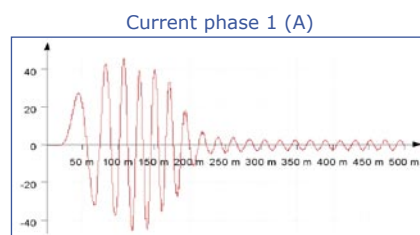

Figure 3a.

Figure 3b.

Figure 4a.

Figure 4b.

Figure 5.