

# Protronic Develops and Optimizes Complex Switched Reluctance Motors

To prevent fabric defects, weaving machines must quickly reach speeds of 1,500 cycles per minute. Protronic, the main group of the technologies division of the Picanol Group, develops mechatronical systems and drives for high-precision weaving machines. To achieve the required dynamic performance, Protronic develops switched reluctance motors (SRMs) that feature a simple and robust construction for handling high torque/volume ratio.

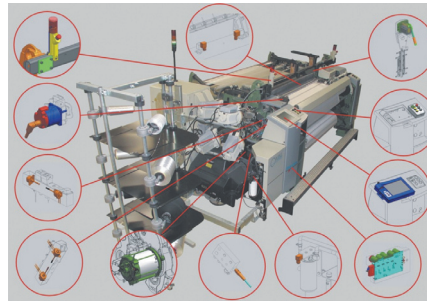
Protronic uses Simulink® and CEDRAT's FLUX finite element analysis tool to simulate and optimize SRM drives for various applications, including non-textile, without building costly hardware prototypes.

"SRM motors are mechanically very simple, but they require complex control," explains Nico Verhelst, systems engineer for Protronic. "Together, Simulink and FLUX enabled us to meet our requirements of simulating the motor control strategy and obtaining an accurate torque waveform, in combination with the simulation of the load."

## THE CHALLENGE

"A weaving machine is a very demanding and complex real-time application," explains Ludo Faes, Protronic research and development manager. "These machines contain many axes, requiring synchronization of multiple high-performance motors."

A key technical challenge was to integrate the motor's electromagnetic properties into the overall design of a dynamic application. To obtain the desired results, Protronic needed a way to simulate the controls and mechanical loads with the electromagnetic effects of the SRM.



Switched reluctance motor application.

Protronic also needed to validate and optimize their designs without building expensive prototypes. With the customer waiting for results, they needed to complete the total design within weeks, while a normal integrated design of this extent would easily take months.

## THE SOLUTION

Protronic met their deadline by using Simulink and FLUX to model, simulate, and optimize the weaving machine and SRM designs.

"We wanted to combine the torque calculated by FLUX with the speed, ease of use, and open control interface of Simulink," notes Verhelst. "This combination of tools provided an ideal simulation environment."

Engineers modeled the dynamics of the load in Simulink using analytical formulas for variable inertia and damping. They modeled the control strategy for the motor with Simulink and incorporated the electromagnetic model of the SRM with FLUX-to-Simulink technology. They optimized system performance by simulating custom motor configurations.

## THE CHALLENGE

To avoid building costly prototypes in the design and optimization of complex weaving machines and other systems driven by switched reluctance motors

## THE SOLUTION

Use Simulink to create comprehensive models and accurate simulations that leverage CEDRAT's FLUX technology for finite element analysis and electromagnetic design

## THE RESULTS

- Development time and costs reduced
- Project completed within a tight deadline
- Platform established to accelerate future projects

To obtain accurate, complete system results, the team used FLUX-to-Simulink technology to run FLUX and Simulink computations in transient cosimulation.

Using MATLAB®, engineers analyzed the effects of the motor torque waveform.

Simulink also enabled engineers to optimize system performance as well as the position, speed, and torque controllers, by iteratively adjusting the motor configuration and then re-running the simulation to validate performance.

Faes notes, “We use Simulink to analyze the effect of our motor performance on different parts of the application. For example, if we are concerned about the exchange of energy between axes, we can easily examine that using scopes in Simulink.”

Combining its technical expertise with Simulink and FLUX, Protronic has become the European leader in applying SRM technology in industrial machines and has built an installed base of more than 150,000 units in the last decade. Protronic plans to continue to use MathWorks tools and FLUX on a wide range of customer applications.

#### APPLICATION AREAS

- Electronics
- Industrial equipment and machinery
- Model-Based Design
- Simulation

#### PRODUCTS USED

- MATLAB
- Simulink

“When we need to customize motor configurations to optimize performance, we simulate the whole system in Simulink, and the development phase gets much faster.”

Ludo Faes, Protronic

## RESULTS

### ■ Development time and costs

**reduced.** “Speed is very important, and time savings is certainly a key benefit of using Simulink,” explains Faes. “We cannot afford to build physical prototypes of weaving machines. It takes too much time, and is far too costly. Simulink helps us reduce costs.”

### ■ Project completed within a tight

**deadline.** Simulink and FLUX accelerated the design and optimization process. “There was a lot of pressure from the customer to complete this project,” notes Faes. “With Simulink and FLUX, we were able to deliver it on time.”

### ■ Platform established to accelerate

**future projects.** Protronic has assembled a set of models that they can reuse to speed up the optimization process on future R&D initiatives. Verhelst estimates the time savings at about 50% for a typical simulation phase in a project.

To learn more about Protronic, visit

[www.protronic.com](http://www.protronic.com)

To learn more about CEDRAT and FLUX,

visit [www.cedrat.com](http://www.cedrat.com)

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