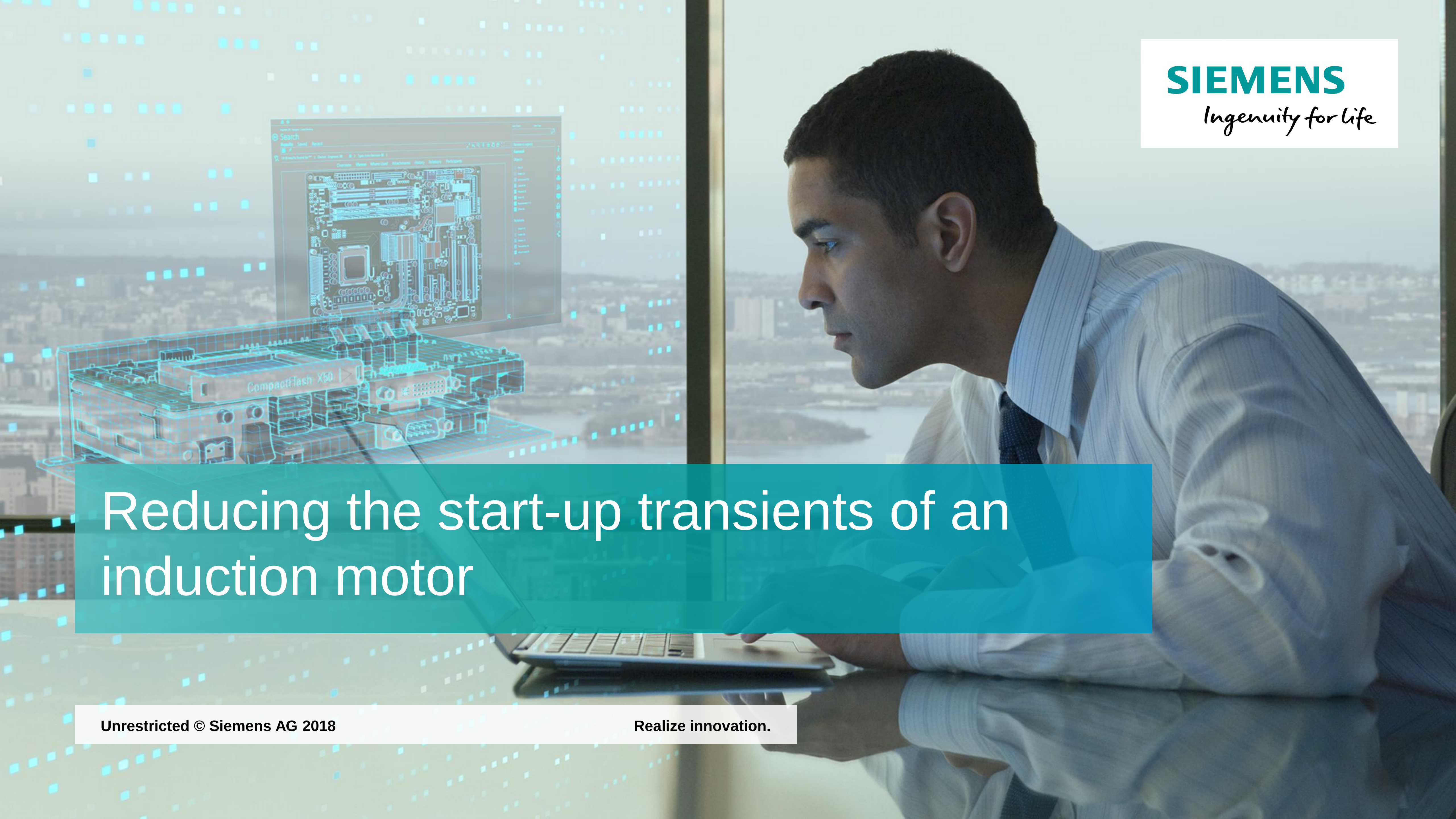


SIEMENS
Ingenuity for life

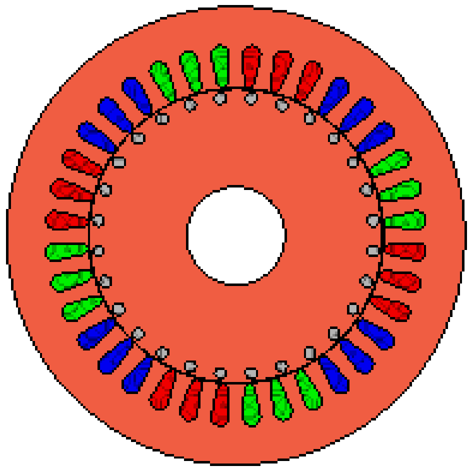
Reducing the start-up transients of an induction motor

Reducing the start-up transients of an induction motor

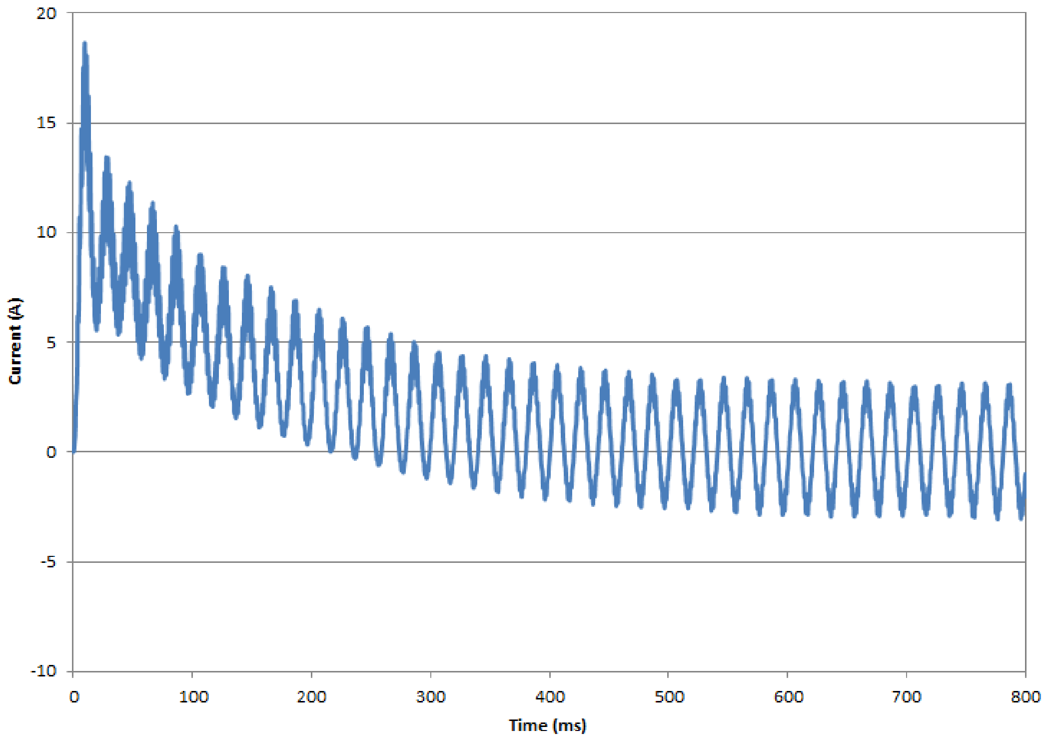
The steady-state characteristics of devices with periodic excitations – such as motors and generators – are often of interest. Unfortunately, the large time constants can have start-up transients that take a considerable amount of time to die out. One example is voltage-driven coils with large inductances.

The start-up response cannot be skipped by simply starting the simulation at a later time. However, there is no need to wait through the slow start-up response either.

There are a number of techniques to significantly reduce the duration of start-up transients using the right initial conditions with Simcenter MagNet. These powerful features are applied to the simulation of an induction machine. These methods can all be automated by scripting as well.



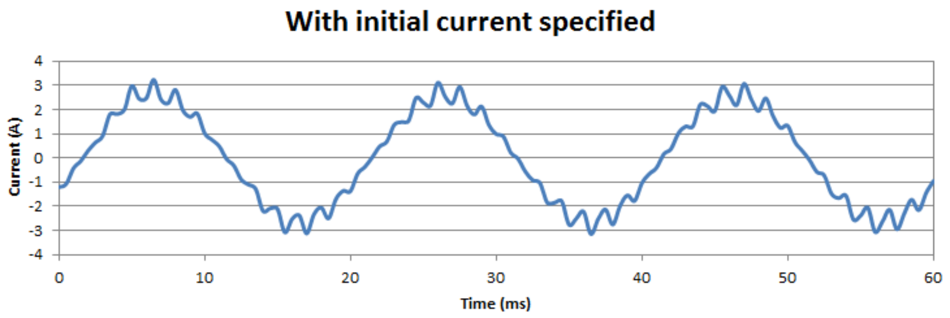
LENGTHY FULL START-UP TRANSIENTS

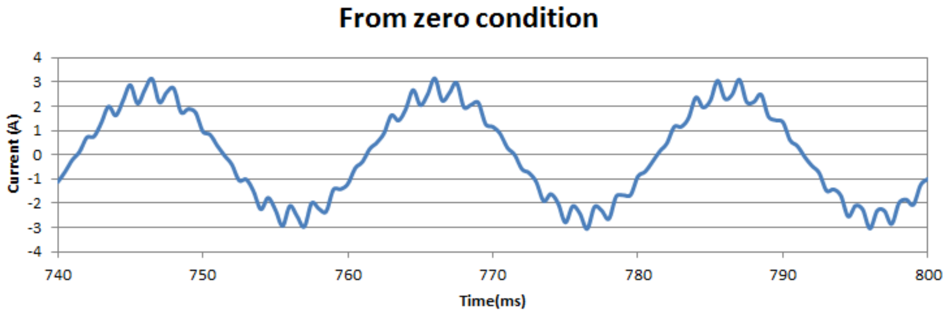


This induction motor displays quite lengthy start-up transients that takes approximately 740ms to die out, i.e. for the DC component of the stator currents to return to zero as expected. The goal is to reduce the time is takes to reach 0 DC.

SPECIFIED INITIAL CURRENT

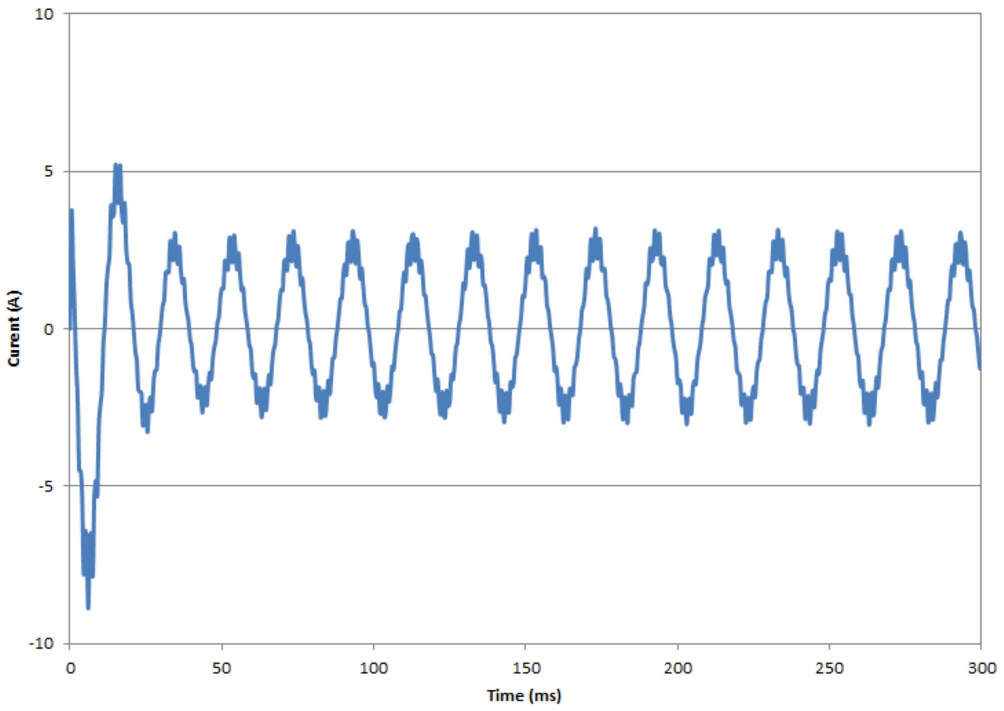
If the instantaneous value of the steady-state current waveform is known at t = 0, then it is possible to enter directly into steady state since Simcenter MagNet makes it easy to specify the current to impose in a coil at t = 0. The Time-Harmonic solver can be very useful in finding the appropriate initial current. In this case, scale the conductivity of the rotor bars based on the machine's slip before proceeding with the time-harmonic solution. Simcenter MagNet's unique capabilities facilitate this temporary change in conductivity in a few specific parts of the machine. Using this approach, the current waveform is the same, right from the beginning of the simulation, as that obtained after 740 ms in the previous model.



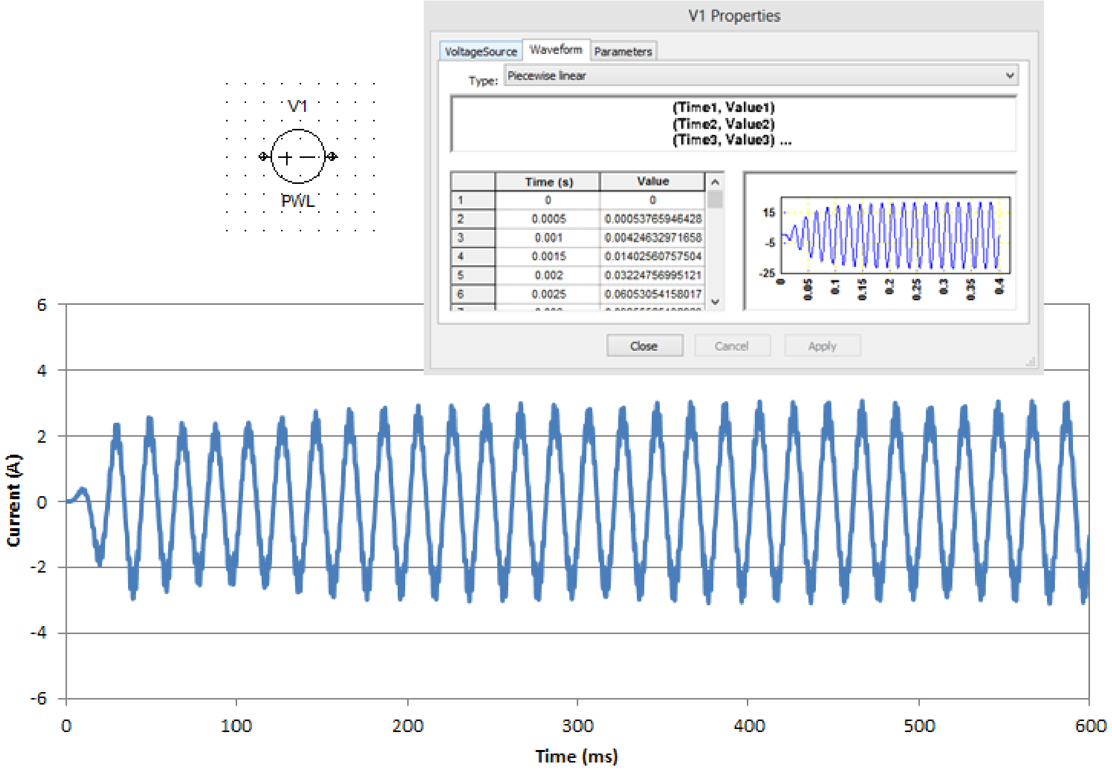


ONE TIME STEP VOLTAGE TRANSITION

It is possible to apply a constant voltage for the first time step of the simulation, before switching on the intended sinusoidal waveform, such that the flux linkage produced after this time step is that expected at steady state. If the voltage is properly calculated, it can significantly reduce the start-up transients that last here only two cycles. In order to specify a sinusoidal voltage waveform with a transition plateau for the first time step, one can use the piecewise linear (PWL) waveform type which allows entering any arbitrary waveform.



PRPGRESSIVE START-UP



Adding a progressive start-up envelop to a sinusoidal voltage waveform allows the system to achieve steady state within a few cycles as illustrated here. This approach once again makes use of Simcenter MagNet's PWL waveform type.