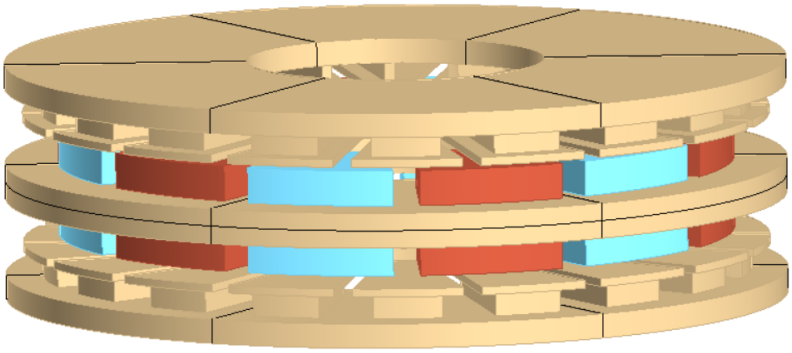
AUTOMATIZED 3D SIMULATION OF AN AXIAL FLUX MACHINE USING ALTAIR FLUX

This tutorial is devoted to the magneto-thermal modeling of an axial flux machine with one internal rotor and two external stators.

Geometry, meshing, physics definition and solving will be automatically carried out by dedicated set of macros which takes as inputs the material properties and the geometrical features of the machine.



Simulated axial flux machine

Installation instructions

To run this tutorial, you need to install **Altair Flux 2021.2 version** or higher.

The required macros are contained in the zipped file ***Macros_AFIR_Machine.zip***. This folder must be unzipped and placed in *[Flux installation folder]/ flux/Extensions/Macros*. Previous *Macros_AFIR_Machine* folder existing in this path must be replaced by the unzipped one. In windows Flux installation directory is, by default, *C:/Program files/Altair/2021.2* for 2021.2 version.

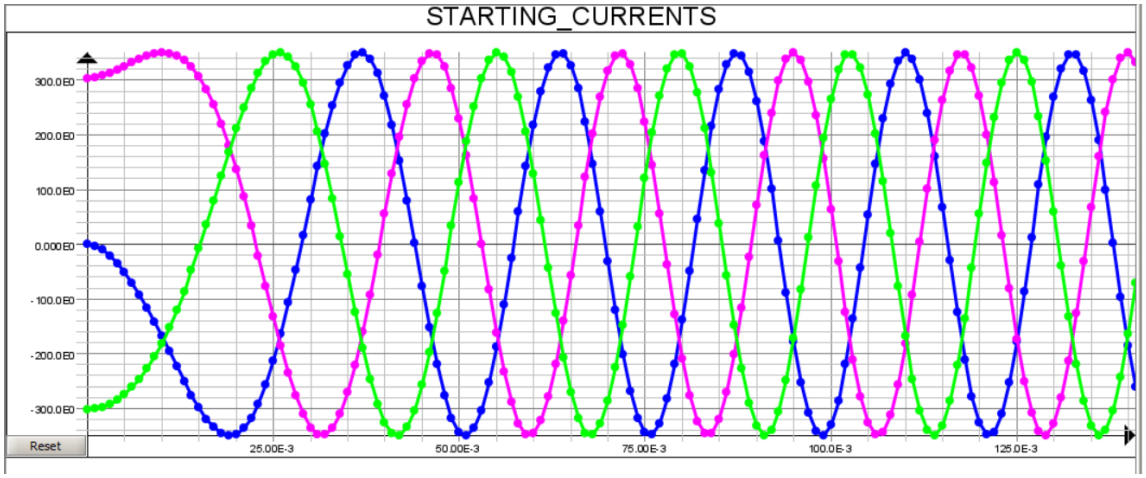
Additionally, to generate the machine's efficiency map (step 2) **Altair Compose 2021.0 version** or higher is required.

Step 1: Electromagnetic simulations

This step contains four different electromagnetic simulations:

- Cogging torque / Back EMF analysis
- Constant speed analysis
- Star up simulation
- Short-circuit failure simulation

Dedicated macros will generate geometry, meshing and physics, solving is also carried out automatically. Finally, a postprocessing including torque, speed and electrical variables visualization is proposed.



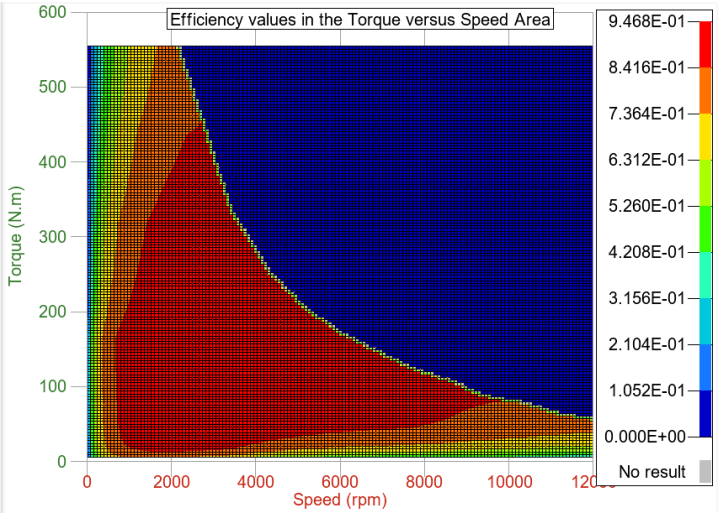
Currents during the star up of the axial flux motor

Step 2: Efficiency map generation

This step contains one single simulation: a parametric magnetostatic analysis at fixed rotor position: currents in D and Q axis are the input parameters, while the flux in these axes is the output.

Finally, these fluxes are the inputs to an Altair Compose algorithm which will calculate and represent the efficiency and the losses maps of the axial flux machine.

The semi-analytical method proposed allows very fast efficiency map calculus (about thirty minutes in a regular laptop).



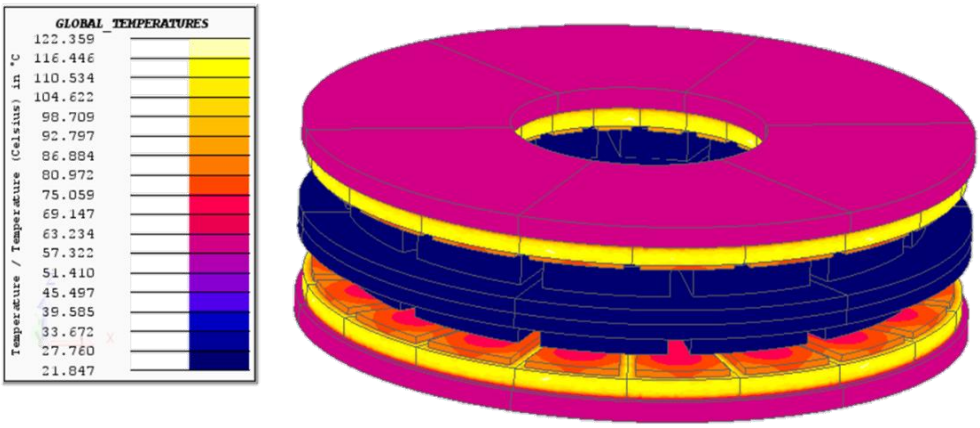
Efficiency map of the axial flux machine

Step 3: Thermal simulations

This step contains two thermal simulations:

- Steady state simulation
- Transient simulation

One dedicated macro translates the geometry generated for the magnetic problem into another suitable for the thermal one. Then meshing, physics and solving are carried out by a second macro. Thermal behavior is studied at normal working conditions, providing iron and eddy current losses as inputs.



Axial flux machine temperatures at normal working conditions