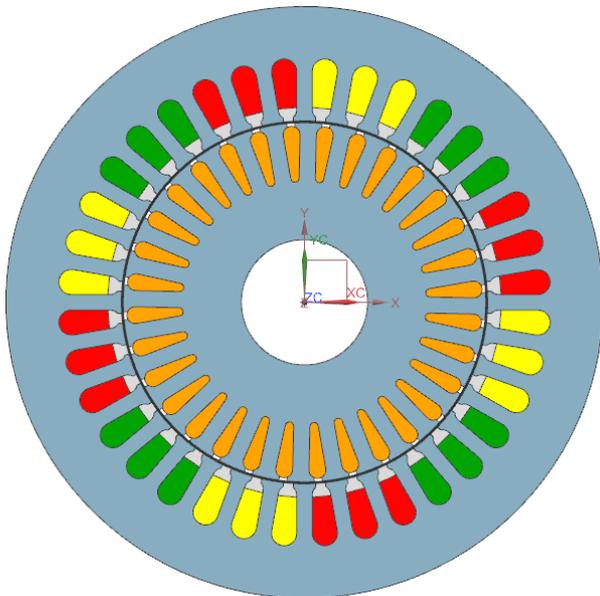


Application: 3KW Induction Motor Analysis

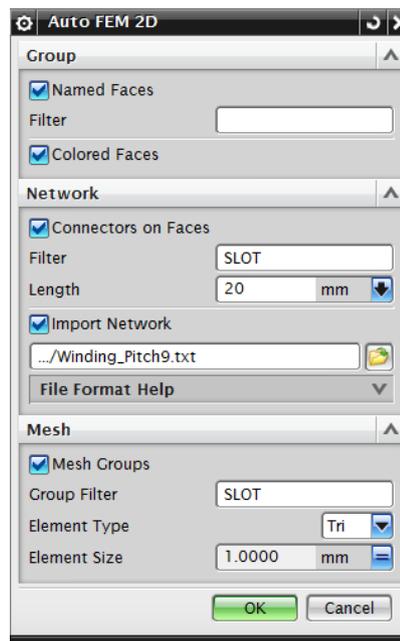
Initial Situation

Four-Pole Induction Machine Simulation

The task is to study typical characteristics such as torque and phase current behavior over the slip, as well as others. The NX CAD model is built up in a parametrically way using synchronous modeling tools and therefore it allows studying variations easily.



Picture: 3 KW Induction Motor



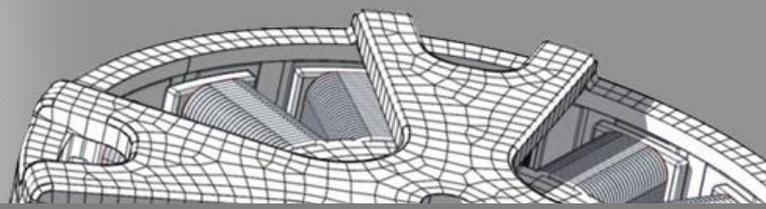
Picture: AUTO FEM Tool for automatic Generation of Analysis Models.

Some input data:

- Input Voltage (rms) 220 V
- Number of Poles: 4
- Number of windings per slot: 17
- Cage: Alu,
- Rotor, Stator: Electrosheet
- Velocity: 1500 U/min (sync)

Following are some references to other work regarding this motor:

- J. Gyselincx, "Twee dimensionale dynamische eindige-elementenmodellering van statische en roterende elektromagnetische energieomzetters", Ph.D. Thesis, Universiteit Gent, 2000.
- J. Gyselincx, L. Vandeveld, J. Melkebeek, "Multi-slice modeling of electrical machines with skewed slots - The skew discretization error", IEEE Trans. Magn., 37(5):3233–3237, 2002.
- J. Gyselincx, L. Vandeveld, P. Dular, C. Geuzaine, W. Legros, "A general method for the frequency domain FE modelling of rotating electromagnetic devices", IEEE Trans. Magn., 39(3):1147-1150, 2003.



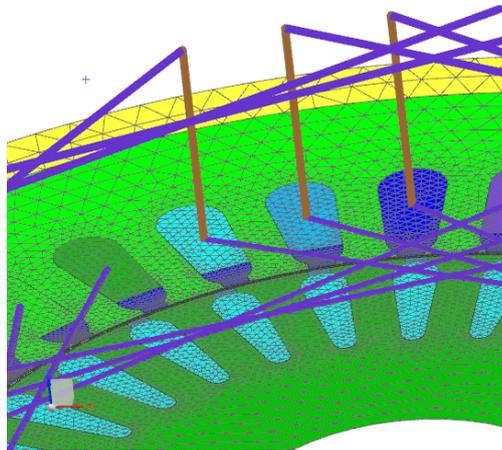
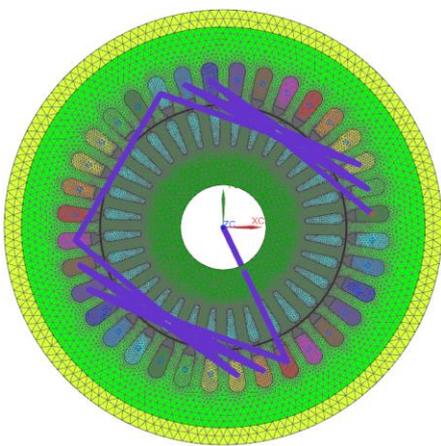
Appropriate Method

Magnetodynamic Analysis in Frequency Domain

In the CAD model all slot and bar faces have names assigned to them. These names allow the automatized building of the FEM model in NX using the AUTOFEM function that belongs to the Magnetics solver kit. This tool works in the following steps:

1. Automatic creation of groups based on CAD names or Colors,
2. automatic creation of circuit elements,
3. import of the winding sheme from a text- or excel file,
3. automatic creation of meshes on the groups.

After the meshes and circuits are built all physical properties are assigned to them. Therefore we assign properties (library-material, number of turns, ...) to one slot and copy these property to all others. In the NX simulation file we assign a motion condition and the currents for U, V, W. All these parameters are stored as NX expressions and allow easily modification.



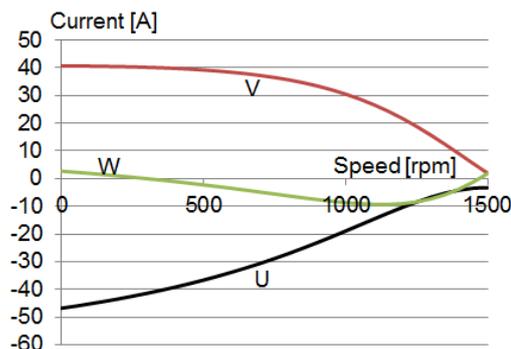
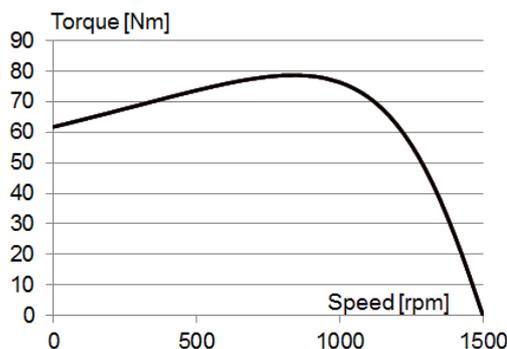
Picture: Automatically generated FEM Model: Meshes and Circuits for the Windings

Picture: Detailed View to some Windings and Slots

Result

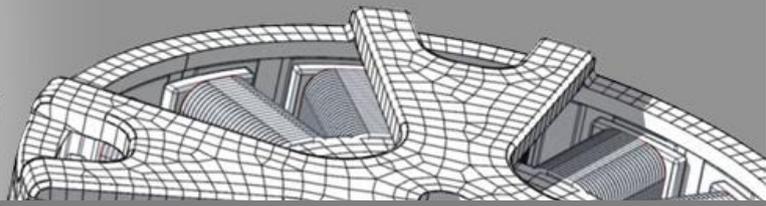
Frequency Sweep over Rotor Slip

The analysis is done using a parameter sweep function that sweeps the slip velocity of the rotor over the desired range. Results are the torque and phase currents.



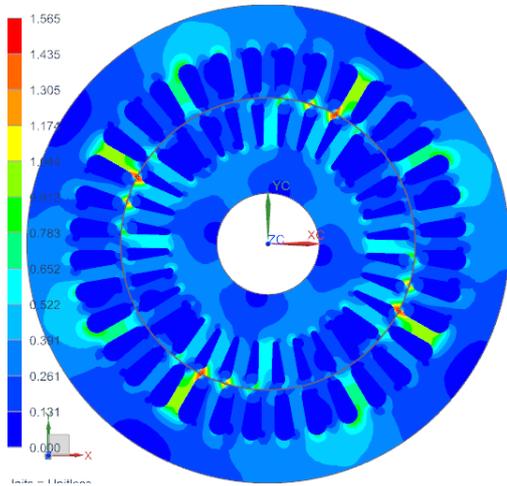
Picture: Torque over Speed Result

Picture: Current over Torque Result

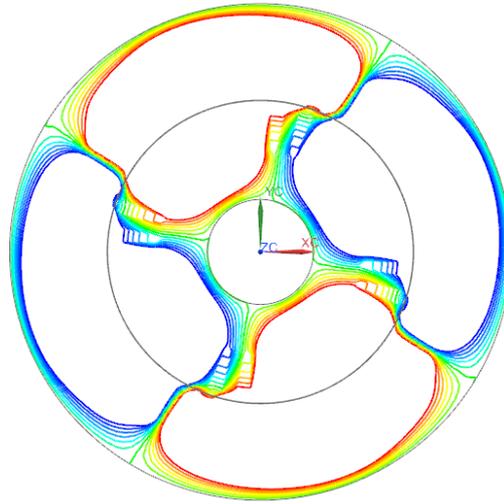


Fluxdensity and Potentiallines

Other interesting results from the FEM analysis include the fluxdensity. This plot gives useful information about utilization of geometry and material.



Picture: Fluxdensity in Contourplot



Picture: Potentiallines show direction of torque

Potentiallines can also give useful information. The following image shows the direction of torque and rotation: This motor will run counterclockwise.