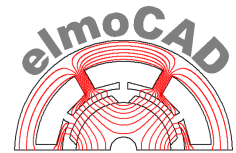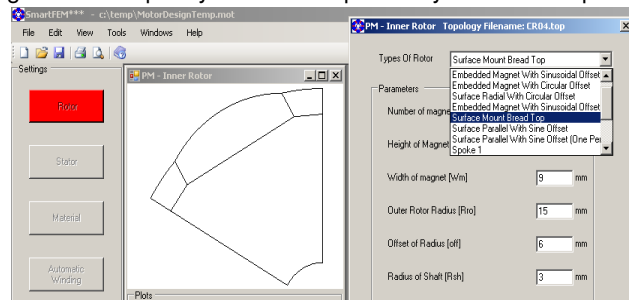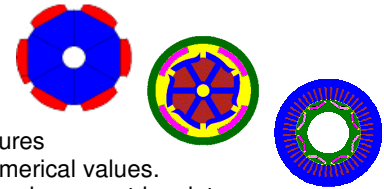# smartFEM & FEMAG

Analysis & Design of PM Electrical Drives

smartFEM is an innovative development system for electrical drives that combines analytical calculations with numerical FEM calculations in consideration of power electronics. smartFEM uses the simulation software FEMAG from Prof. Dr.-Ing. Konrad Reichert as FEM solver and offers a lot of special functions for dimensioning and optimization. With smartFEM can users even without specific FEM knowledge determine easily and quickly the characteristics of an electrical drive.

Modelling

The graphical user interface offers very good possibilities to the users to model geometries quickly and uncomplicatedly. This is a special essential for contours, which cannot be described by lines and circular arcs. All measures are entered as alphanumerical values.

The effects of changed geometric data are immediately shown in corresponding graphical windows. The node chains are created in such a way, that good meshes according to the actual motor design will be created and can also be adapted by the user. The Material Explorer allows the specification of non-linear material data of electrical steel and magnets.

FEM-Simulations and Analytical Calculations

allow fast and precise calculations of important parameter, which are computed by parametric over i.e. rotor position, magnetisation, current and voltage shapes. Time consuming FEM simulations are only executed if necessary. The impact of changes (i.e. of the winding scheme or rotor/stator skewing) are presented immediately without additional FEM calculation. Analytical calculations of the dynamic behaviour during start up or steady state can be executed selectively with user defined or with in co-simulation by FEMAG determined parameter with simultaneous consideration of the impact of electronic controllers. The control of FEMAG is done by smartFEM full automatically.
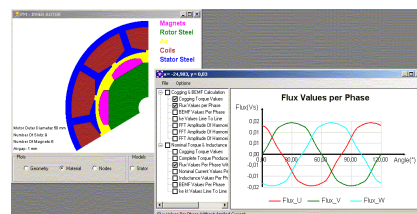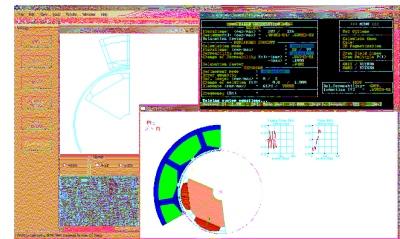
Analysis and Characteristics

including important values for the evaluation of motor behaviours are created basically on the FEM and analytical calculations, i.e. progression of magnetic flux, BackEMF, cogging torque, current, inductance, etc. The results of the dynamical calculations show the progression of speed, torque, current, during start up and steady state operations. All results can be copied and used in other applications.

Functionality overview

- Geometry
  - Inner-/outer rotor, brushed, universal and linear motors/generators, magnetization coils
- Materials
  - Electrical steel incl. loss values, magnets, conductors
- Winding scheme
  - Single and double layer windings
- FEM and Analytical-FEM coupled simulation
  - BEMF, Cogging Torque, Torque, Inductance, Losses, Forces
- Parametric calculations
  - Possible for geometry and calculation parameters
- Graphical analysis
  - Field plots, curve diagrams, result values in text tables
- Documentation generator
  - Word document containing design and result data/grafics
- Interfaces
  - CAD, electronic simulation, office products