JumpStart seminar for magnetic engineers

1. Introduction. Solving a problem in QuickField
1.1. QuickField analysis types
1.2. Finite Element method basics. Features and limitations of QuickField FEA model
1.3. QuickField license types
1.4. QuickField system requirements
2. QuickField basics
2.1. QuickField problem solving stages
2.2. QuickField problem database
2.3. Problem creation
2.4. Geometry model creation
2.5. Physical properties definition
2.6. Result analysis
3. DC Magnetics.
3.1. Features, boundary conditions, field visualization methods.
Example: single loop coil with known current density
Example: uniform field generation by Helmholtz coil
Example: solenoid as a uniform field source. Using boundary conditions for defining the infinitely long solenoid.
3.2. Magnetic potential analogy with the temperature in heat transfer problems
Example: Finding the potential distribution needed for generation of the uniform field with given flux density in the plane –parallel problem
3.3. Inductance. Inductance wizard in QuickField postprocessor.
Example: Helmholtz coil inductance.
3.4. Mutual inductance of two electric contours. Inductance of the distributed coil with a non-ideal link. Circuit approach for the inductance calculation for two magnetic coupled contours.
3.5. Magnetic simulations of non-linear materials. BH curve definition. Static and dynamic permeability.
Example: Calculation of the dynamic permeability
3.6. Permanent magnets in QuickField. Using the surface currents and coercive force for defining the magnets. Magnetized sphere, magnetized brick.
Example: Radially magnetized pipe
Example: Periodic structure with permanent magnets
Example: Force of two cylindrical magnets interaction
3.7. Simulation of the magnets with complicated shape
Example: C-magnet
3.8. Boundary conditions commonly used in magnetic problems. Symmetry conditions. Conditions for superconductor surface (Bn=0). Condition Ht=0. Condition A=0.
4. AC Magnetic field analysis.
4.1. Features, boundary conditions, field visualization methods

4.2. Impedance wizard
Example: 2-wire line inductance calculation using field and circuit approaches.
Example: 3-phase transmission line inductance

4.3. Eddy currents in the solid conductors. Frequency dependence of the eddy currents. Eddy current effect on the inductance.

4.4. Complicated cases of the inductance calculations. AC magnetic inductance in the presence of the DC magnetization. Static and dynamic inductivities. Eddy current effects on the inductance.
Example: Calculation of the current and inductance for the conducting disk in the AC magnetic field

4.5. Virtual experiments with the AC excitation of the coil in the air.
Examples: How the current in the coil is affected by putting the permanent magnet, conducting disk, steel disk close to the coil.

5. Transient magnetic field analysis.

5.1. Features, boundary conditions, field visualization methods
Example: Transient magnetic problem with permanent magnet and AC current

5.2. Inductance from the circuit point of view. Change of inductance during the transient magnetic process.
Example: transient magnetic analysis of the pulse in the conducting disk

6. Coupling in QuickField.

6.1. Types of coupling in QuickField

6.2. Export of the magnetic state.
Example: AC signal over DC bias. Two ways of QuickField analysis (AC magnetic-DC magnetic coupling vs Transient Magnetic simulation)

7. Thermal analysis of the electromagnetic systems

7.1. Static thermal analysis. Features, boundary conditions, field visualization methods
Example: slot of electric machine

7.2. Transient thermal analysis. Features, boundary conditions, field visualization methods
Example: Heating and cooling of the coil

7.3. Coupled electromagnetic – heat transfer analysis
Example: Heating of the conducting disk by eddy currents
Example: Heating and cooling of the coil and disk by switching DC source

7.4. Other heat sources for coupled analysis. DC Conduction as a heat source.
Example: Heating of the grounding system

8. Electric analysis. Problem formulations.

8.1. Difference between the magnetic and electric formulations in QuickField. Correct choice of the analysis type

8.2. Electrostatic analysis. Features, boundary conditions, field visualization methods.
Example: Capacitance of the flat capacitor
Example: Self and mutual capacitances of the multiphase transmission line
Example: Object near the high voltage power line

8.3. DC Conduction analysis. Features, boundary conditions, field visualization methods.
Example: Grounding system (see 7.4)

8.4. AC Conduction analysis. Losses in the dielectrics. Features, boundary conditions, field visualization methods
Example: Slot insulation
8.5. Transient electric analysis
Example: ZnO voltage arrester
9. Stress analysis of the electromagnetic systems
9.1. Mechanical problems description and results in QuickField
Example: Plain stress simulation
Example: Plain strain simulation
Example: Axisymmetrical stress analysis
9.2. Coupled problems of electromagnetic and stress analysis
Example: Tokamak coil
9.3. Multiphysical problems with combined analysis of electromagnetics, heat transfer and stress
Example: Multicore cable.