SPEED: Software for Electric Machine Design and Analysis

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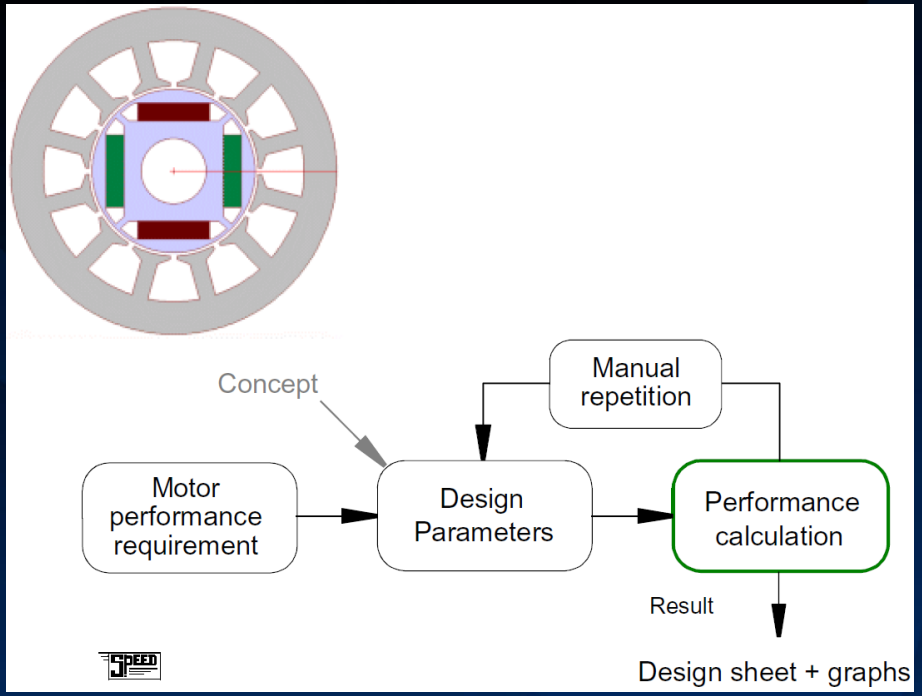
What is *SPEED*?

- The leading design software for electric machines
- Detailed analysis with finite-element links or finite-embedded solver for
  - Motors, Generators and Alternators
  - including inverters and other electronic controls
- Application areas (main)
  - Automotive including electric & hybrid vehicles
  - Aerospace
  - Industrial and automation
  - Domestic appliances
  - Power tools
  - Medical systems
- Over 150 corporate accounts
  - Over 1500 users
  - A Worldwide Distributors Network including support
  - Operating in all industrialized countries

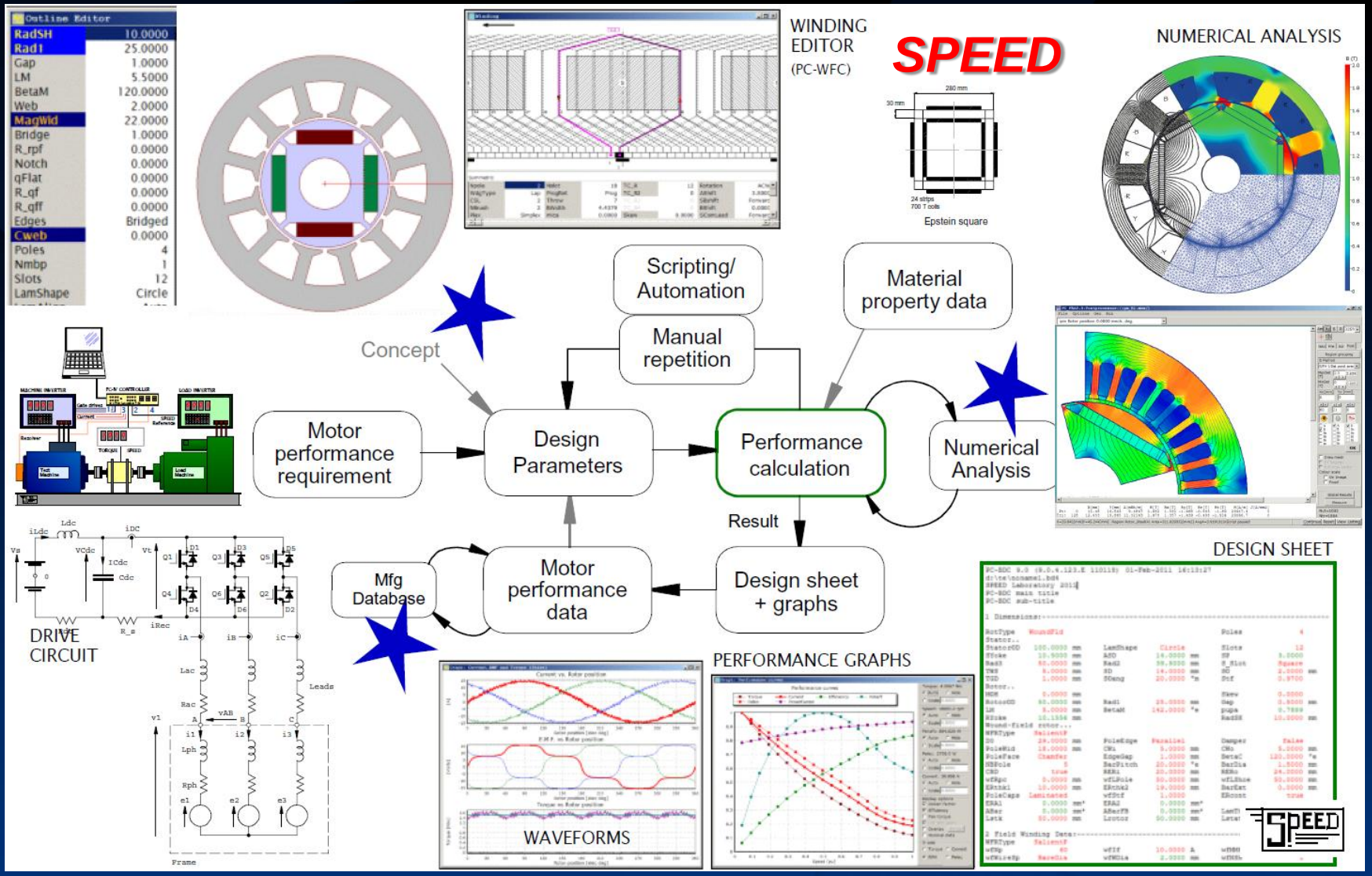
What is *SPEED*?

- ***SPEED* brings authority in electrical machine theory and design**
  - based on a vast range of applications in real product design
  - much more than just a calculator
- **Not just software, but as well as**
  - Training,
  - Technical support,
  - Documentation (manuals, tutorials and electrical machine theory books)
  - Engineering services and
  - Consulting through the distributors

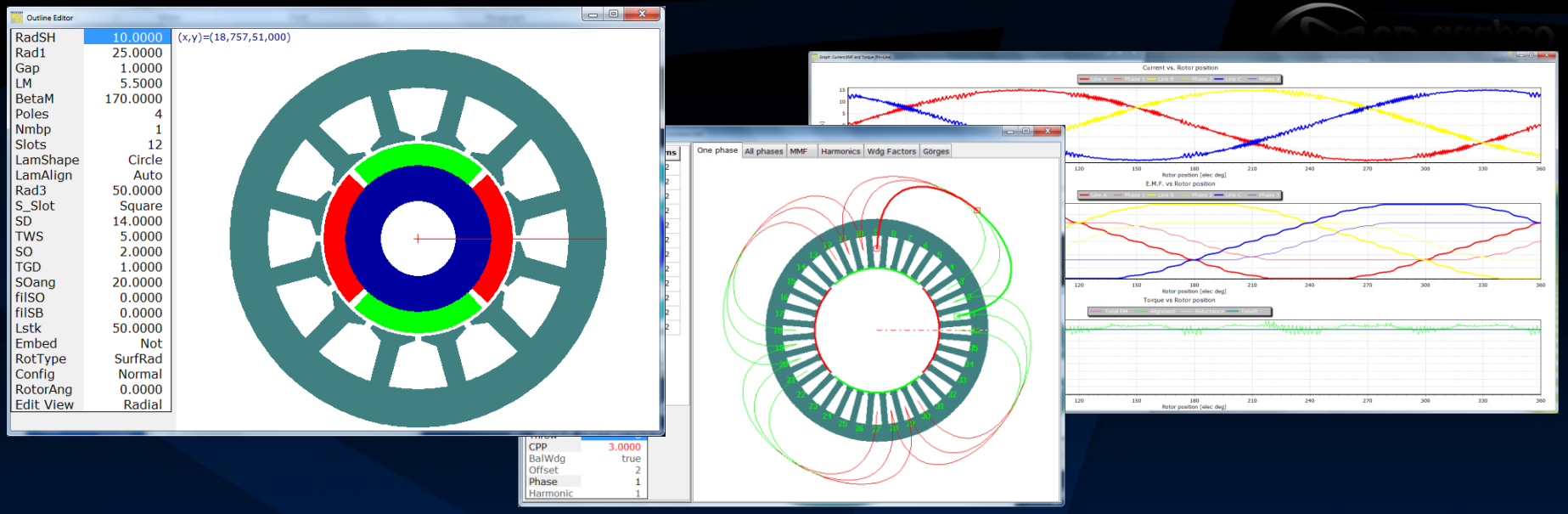
Electric machine calculations: In general



Electric machine calculations using *SPEED*: not to replace the designer but provide a fast calculation tool to try ideas



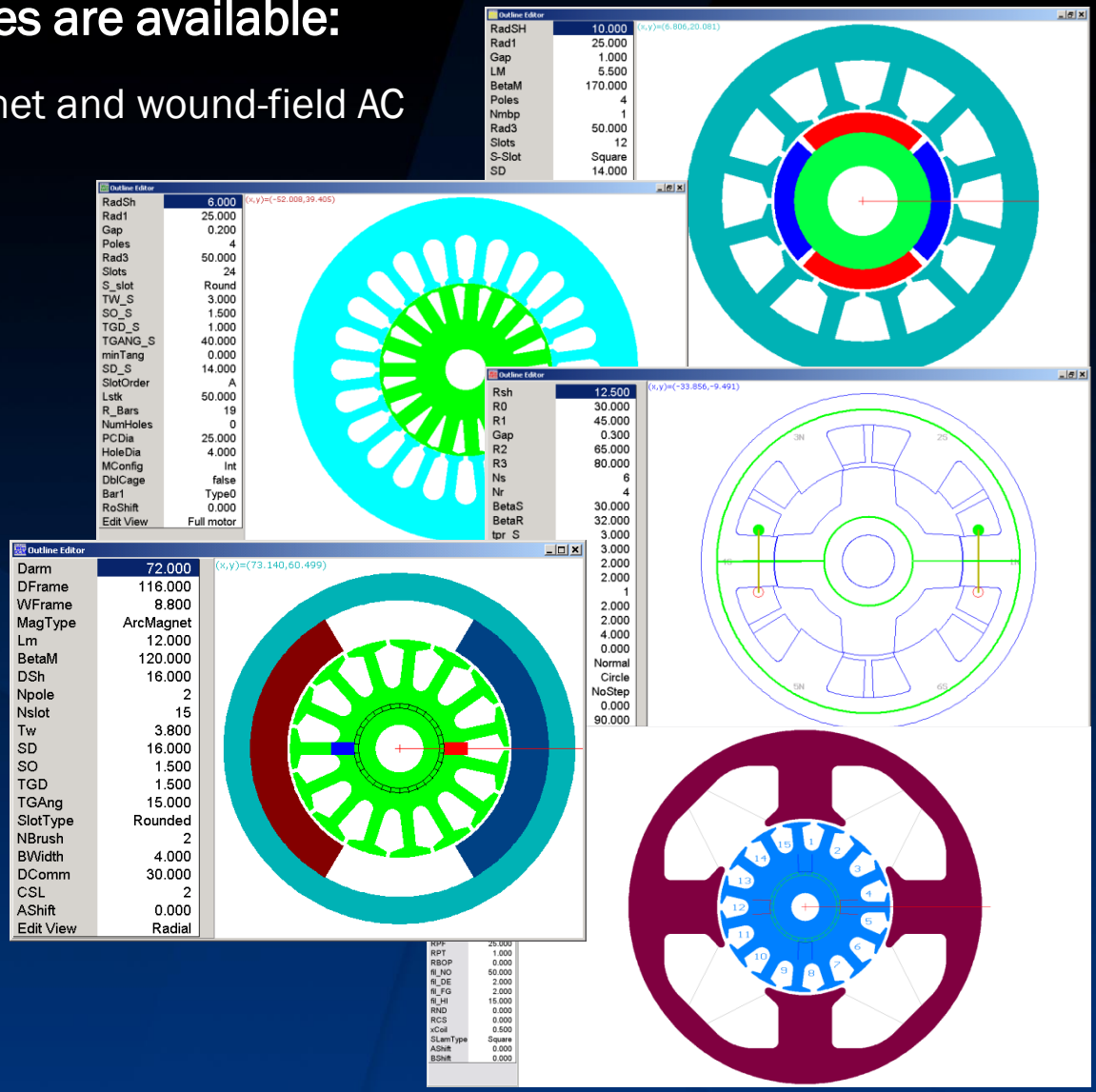
The *SPEED* Software



- **Analytical based so gives near instantaneous calculation speeds**
  - input dimensions, select materials and drive and calculate performance
    - Initial Design – 10 Minutes
    - Optimized Design – within hours
- **Specialised user interface to ease data input and interpretation of results**
  - dedicated geometry and winding editors
  - produces performance graphs to aid understanding
- **Detailed analysis with finite-element links or**
  - The embedded finite-element solver for key problems

The *SPEED* software programs

- **The following machine types are available:**
  - brushless permanent magnet and wound-field AC synchronous
    - PC-BDC
  - induction
    - PC-IMD
  - switched reluctance
    - PC-SRD
  - direct current (PM)
    - PC-DCM
  - wound field and PM commutator
    - PC-WFC



The *SPEED* Software history (main programs)

1986 – Speed Laboratory set up

1987 – PC-SRD released (DOS)

1989 – PC-BDC released (DOS)

1992 – PC-DCM released (DOS)

1994 – PC-IMD released (DOS)

…

2000 – Release of full Windows versions

…

2004 – PC-WFC released

…

2011 – CD-adapco acquired SPEED in June 2011

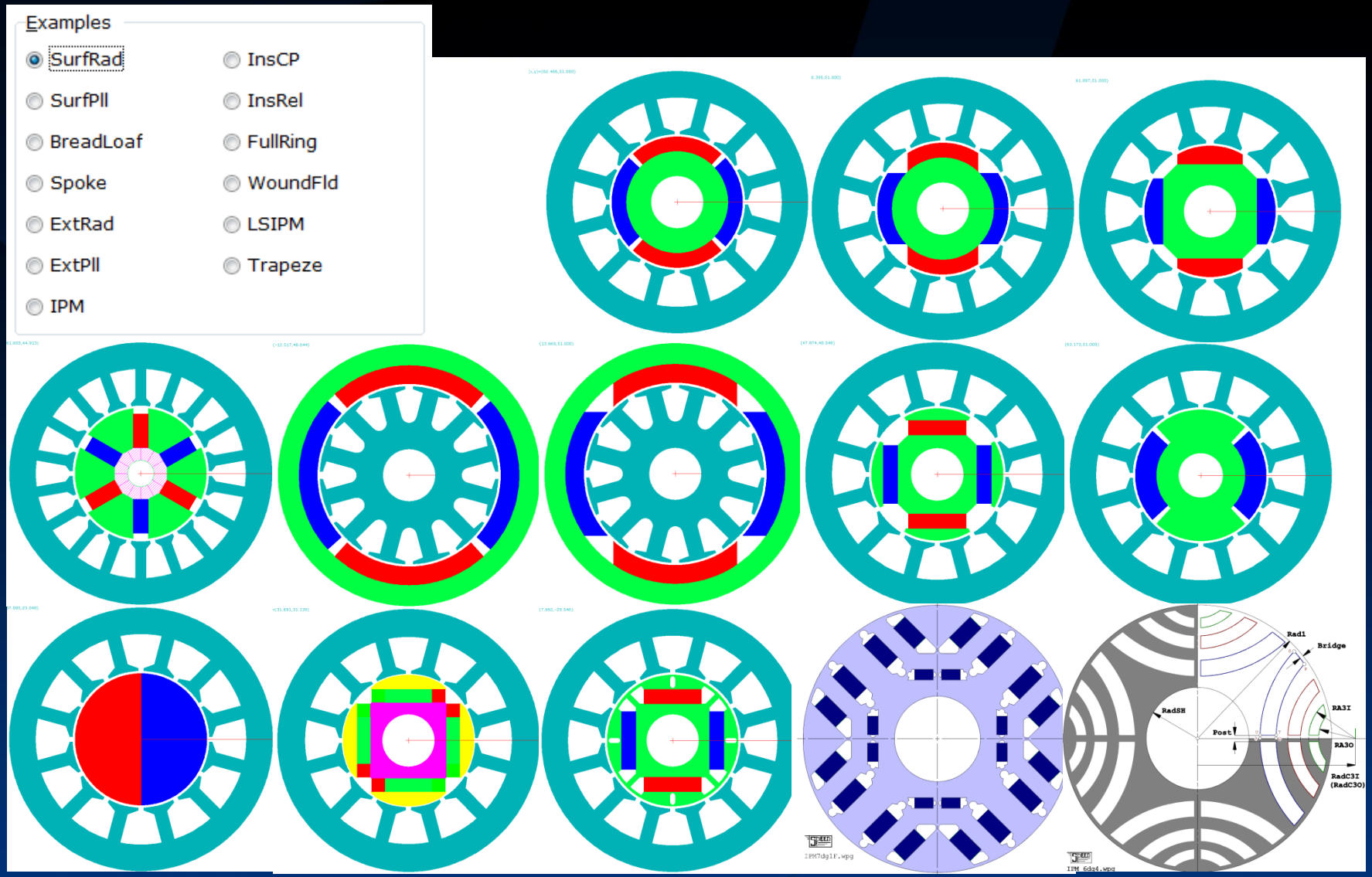
Present – Release versions (2011):

- PC-SRD 8.8, – PC-BDC 9.1
- PC-IMD 4.1, – PC-DCM 3.9 and
- PC-WFC 2.6

… Continuing development …

SPEED PC-BDC machine types

more than 40 basic standard templates



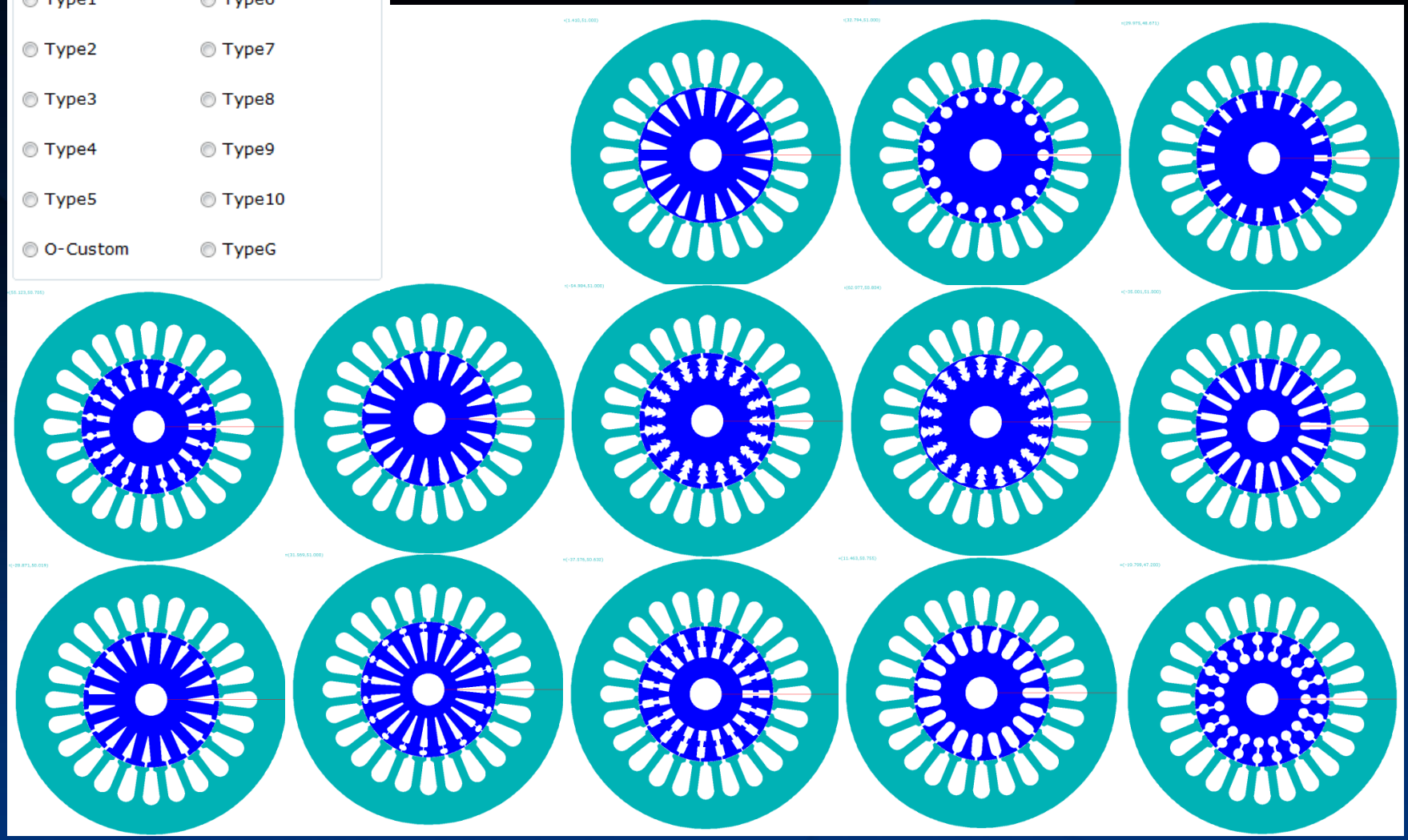
SPEED PC-IMD machine types

more than 40 basic standard templates

CD-adapco

Examples

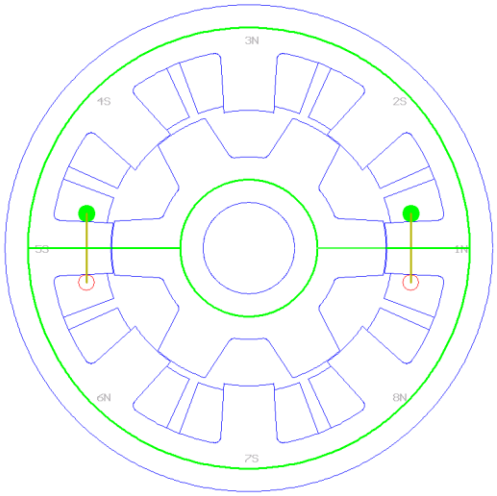
- Type0
- Type1
- Type2
- Type3
- Type4
- Type5
- O-Custom
- C-Custom
- Type6
- Type7
- Type8
- Type9
- Type10
- TypeG

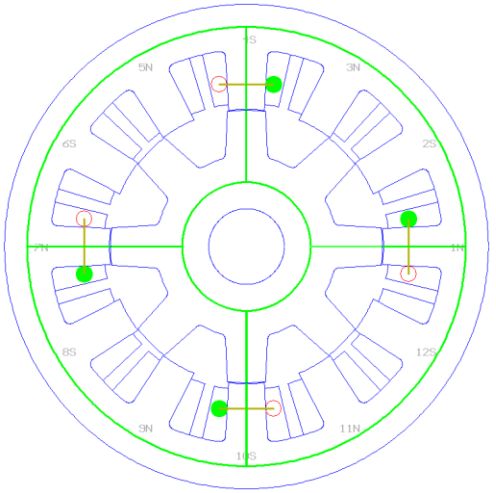


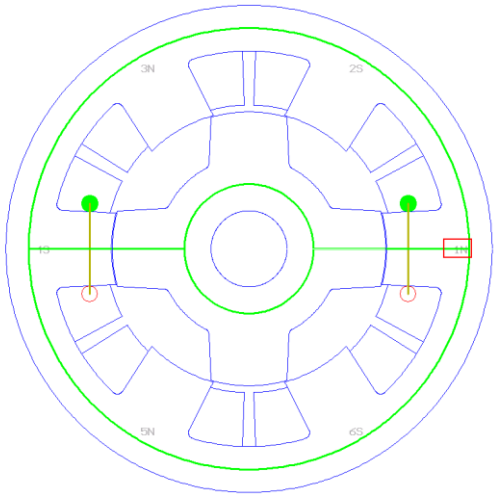
SPEED PC-SRD machine types

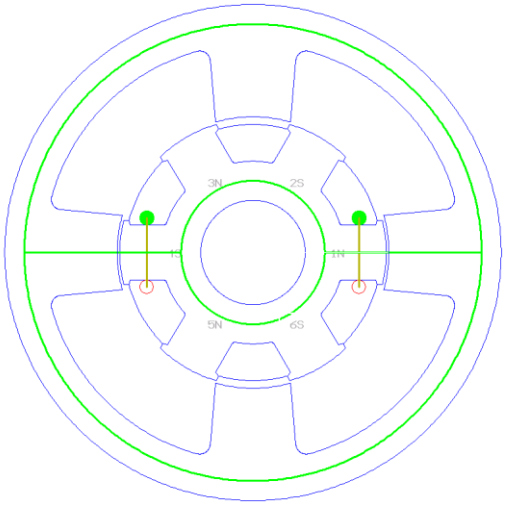
Examples

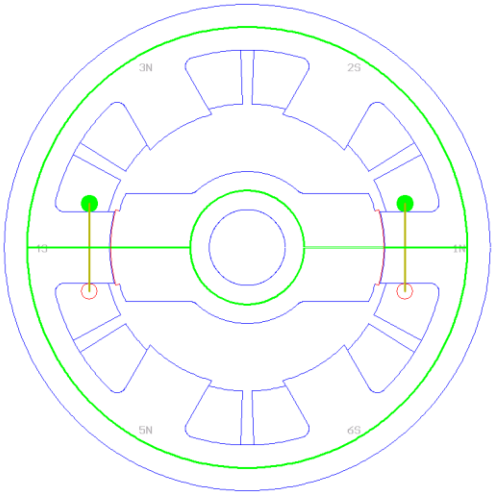
- (•) A little 3-phase motor
- ( ) A little 4-phase motor
- ( ) A 3-phase 12/8 motor
- ( ) An outside-rotor motor
- ( ) A stepped-gap 6/2 motor



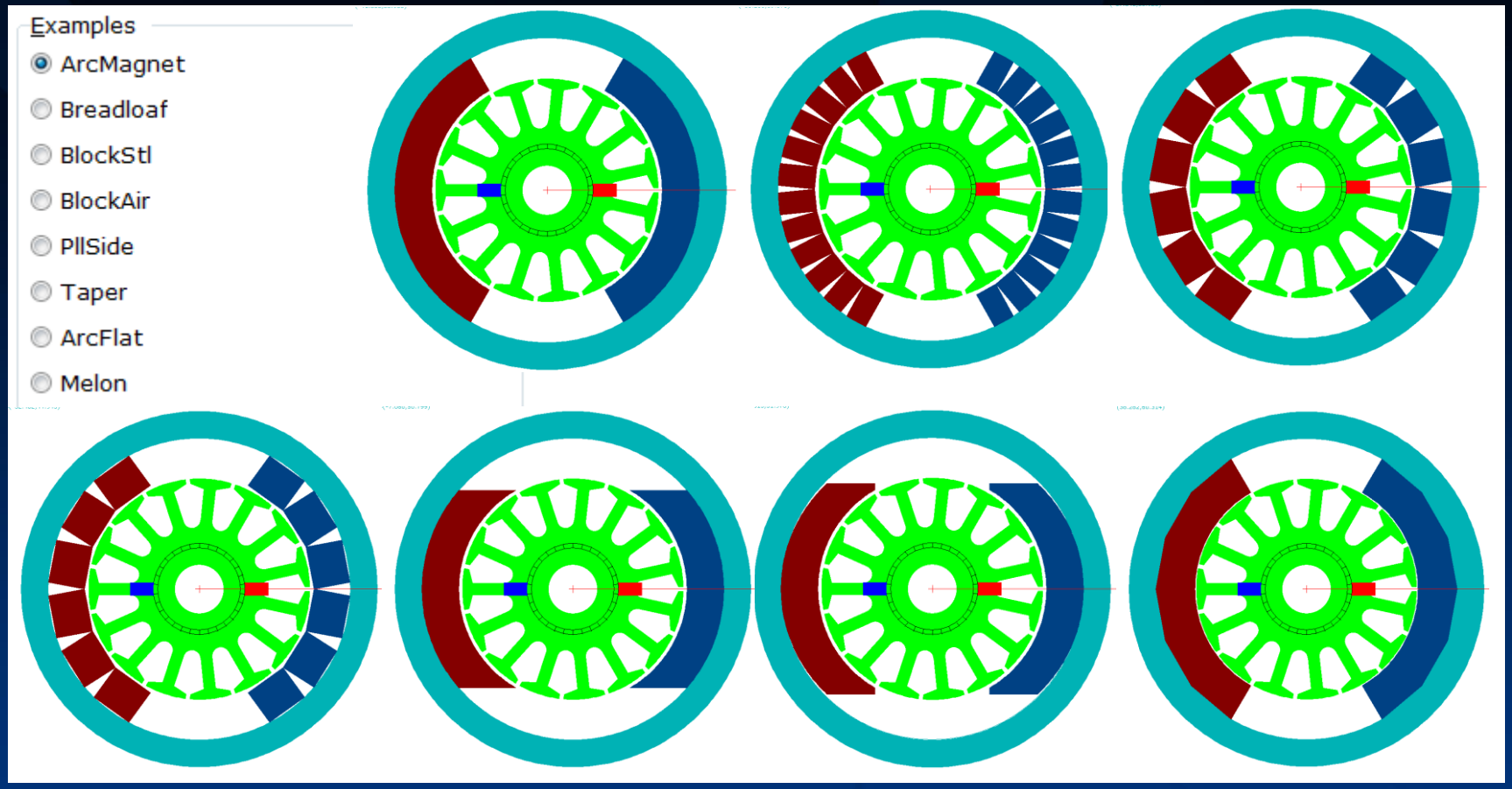




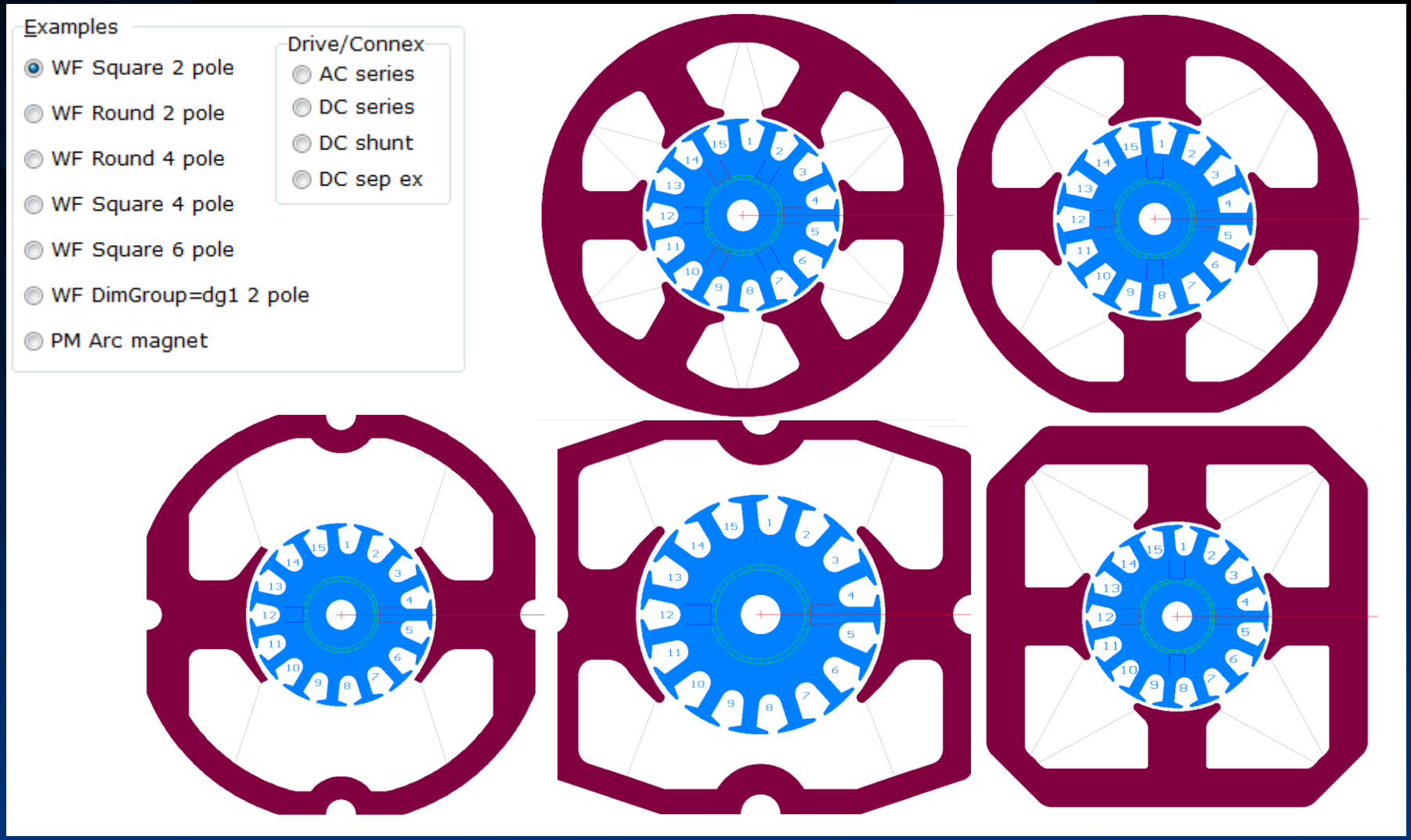




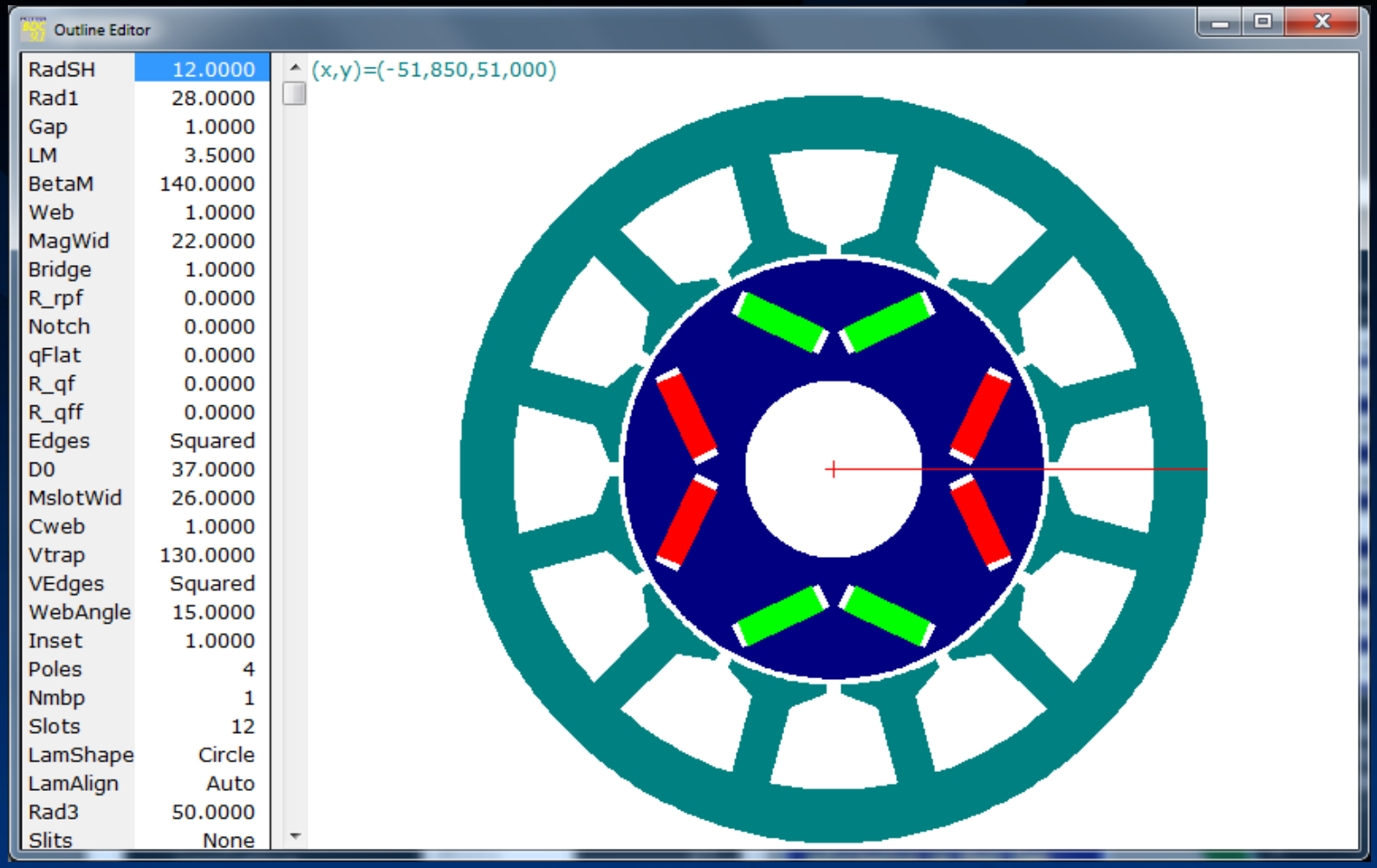
SPEED PC-DCM machine types



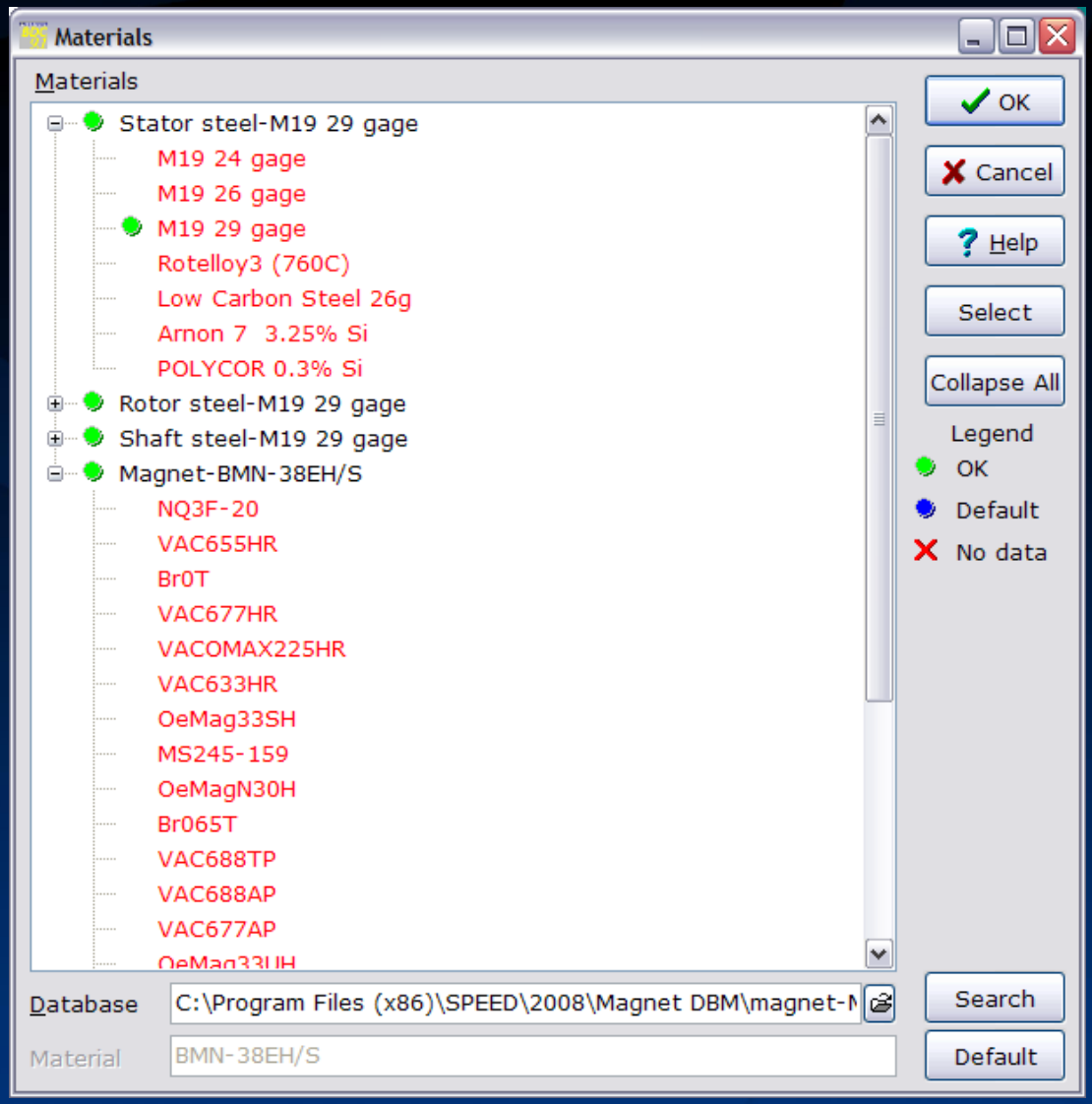
SPEED PC-WFC machine types



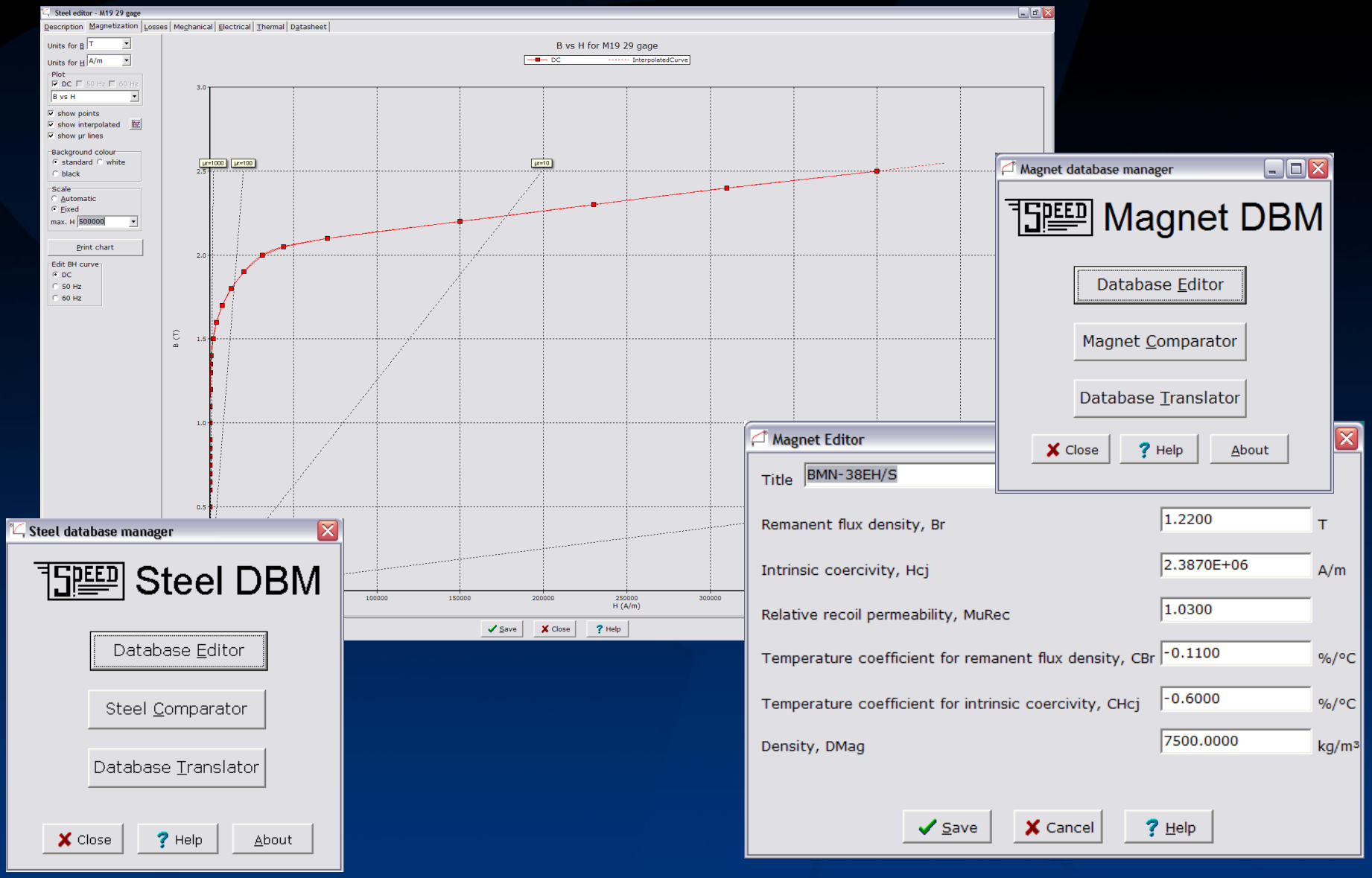
SPEED in use: Define the geometry The outline editor



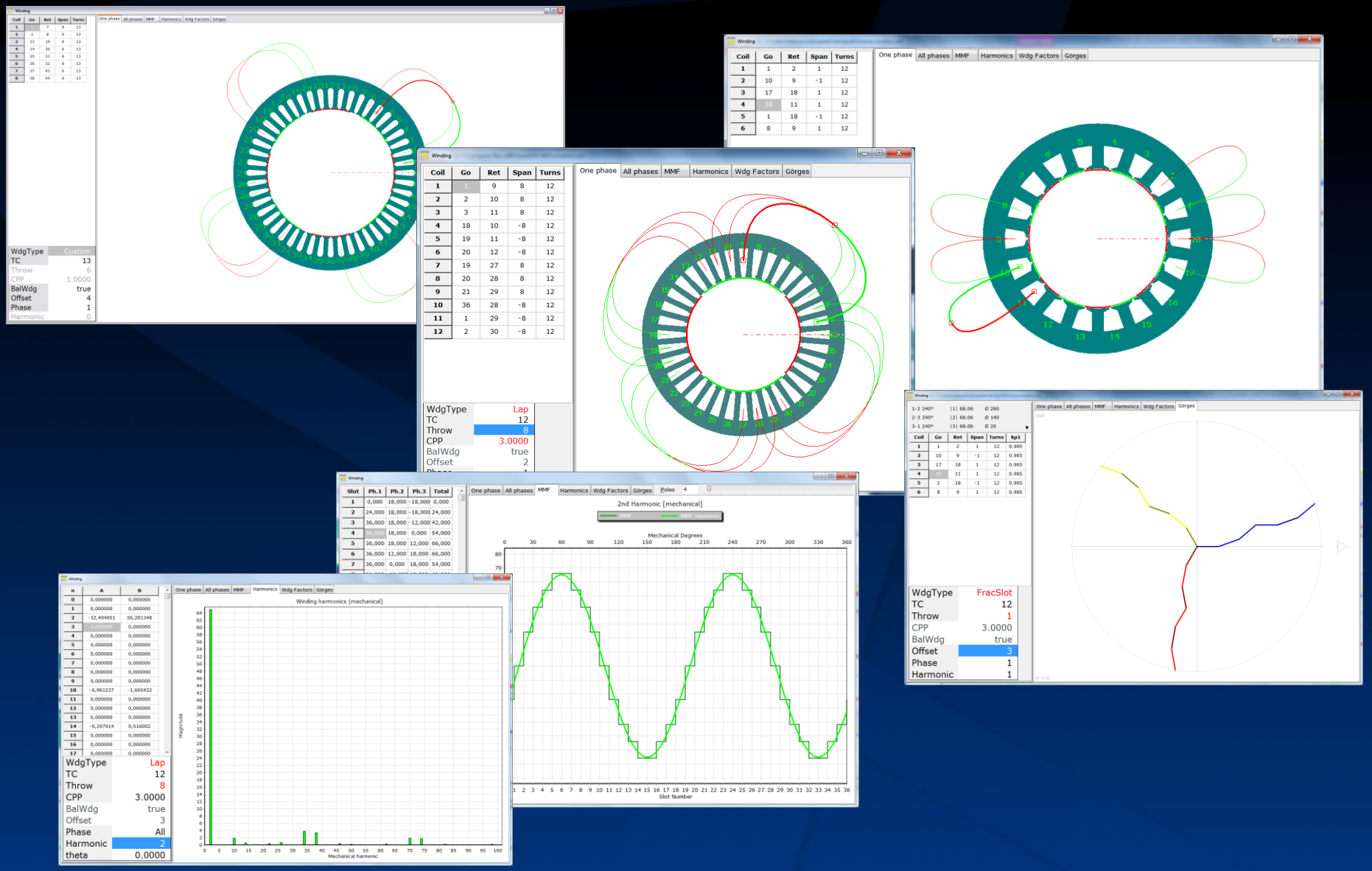
SPEED in use: Select material from the material database



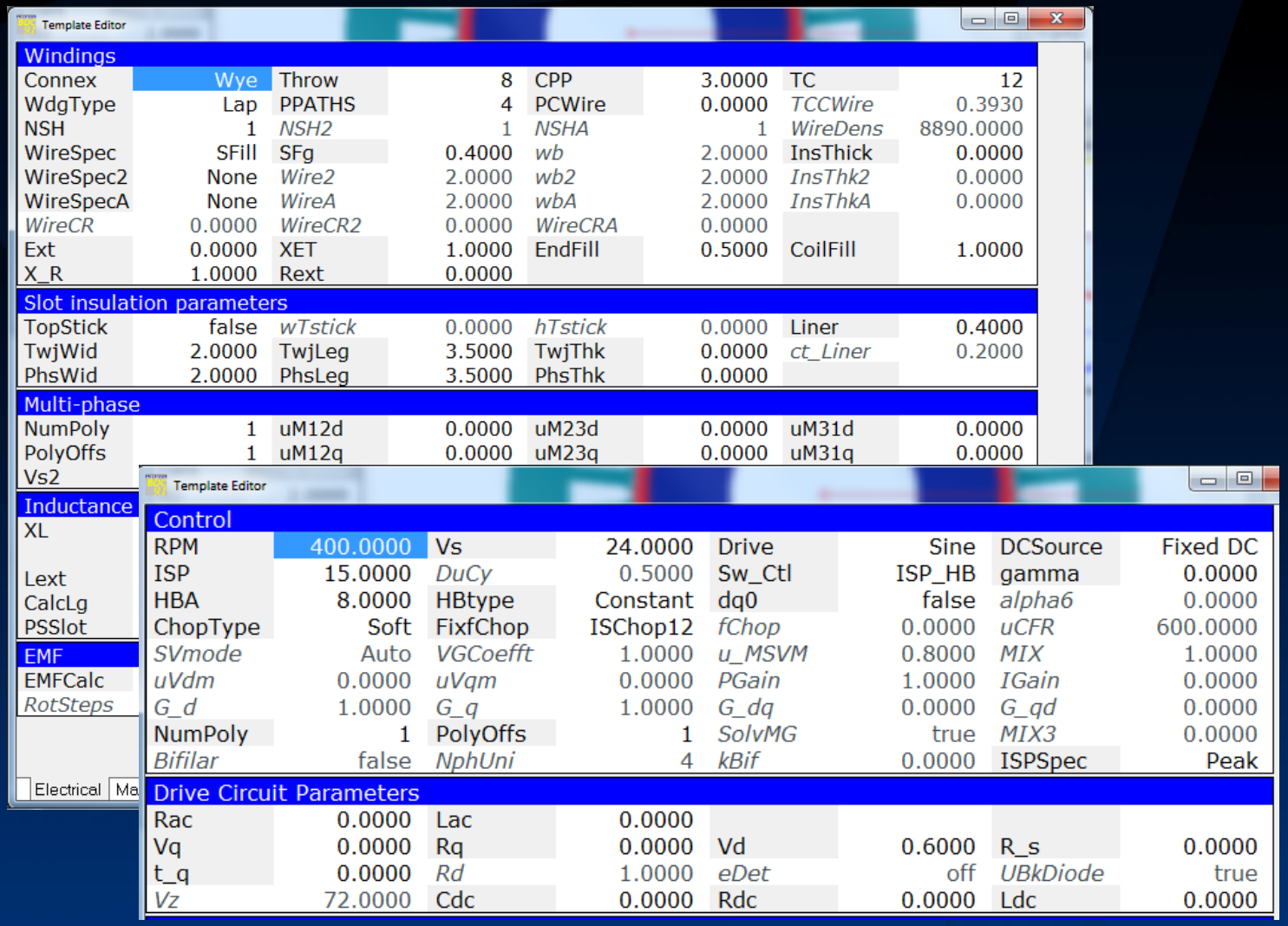
SPEED in use: Definition of the material using the Data Base Manager programs



SPEED in use: Definition of the winding – The winding editor

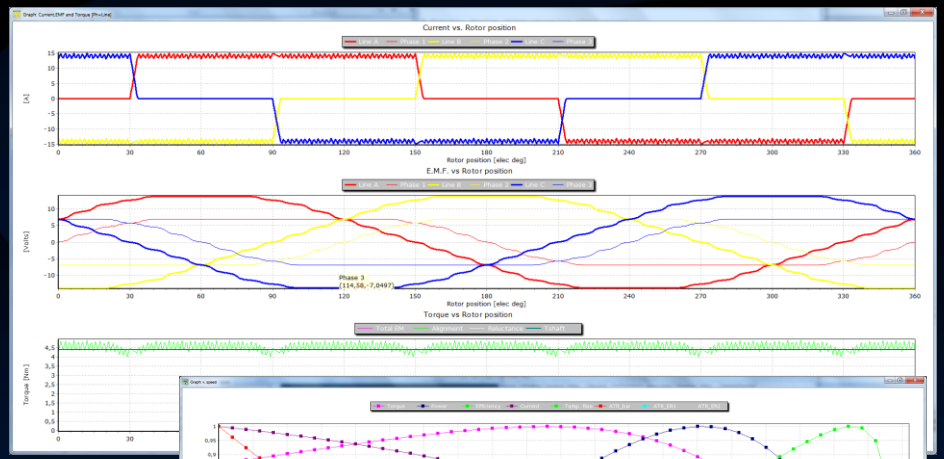


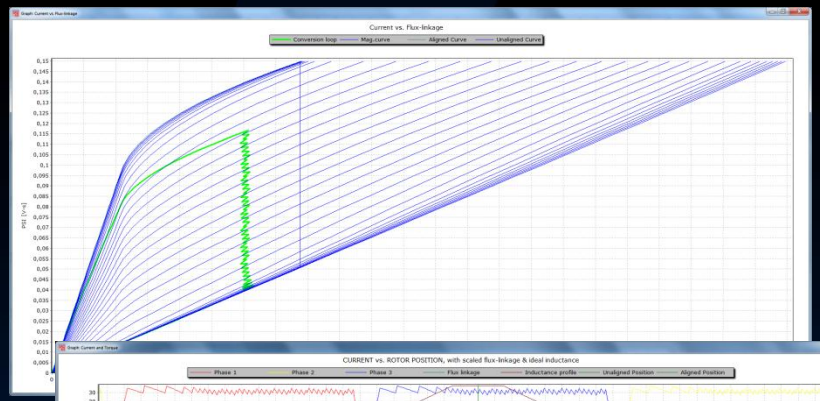
SPEED in use: The Template editor – input data for calculation options, temperature, control parameters, etc.

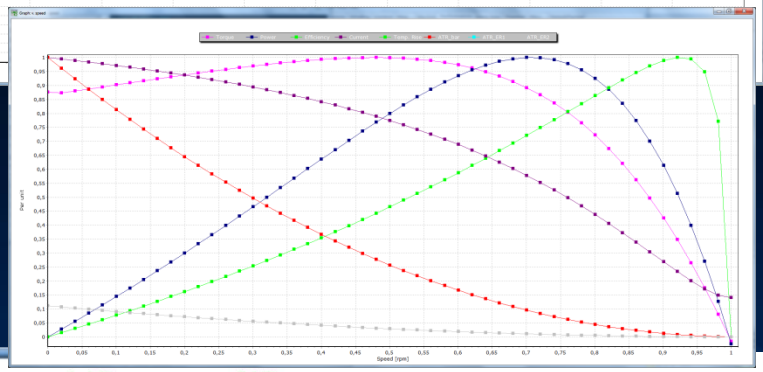


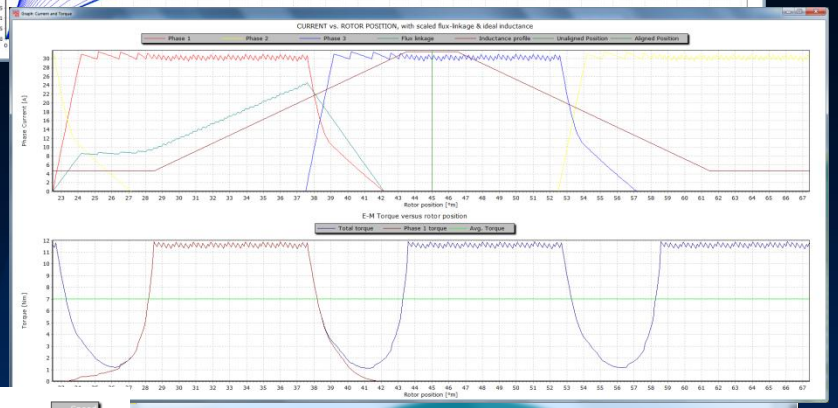
SPEED in use: Graphical Output – graphical feedback available

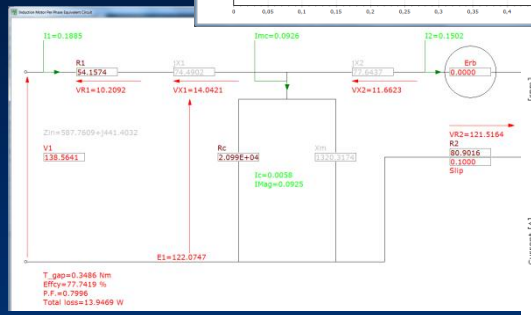
range of CD-adapco

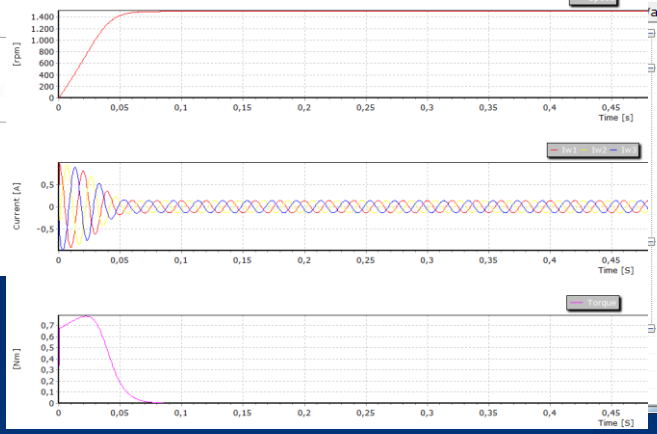


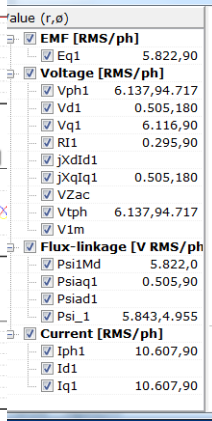


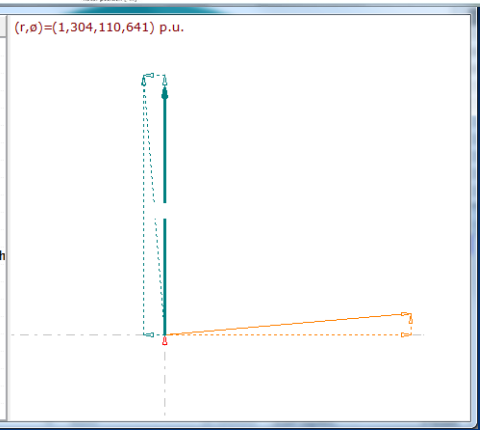




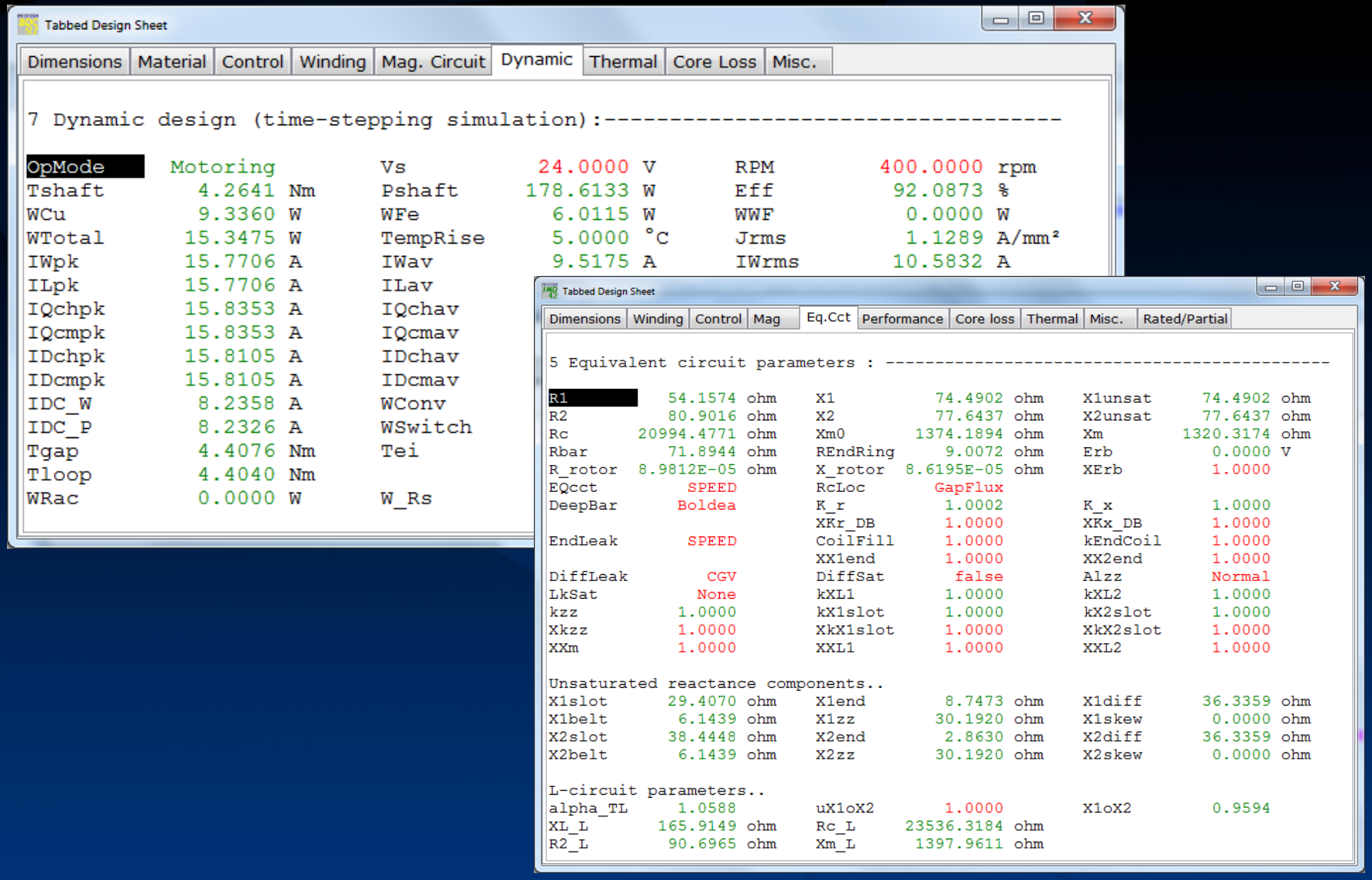






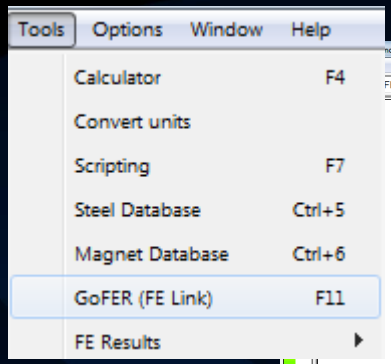


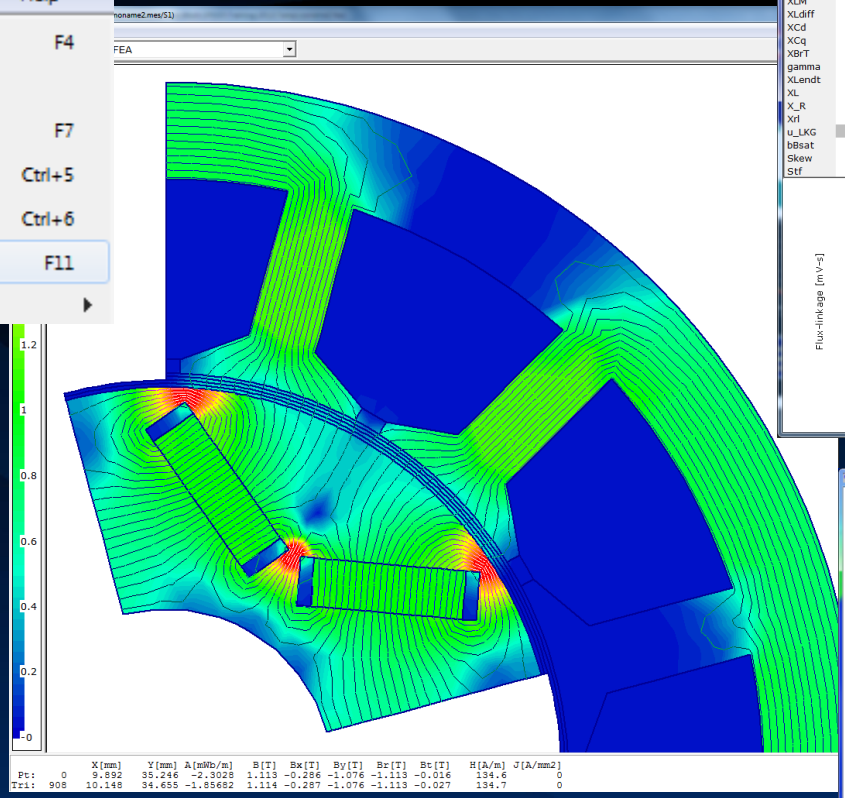
SPEED in use: Output design sheet – large range of numerical values available

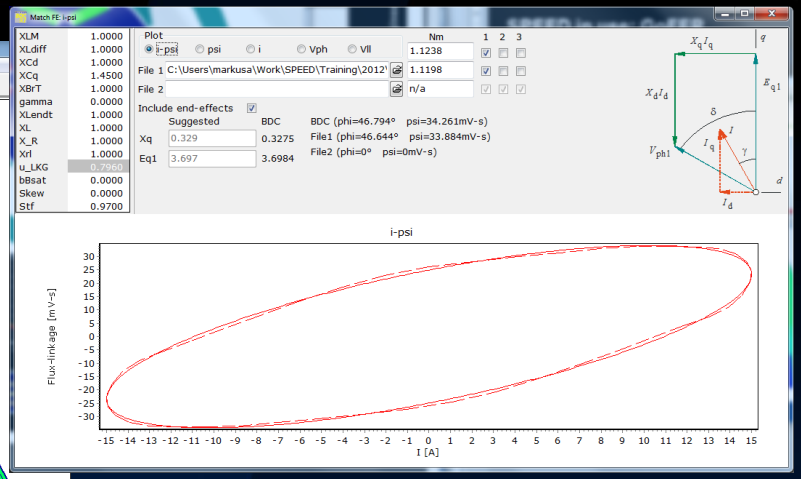


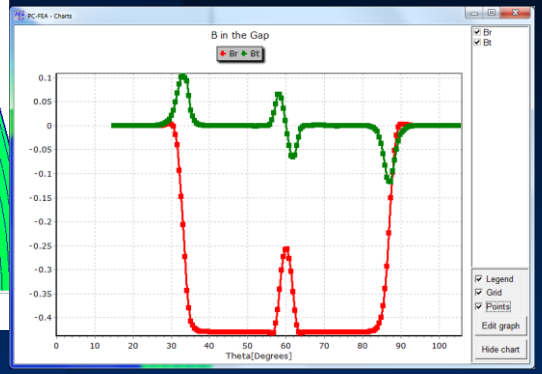
SPEED in use: GoFER

Go to Finite-Elements and Return





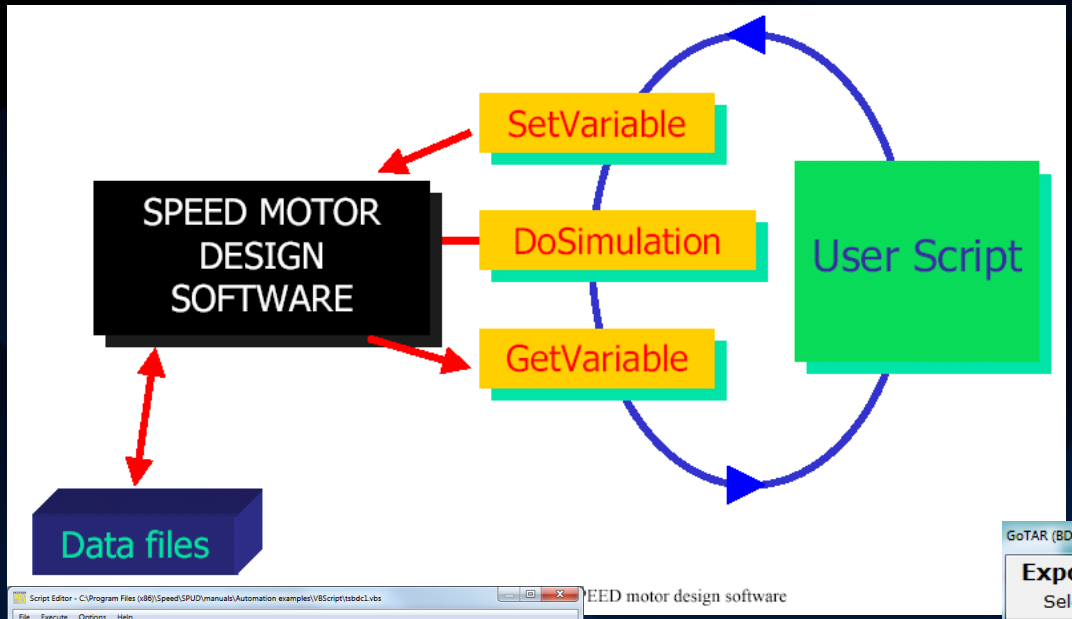


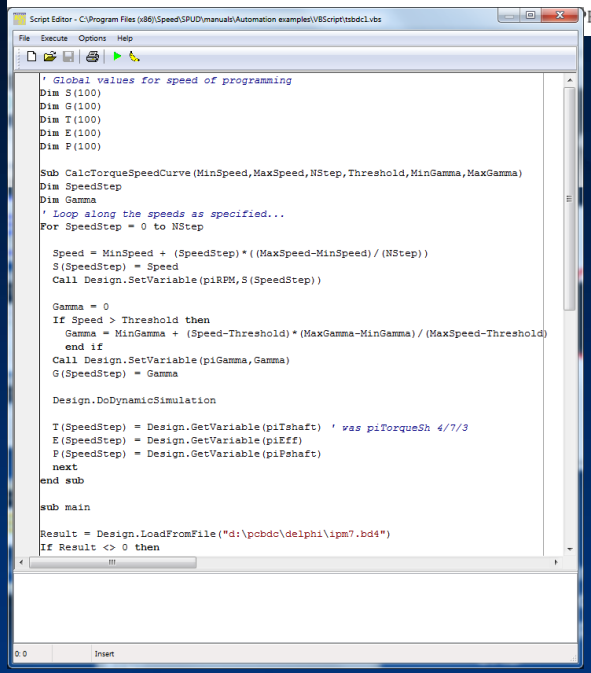


... or use the embedded FE-solver directly (PC-BDC only)

Embedded FEA Parameters							
ipsiCalc	PC-FEA	DDFE	FEdqDD(Q)	MatchFES	true	ipsiStep	18
SolDom	Default	*FEPoles*	1	IncShaft	false	Stator0	Slot c/l
MagMode	BrTEff/XBrT	AGLayers	4	UseFaces	true	FEBeep	true
FEEMFwfm	false	Id_min	1.0000	Iq_min	1.0000	*FEUppsi*	true
FEShow	false	PhysShim	false	FEAir	1.0000	MaxAngle	120.0000
SolTol	1.0000E-07	MaxIter	99	IncVirt	true		

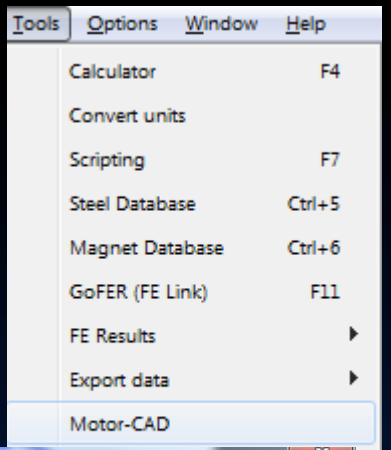
SPEED in use: Scripting (ActiveX)

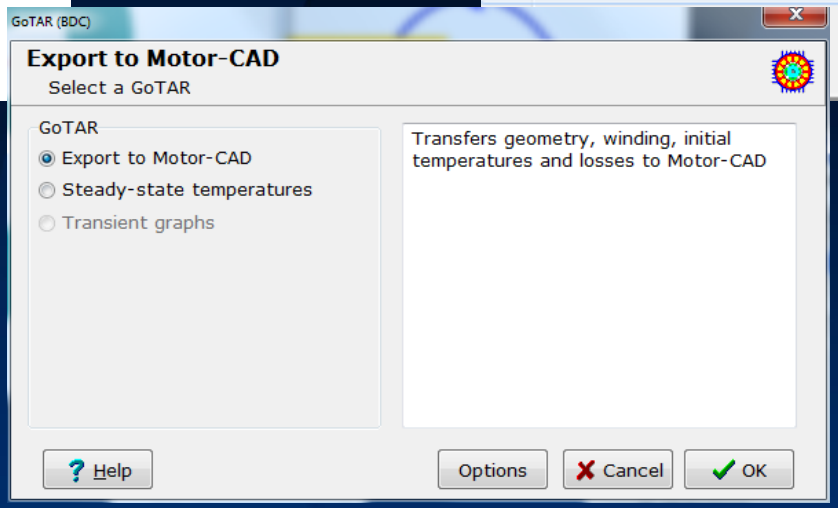




```
' Global values for speed of programming
Dim S(100)
Dim G(100)
Dim T(100)
Dim E(100)
Dim P(100)

Sub CalcTorqueSpeedCurve(MinSpeed,MaxSpeed,NStep,Threshold,MinGamma,MaxGamma)
Dim SpeedStep
Dim Gamma
' Loop along the speeds as specified...
For SpeedStep = 0 to NStep

  Speed = MinSpeed + (SpeedStep)*((MaxSpeed-MinSpeed)/(NStep))
  S(SpeedStep) = Speed
  Call Design.SetVariable(piRPM,S(SpeedStep))

  Gamma = 0
  If Speed > Threshold then
    Gamma = MinGamma + (Speed-Threshold)*(MaxGamma-MinGamma)/(MaxSpeed-Threshold)
    end if
  Call Design.SetVariable(piGamma,Gamma)
  G(SpeedStep) = Gamma

  Design.DoDynamicSimulation

  T(SpeedStep) = Design.GetVariable(piTshaft)  ' was piTorqueSh 4/7/3
  E(SpeedStep) = Design.GetVariable(piEff)
  P(SpeedStep) = Design.GetVariable(piPshaft)
  next
end sub

sub main

Result = Design.LoadFromFile("d:\pcbdc\delphi\ipm7.bd4")
If Result <> 0 then
```

GoTAR: Go to Thermal Analysis and Return





- **ActiveX links allows**
  automated linkage to other software packages such as Visual Basic, Matlab, Motor-CAD and more …