SPEED: Software for Electric Machine Design and Analysis

Markus Anders
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.
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 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 programs
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


– 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

Examples

- SurfRad
- SurfPll
- BreadLoaf
- Spoke
- ExtRad
- ExtPll
- IPM
- InsCP
- InsRel
- FullRing
- WoundFld
- LSIPM
- Trapeze
SPEED PC-IMD machine types
more than 40 basic standard templates
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

Examples:
- WF Square 2 pole
- WF Round 2 pole
- WF Round 4 pole
- WF Square 4 pole
- WF Square 6 pole
- WF DimGroup=dg1 2 pole
- PM Arc magnet

Drive/Connex:
- AC series
- DC series
- DC shunt
- DC sep ex
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
**SPEED in use: Output design sheet – large range of numerical values available**

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### Dynamic Design (time-stepping simulation):

<table>
<thead>
<tr>
<th>OpMode</th>
<th>Motoring</th>
<th>Vs</th>
<th>RPM</th>
<th>400.0000 rpm</th>
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<tbody>
<tr>
<td>Tshaft</td>
<td>4.2641 Nm</td>
<td>Pshaft</td>
<td>178.6133 W</td>
<td>Eff</td>
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<tr>
<td>WCu</td>
<td>9.3360 W</td>
<td>WFe</td>
<td>6.0115 W</td>
<td>WWF</td>
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<tr>
<td>WTotal</td>
<td>15.3475 W</td>
<td>TempRise</td>
<td>5.0000 °C</td>
<td>Jrms</td>
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<tr>
<td>IWpk</td>
<td>15.7706 A</td>
<td>IWav</td>
<td>9.5175 A</td>
<td>IWrms</td>
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### Equivalent Circuit Parameters:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
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<tbody>
<tr>
<td>R1</td>
<td>54.1574 ohm</td>
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<tr>
<td>X1</td>
<td>74.4902 ohm</td>
</tr>
<tr>
<td>X1unsat</td>
<td>74.4902 ohm</td>
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### Unsaturated Reactance Components:

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<tr>
<td>X1slot</td>
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<td>X1belt</td>
<td>6.1439 ohm</td>
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<tr>
<td>X2slot</td>
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<tr>
<td>X2belt</td>
<td>6.1439 ohm</td>
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### L-circuit Parameters:

<table>
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<td>UX1oX2</td>
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<tr>
<td>X1oX2</td>
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</table>
SPEED in use: GoFER
Go to Finite-Elements and Return

... or use the embedded FE-solver directly (PC-BDC only)
SPEED in use: Scripting (ActiveX)

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