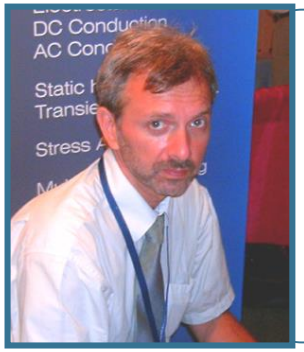
Electric circuit analysis with QuickField

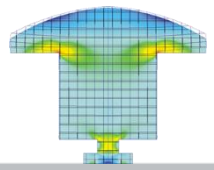
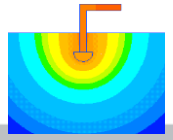
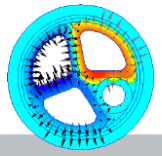
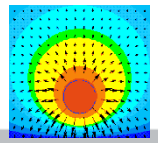
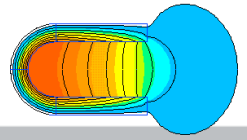
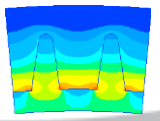
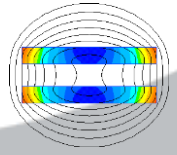
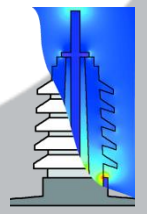


Vladimir Podnos,
Director of Marketing and Support,
Tera Analysis Ltd.

Alexander Lyubimtsev
Support Engineer, Tera Analysis Ltd.

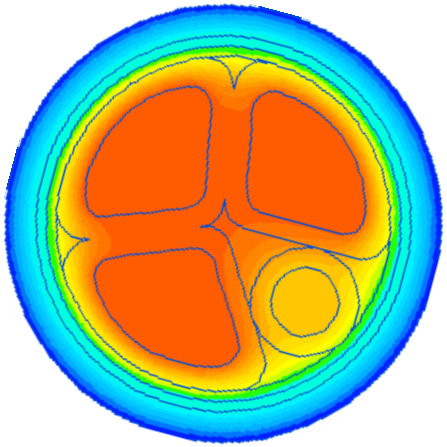
QuickField Analysis Options

Magnetic analysis suite	
Magnetic Problems	Magnetostatics
	AC Magnetics
	Transient Magnetic
Electric analysis suite	
Electric Problems	Electrostatics and DC Conduction
	AC Conduction
	Transient Electric field
Thermostructural analysis suite	
Thermal and mechanical problems	Steady-State Heat transfer
	Transient Heat transfer
	Stress analysis

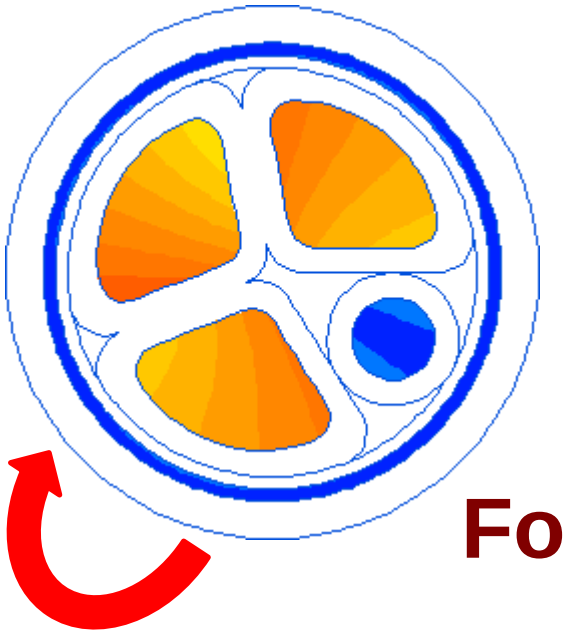









MultiPhysics.

Temperature Field

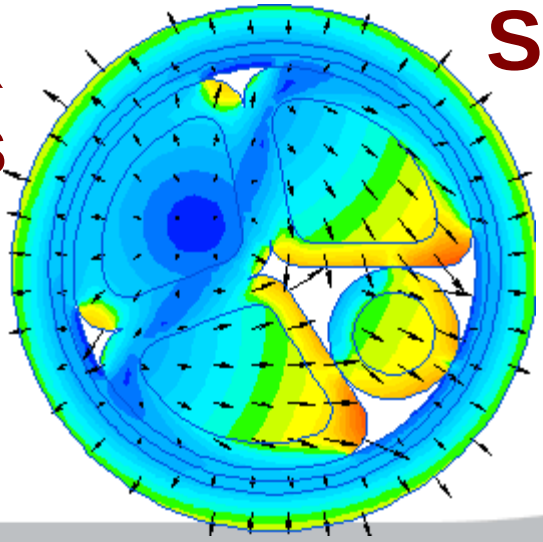


Electromagnetic fields



Thermal Stresses

Forces



Magnetic state import

Stresses & Deformations

Problems with electric circuits

Magnetic analysis suite	
Magnetic Problems	Magnetostatics
	AC Magnetics
	Transient Magnetics
Electric analysis suite	
Electric Problems	Electrostatics and DC Conduction
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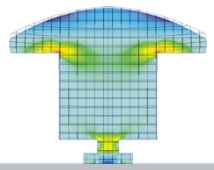
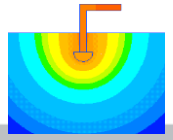
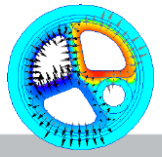
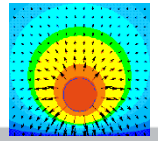
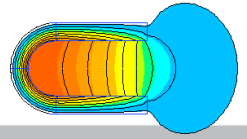
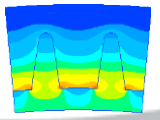
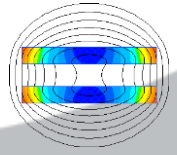
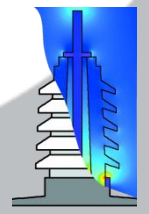
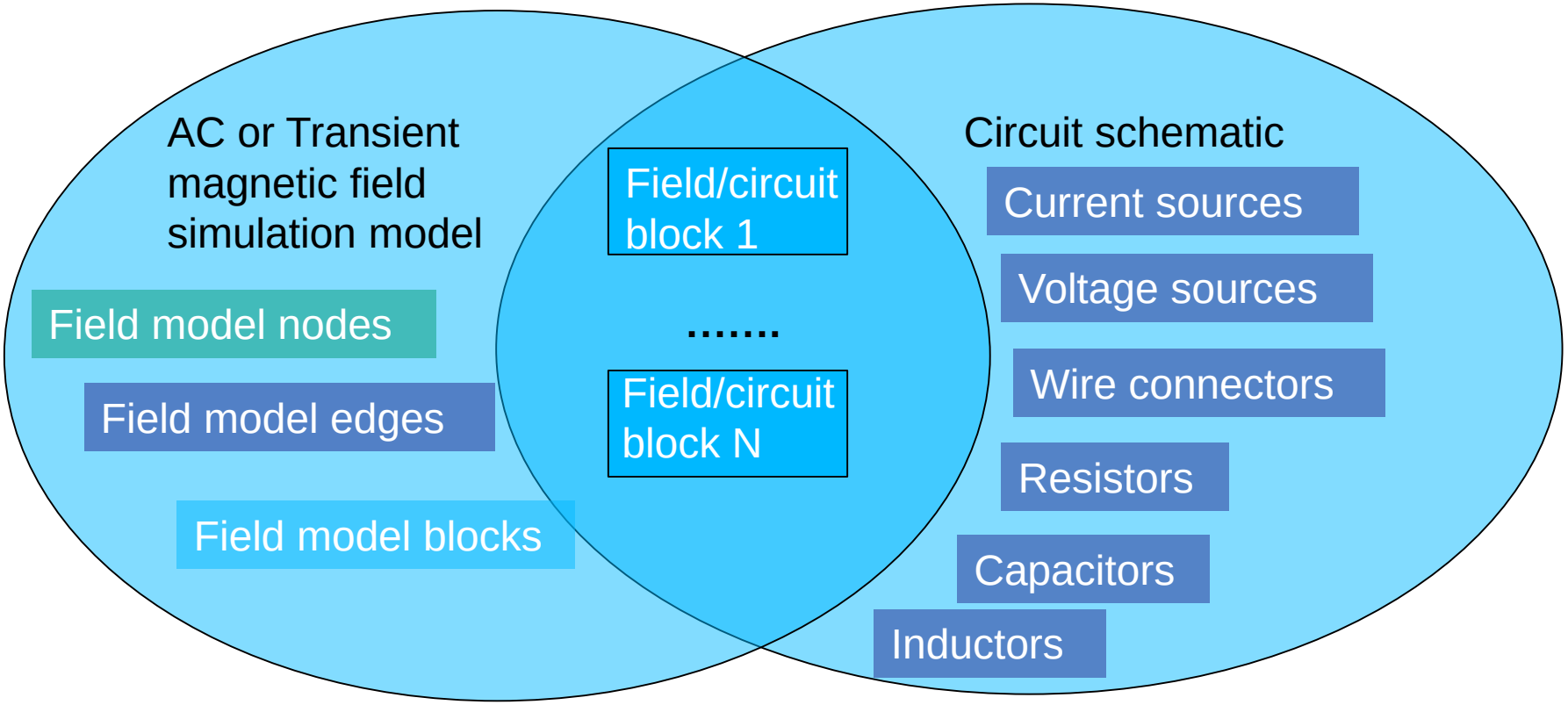
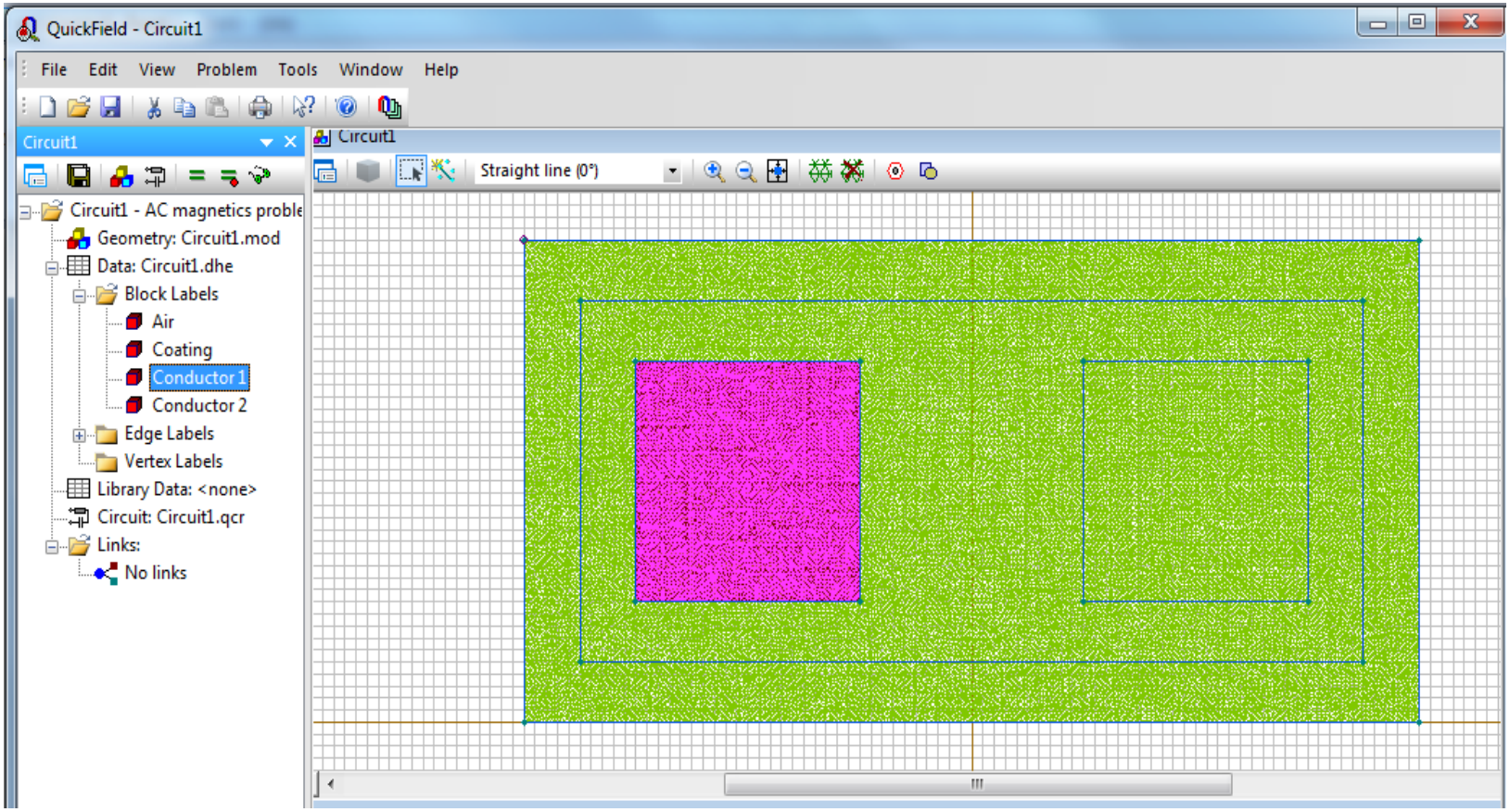
	Stress analysis

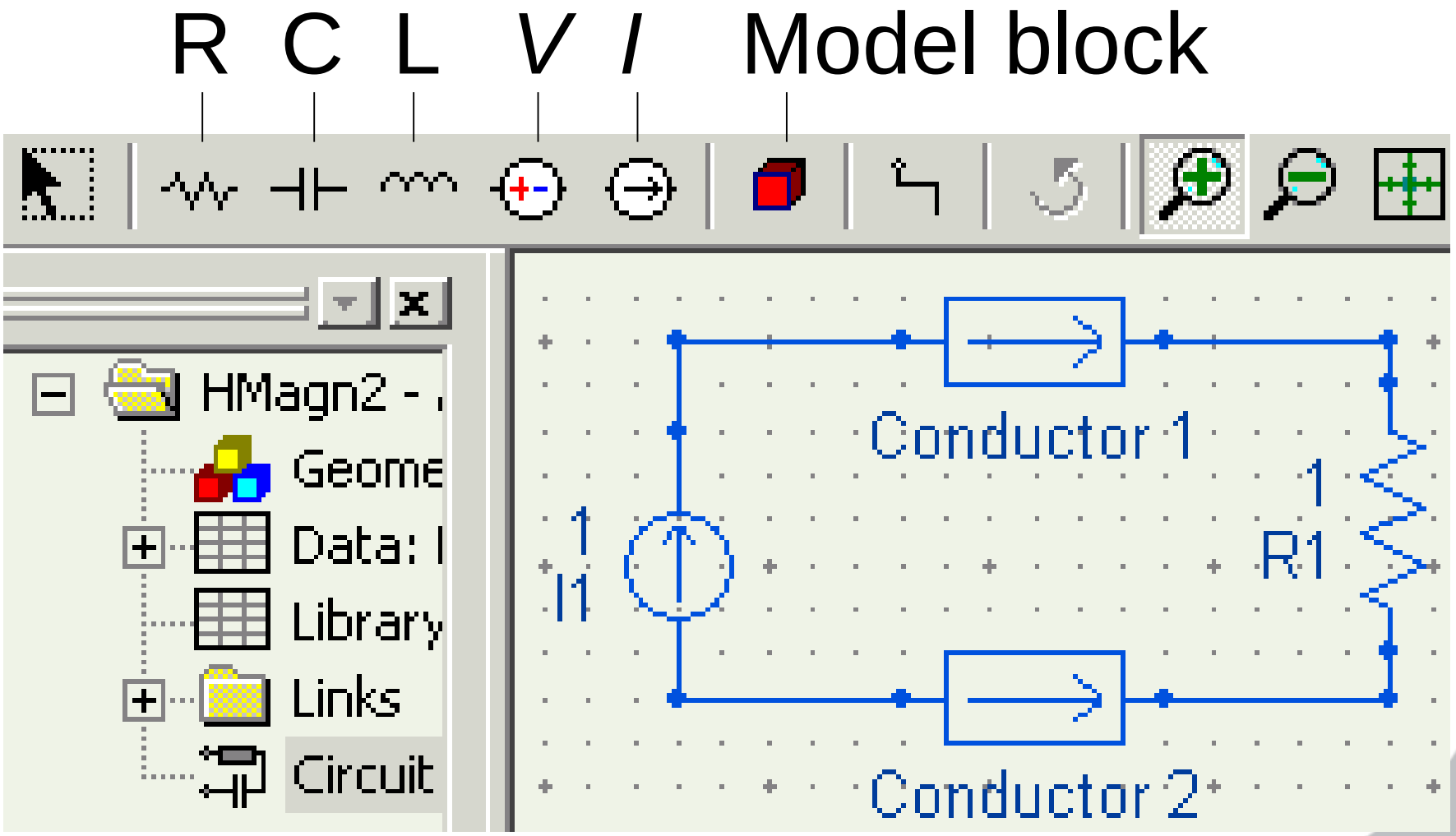
QuickField built-in circuit simulation



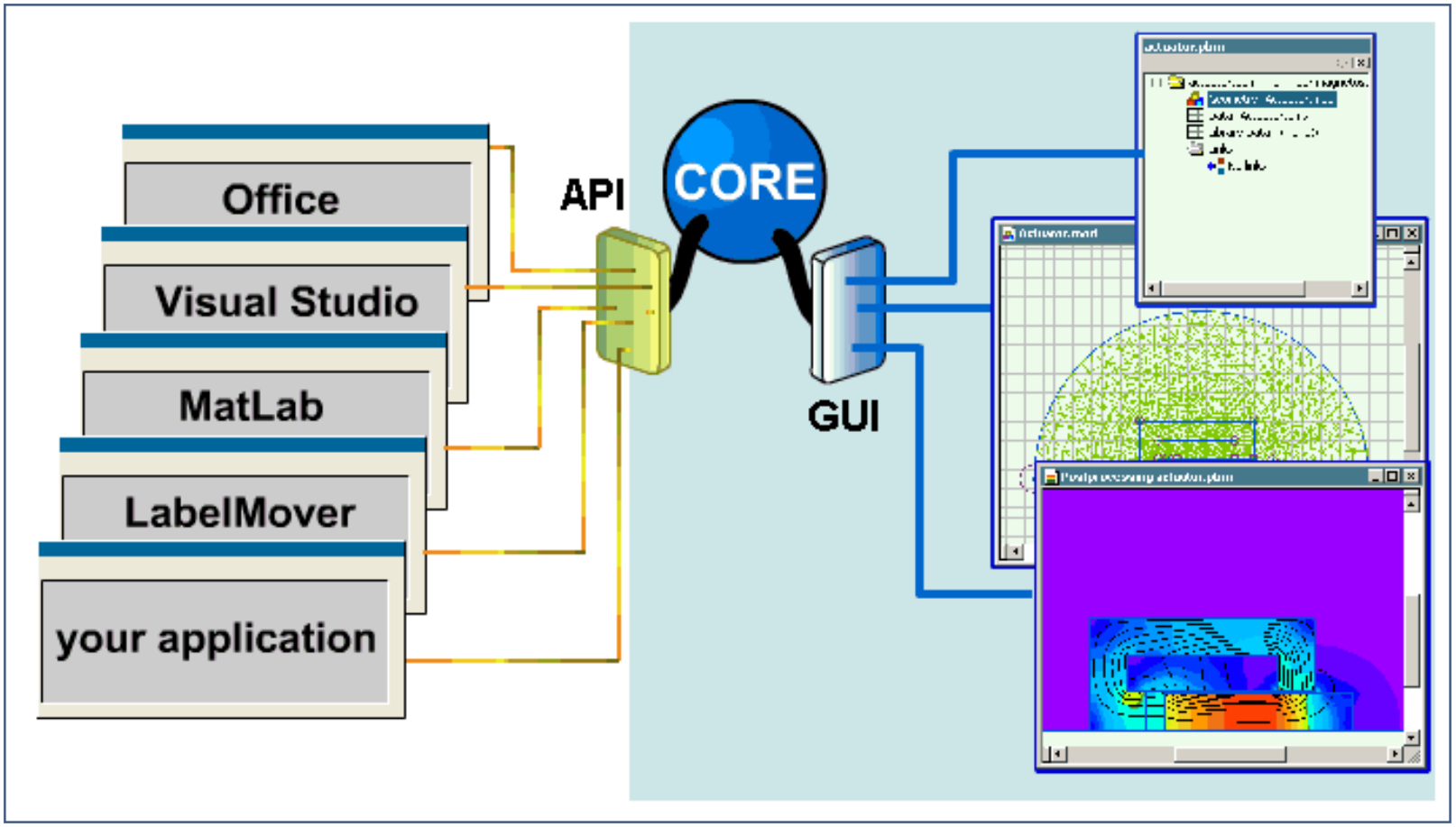
QuickField field model



QuickField circuit elements

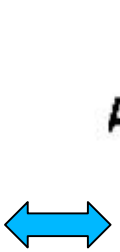


Open object interface

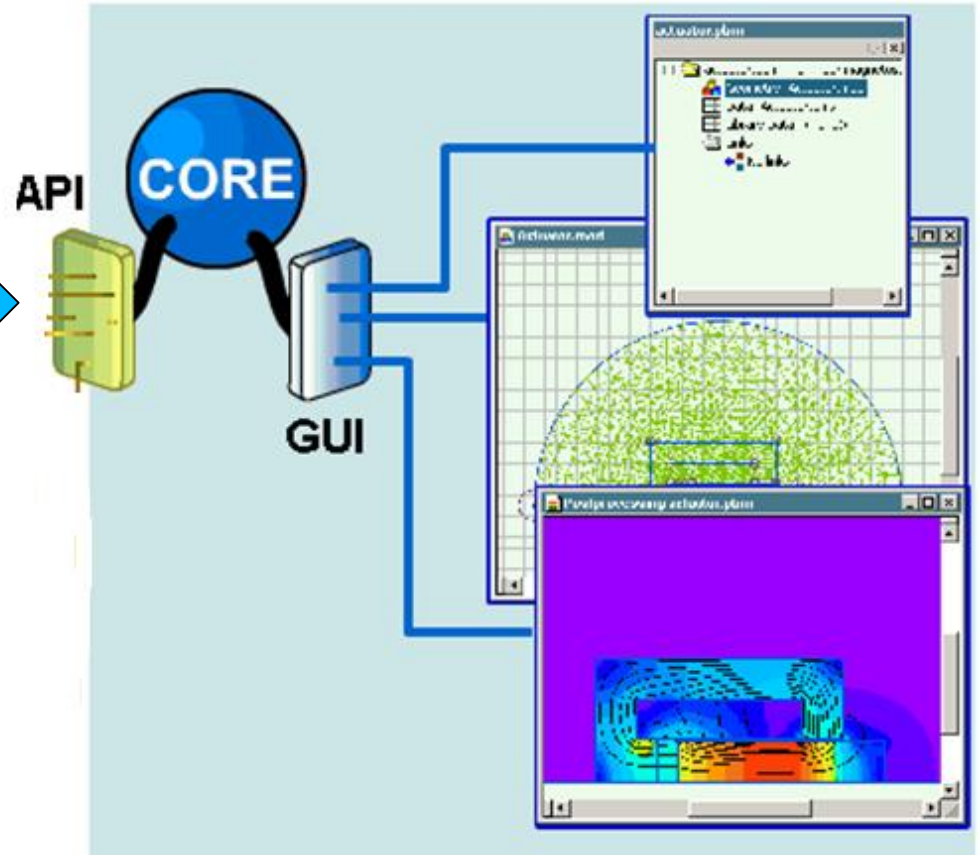


Co-simulation with Ngspice*

MS Excel VBA application



Ngspice simulator



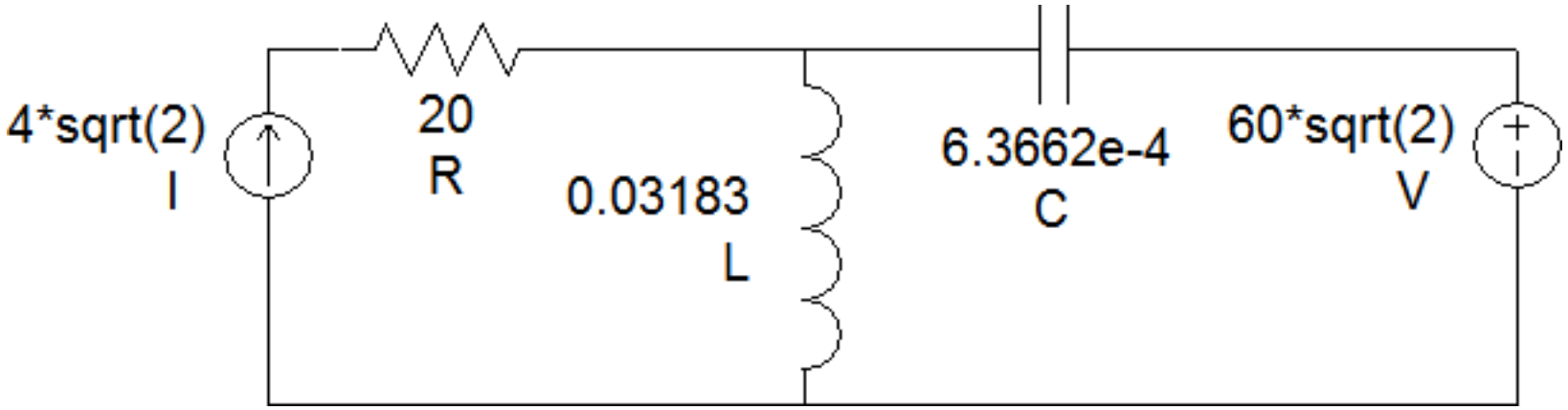
* http://ngspice.sourceforge.net/

QuickField Difference

Electric circuit analysis with QuickField

1. AC analysis.
2. AC frequency sweep (LabelMover tool).
3. AC analysis + field simulation (transformer).
4. Transient analysis.
5. Nonlinear circuit elements.
6. Combining QuickField with the external circuit simulator (Ngspice).

AC analysis



Problem specification:

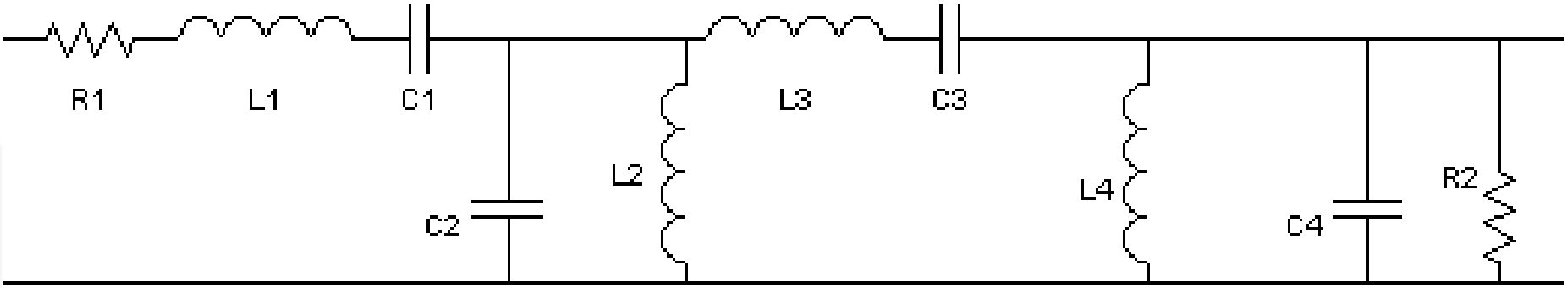
Frequency f = 50 Hz
X_L = 10 Ohm
X_C = 2 Ohm
Current source I = 4 A (RMS)
Voltage source U = 60 V (RMS)

QuickField specific:

1. **Peak values for sources**
2. **No fixed ground**
3. **Coupled field + circuit analysis**

http://quickfield.com/advanced/circuit_linear_ac.htm

AC frequency sweep



Problem specification:

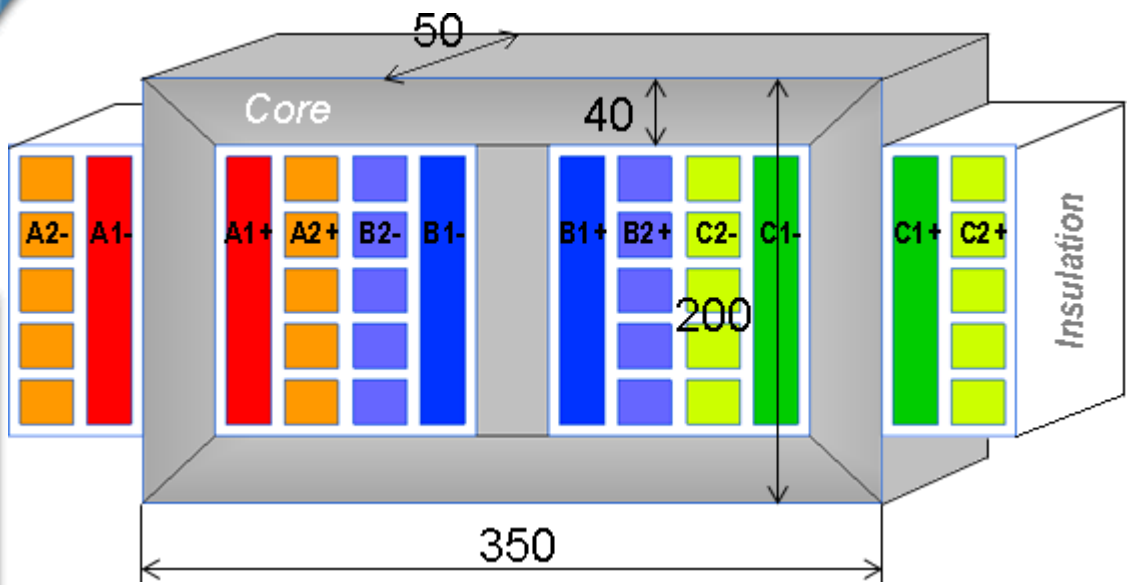
R1 = 150 Ohm, R2 = 150 Ohm
C1 = 840 pF, C2 = 0.1637 uF, C3 = 852 pF, C4 = 0.0558 uF
L1 = 12.11 mH, L2 = 62.08 uH, L3 = 11.91 mH, L4 = 182.3 uH

Tasks:

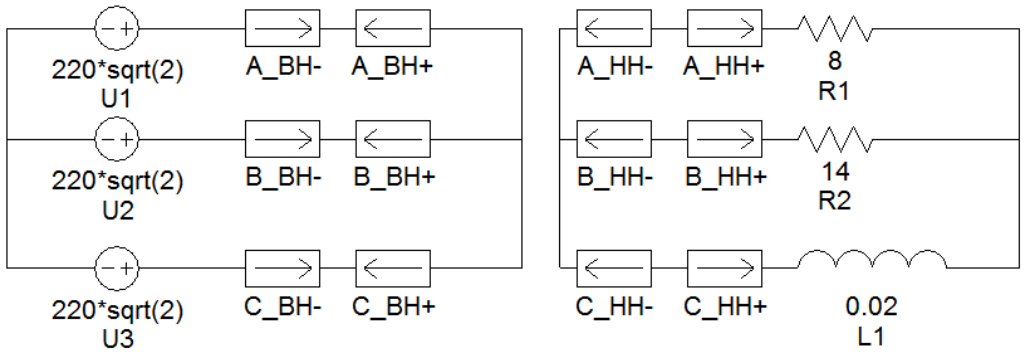
Filter transfer function at frequency range *f* = 40..60 kHz.

http://quickfield.com/advanced/circuit3.htm

Transformer



Dimensions are given in mm

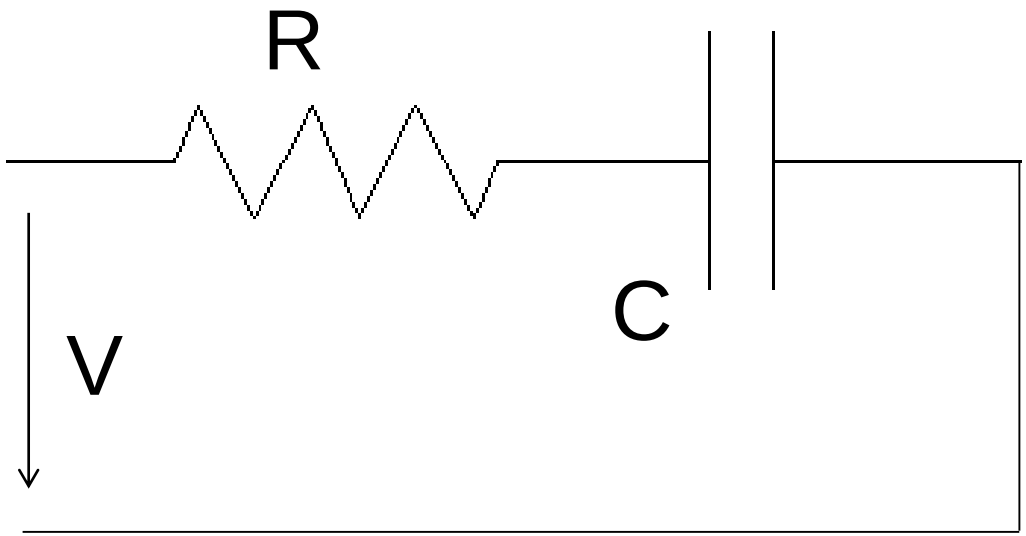


Problem specification:

Phase voltage U = 220 V,
Frequency f = 50 Hz,
Phase loads:
$R1_A$ = 8 Ω,
$R2_B$ = 14 Ω,
$L1_C$ = 0.02 H (6.3 Ω).
Windings turns (Y/Y):
N_{LV} = 150, N_{HV} = 384.

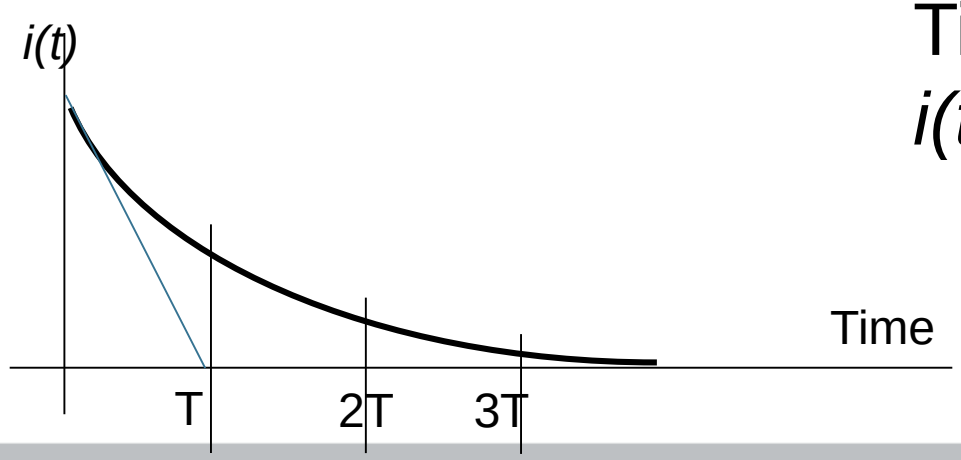
http://quickfield.com/advanced/transformer_losses.htm

Transient analysis



Problem specification:

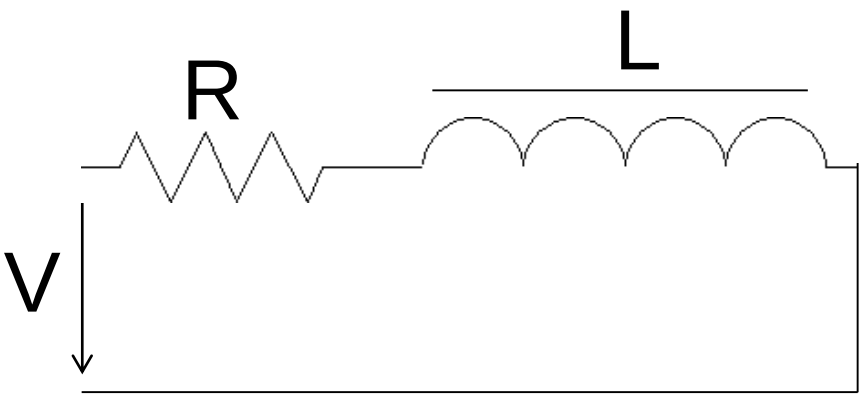
R = 4.5 Ohm, C = 100 uF.
Voltage source V= 100 V

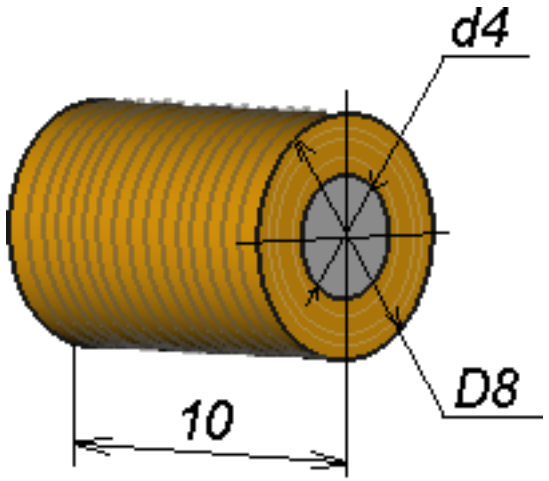


Time constant T = C*R

$i(t) = V/R * e^{-t/T}$

Nonlinear elements

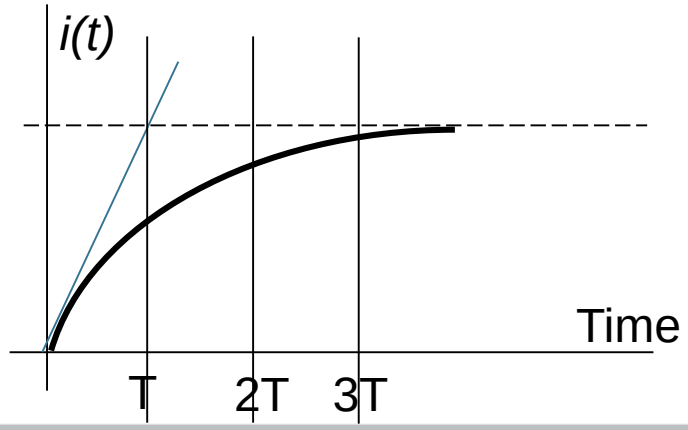




Time constant $T = L/(R + R_L)$

$i(t) = V/(R + R_L) * (1 – e^{-t/T})$

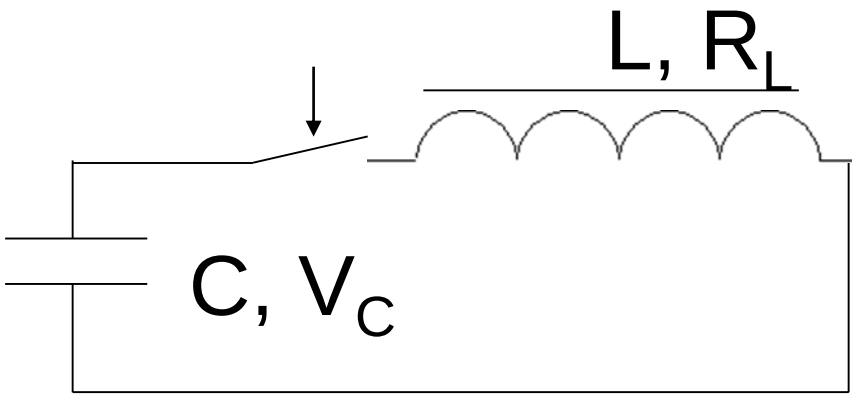
R_L = 4.2 Ohm
L = 2.8 mH

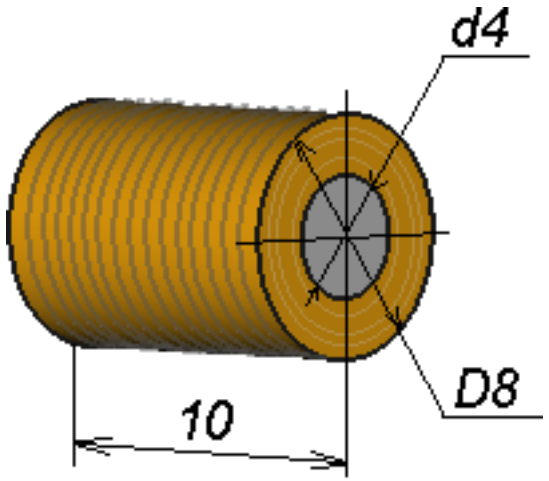


<u>Problem specification:</u>

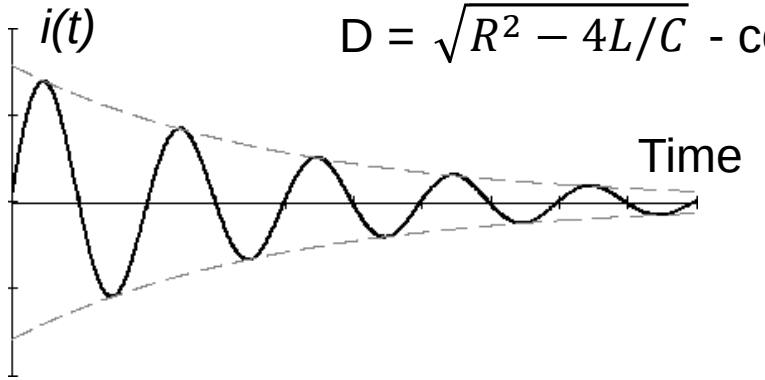
R = 10 Ohm,
R_L = 4.2 Ohm, L = 2.8 mH
Voltage source V= 100 V

Co-simulation with Ngspice





$$L*di(t)/dt + R*i(t) + q(t)/C = e$$



D = $\sqrt{R^2 - 4L/C}$ - complex value

Problem specification:

C = 100 uF, V_C = 100 V
R_L = 4.5 Ohm, L = 2.5 mH

http://quickfield.com/advanced/capacitor_discharge.htm