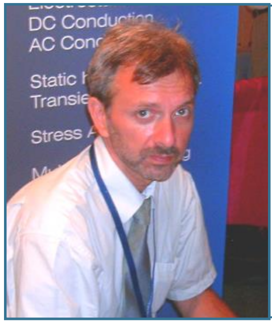
Physical laws simulation in QuickField



Vladimir Podnos

Director of marketing and support

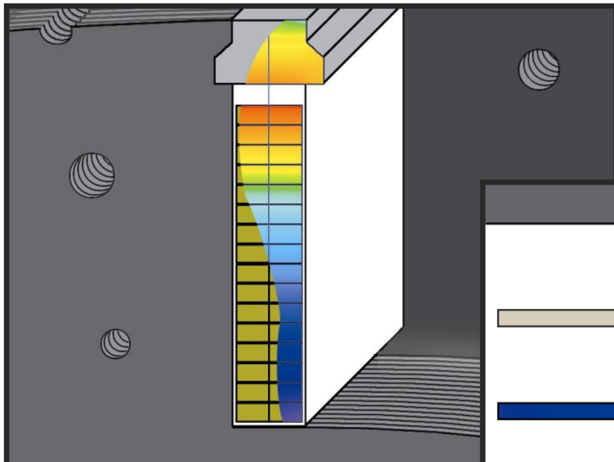
Overview of QuickField capabilities

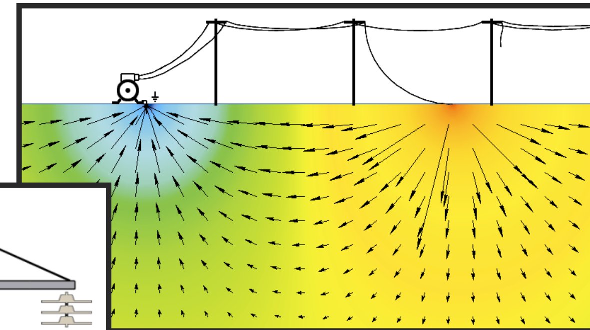
Alexander Liubimtsev

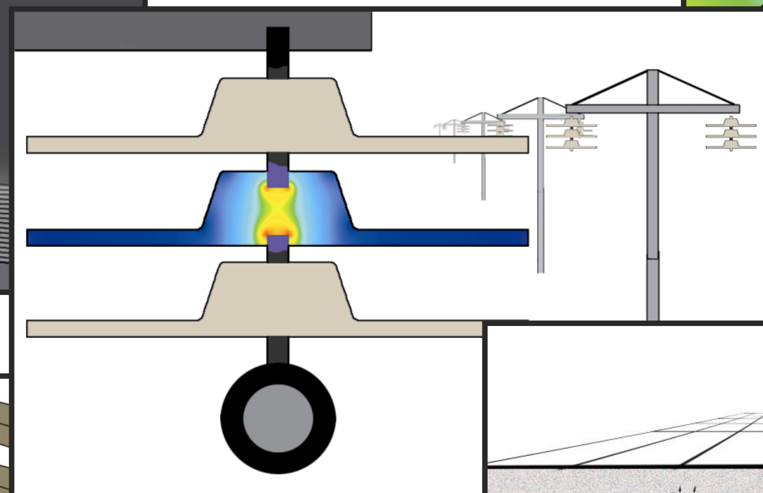
Support engineer

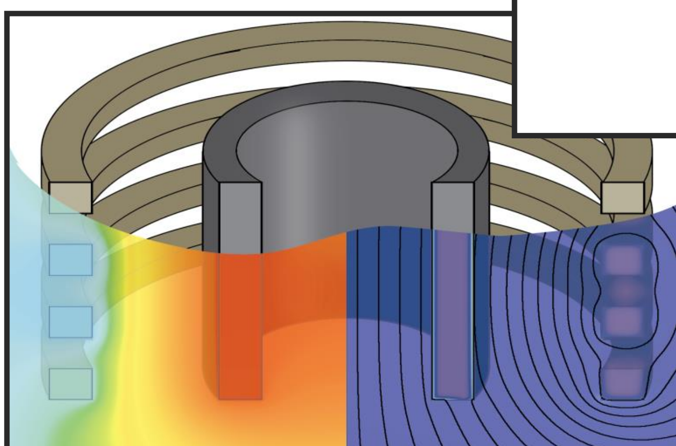
Live presentation of QuickField simulations

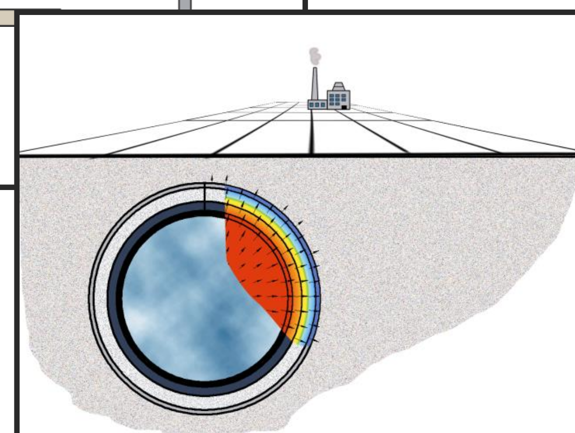
QuickField is FEA for EM, heat transfer, stress and mutliphysics





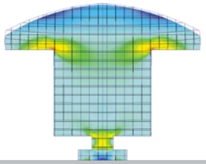
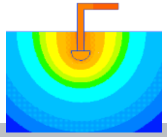
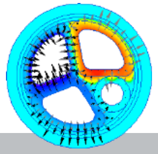
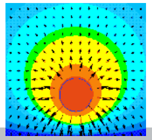
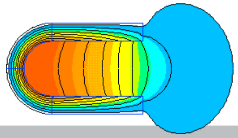
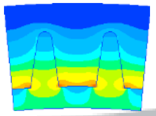
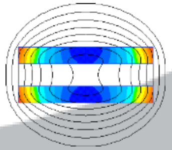
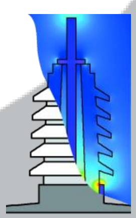




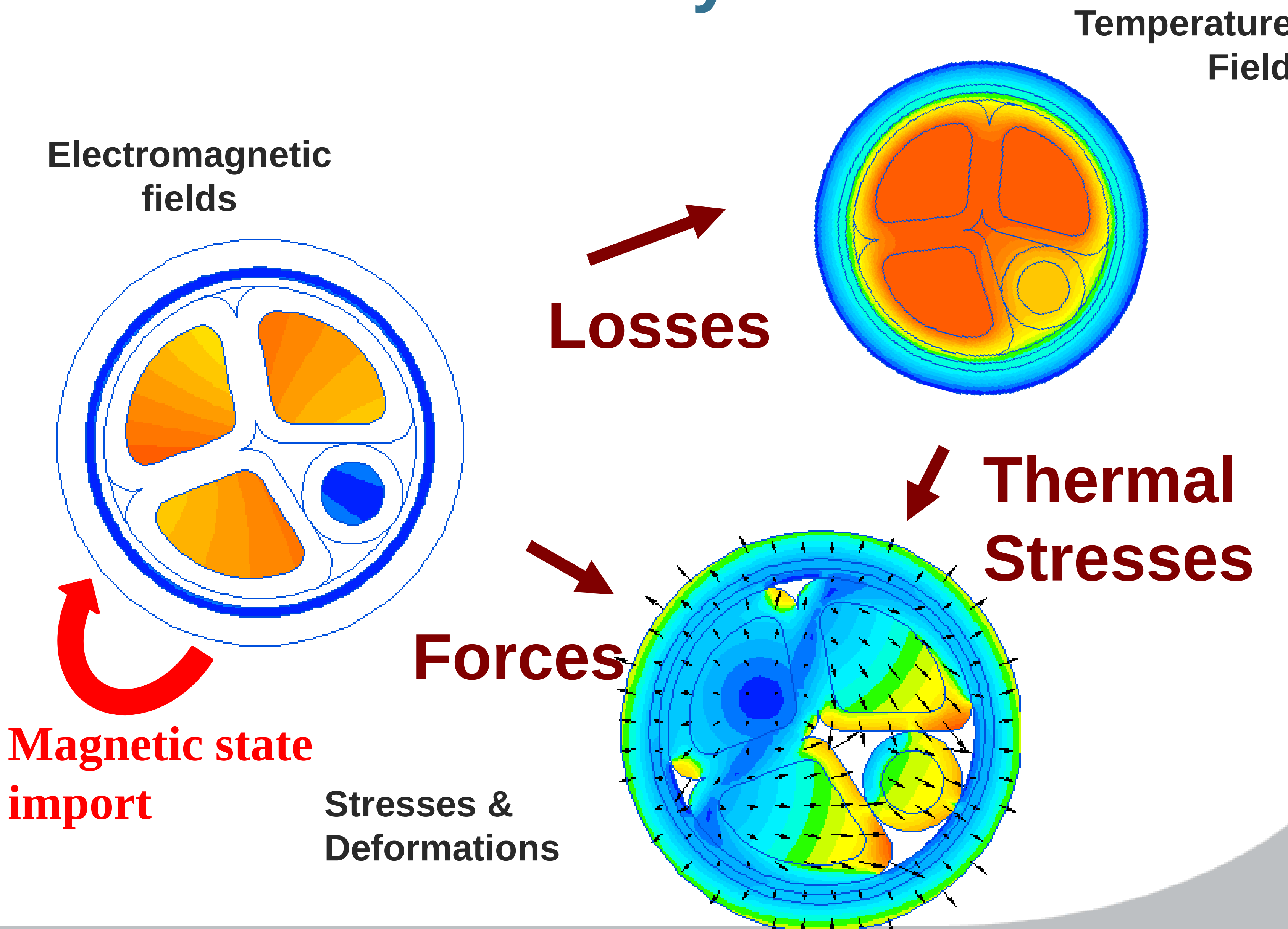


QuickField Analysis Options

Magnetic analysis suite	
Magnetic Problems	Magnetostatics
	AC Magnetics
	Transient Magnetic
Electric analysis suite	
Electric Problems	Electrostatics (2D,3D) and DC Conduction (2D,3D)
	AC Conduction
	Transient Electric field
Thermostructural analysis suite	
Thermal and mechanical problems	Steady-State Heat transfer (2D,3D)
	Transient Heat transfer
	Stress analysis

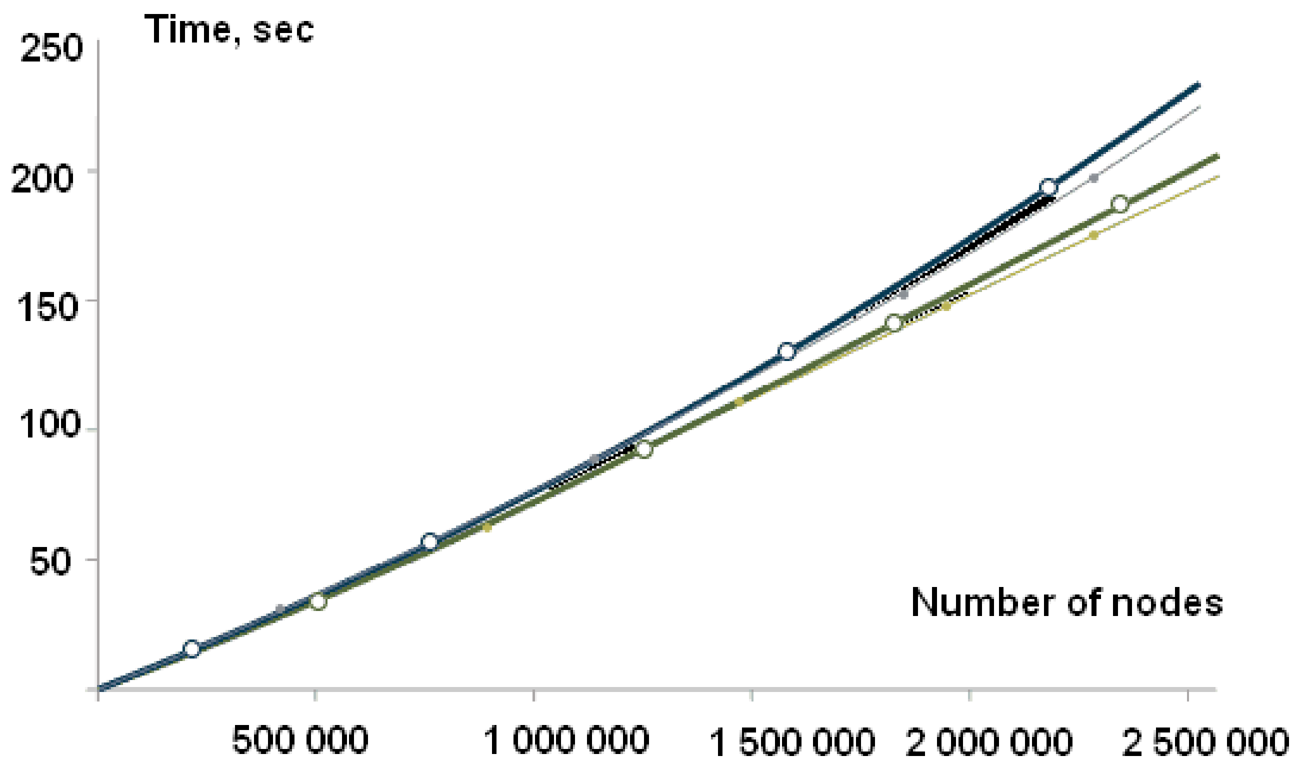









MultiPhysics

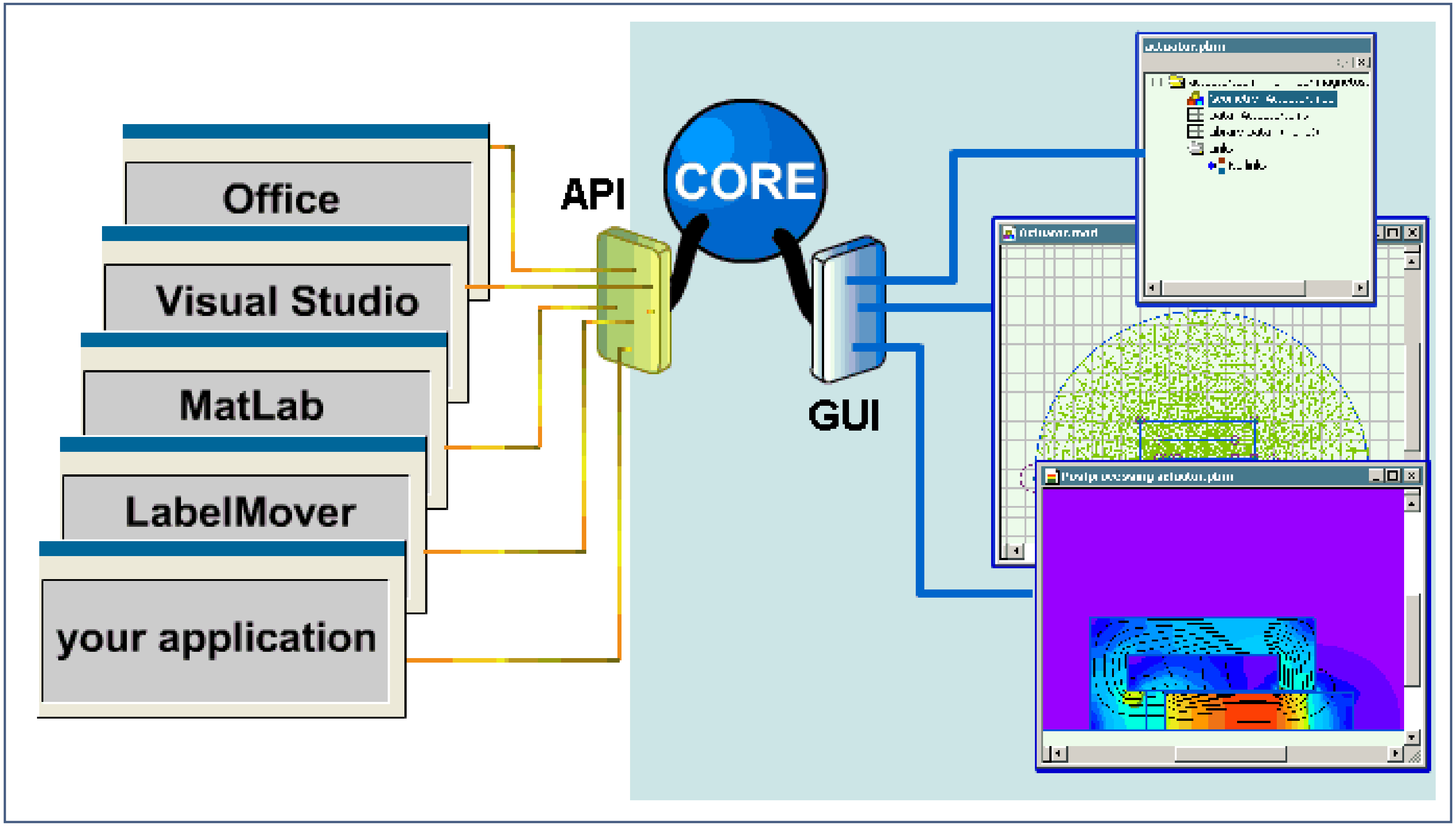


QuickField solvers

Solution time for various sizes of finite element mesh

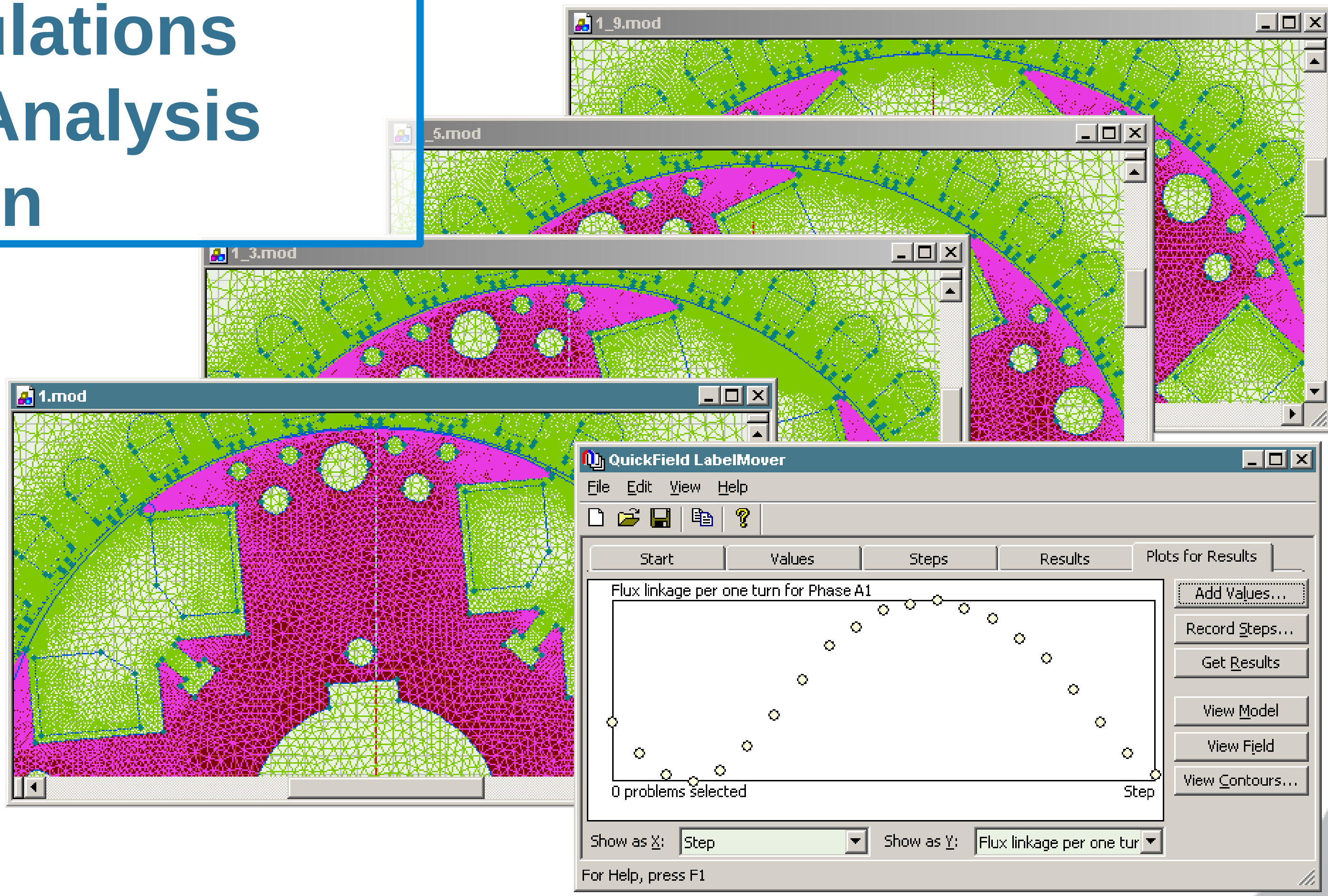


For experts: open object interface

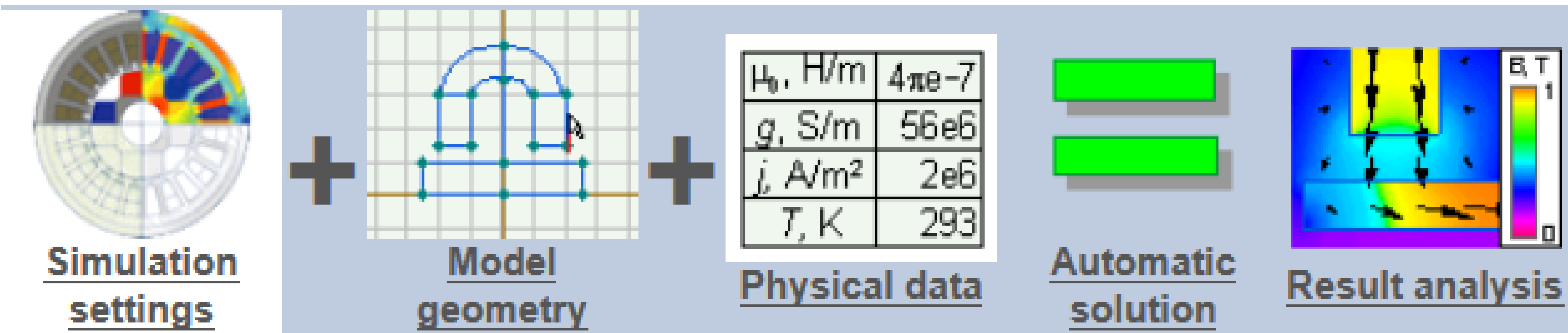


More for experts….

Serial calculations
Tolerance Analysis
Optimization



Simple and straightforward



QuickField is used in

- Industrial engineering
- Scientific research
- Education

QuickField as a teaching tool for teachers:

QuickField enables teachers to:

- explain the physical nature of studied effects and processes and demonstrate the principles of operating industrial devices
- develop "practical engineering sense" in their students by showing them how to visualize field equations and formulae they have studied
- produce pictures and animated presentations of fields in various conditions
- prepare students assignments in the form of example models or as design concepts to be simulated with

QuickField as a teaching tool for students:

QuickField enables students to:

- improve their understanding of assignments prepared by teachers studying various effects and processes
- implement student research projects
- gain a fundamental understanding of modern CAD/CAE technologies through entry level FEA analysis
- gain experience of utilizing a real engineering tool which may be used in their professional career

Where to start from:

An effortless way to introduce QuickField to students of any level is via our Virtual Classroom. Students can work through a set of tutorials on-line in the browser window or tutors can download and present to their class without the internet connection .

QuickField Student Edition may be installed on any number of student computers and used for simple simulations or as a free browser of results obtained with the Professional or Lite Editions of QuickField.

What to do next:

QuickField examples.

This webinar presentations:

- Ampere's force law
- Biot-Savart law
- Hook's law
- Coulomb's law
- Joule-Lenz law
- Ohm's law
- Faraday's law of electromagnetic induction
- Fick's laws of diffusion
- Thermal conduction Fourier's law

Where to go next:

Additional examples: Examples gallery

Filter (show the examples with specified features only). Reset filter flags

Analysis type
- ☐ DC magnetics
- ☐ AC magnetics
- ☐ Transient magnetics
- ☐ Electrostatics
- ☐ DC conduction
- ☐ AC conduction
- ☐ Transient electric
- ☐ Steady-state Heat Transfer
- ☐ Transient Heat Transfer
- ☐ Stress Analysis
- ☐ Multiphysics
- ☐ Electric circuit

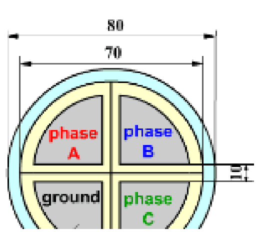
Model class
- ☐ Plane-parallel
- ☐ Axisymmetric
- ☐ 3D Extrusion
- ☐ 3D Import

Application
- ☐ Electrical engineering
- ☐ Mechanical engineering
- ☐ Bio engineering
- ☐ Thermal engineering
- ☐ Other

- ☐ for Student Edition
- ☐ with programming
- ☐ with LabelMover

Pages: << 1 2 3 4 5 . . . 50 >>

Three phase cable
QuickField Support team

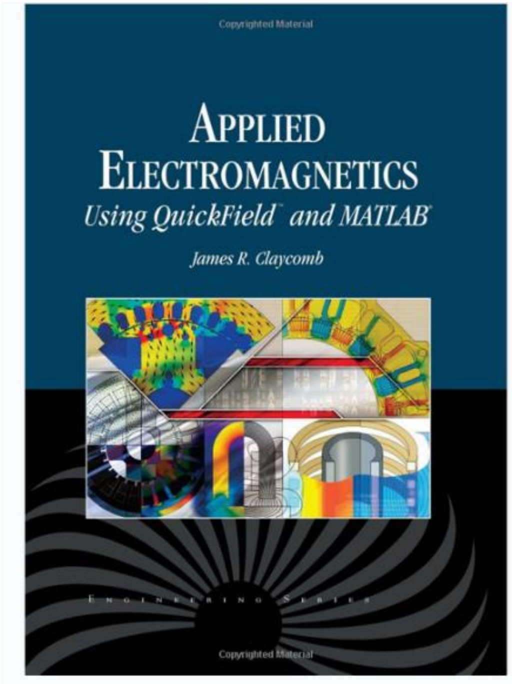


Model class: Plane-parallel
Analysis type: AC conduction
Application: electrical engineering

High frequency (400 Hz) three phase cable leakage current calculation

Where to go next:

The book Applied Electromagnetics Using QuickField & MATLAB includes demonstrations and simulations of various physical phenomena using QuickField.



https://www.amazon.com/Applied-Electromagnetics-Using-Quick-Matlab/dp/9380298161

Physical laws simulation in QuickField

- Ampere's force law
- Biot-Savart law
- Hooke's law
- Coulomb's law
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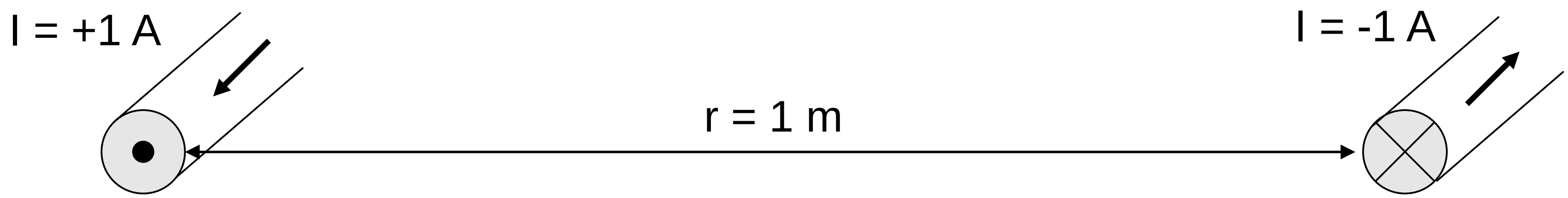
Ampere's force law



Task:

Calculate interaction force (per meter of length) between two wires

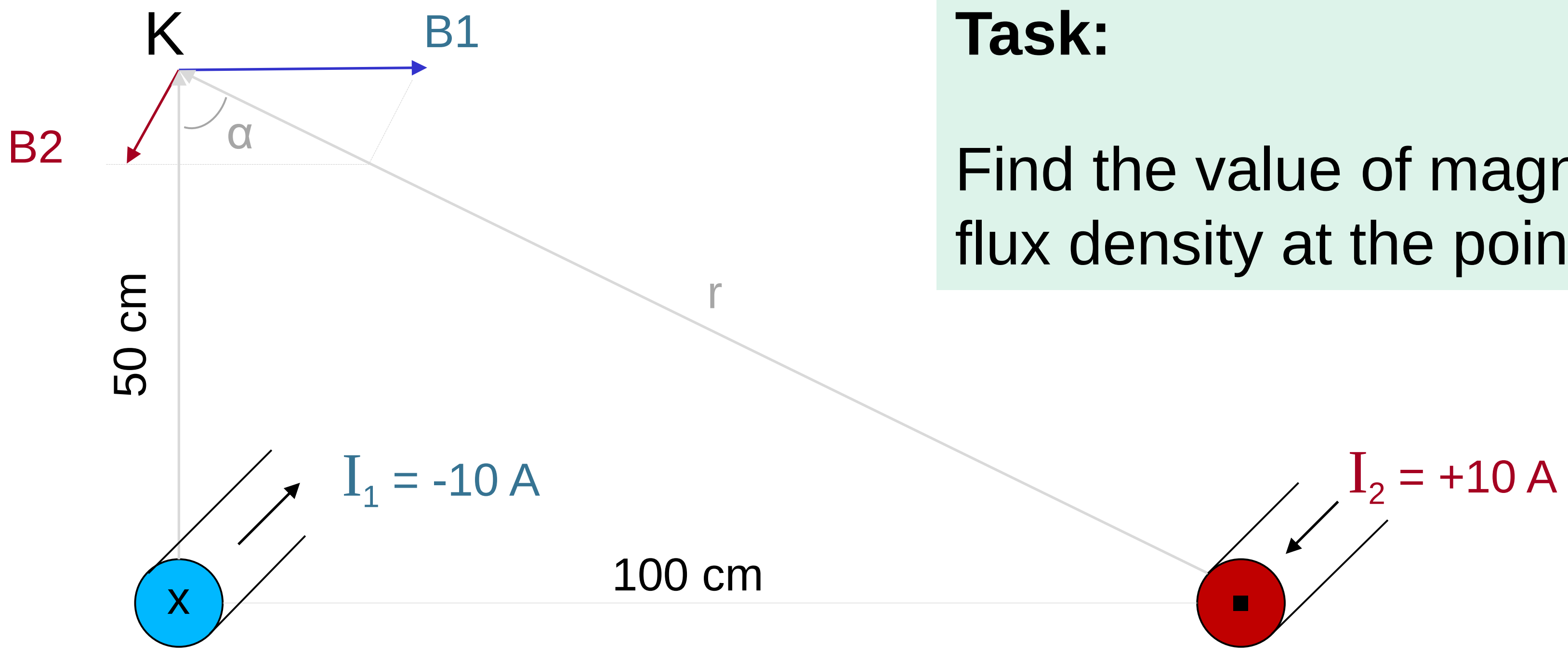
Amprere’s law

$$F = \frac{2\mu_0}{4\pi}\frac{|I|\cdot|I|}{r^2}$$

$$F = 2 \cdot 10^{-7}\, N/m$$

https://quickfield.com/advanced/ampere_force_law.htm

Biot-Savart law



Task:

Find the value of magnetic flux density at the point *K*.

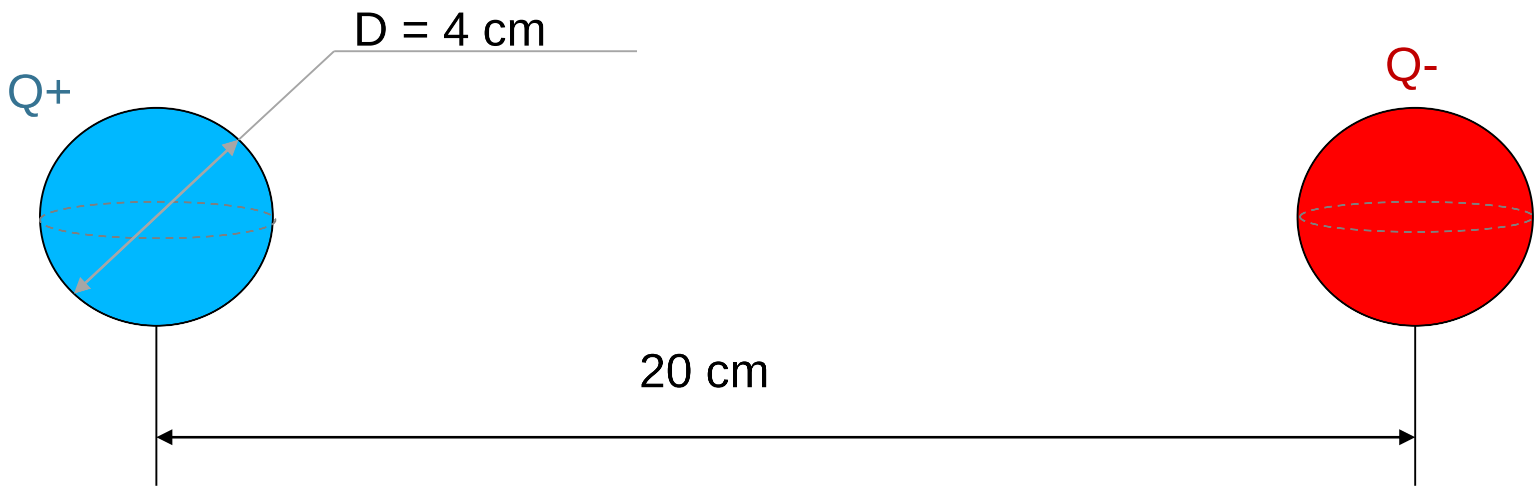
$$d\bar{B} = \frac{\mu_0 \cdot 2I}{4\pi} \cdot \frac{[d\bar{L} \times \bar{r}]}{r^3}$$

$B1_x$ = 4 μT, $B1_y$ = 0 T

$B2_x$ = -0.8 μT, $B2_y$ = -1.6 μT

https://quickfield.com/advanced/biot-savart_law.htm

Coulomb's law



Task:

Calculate the charged bodies attraction force
Q+ = |Q-| = 0.1 nC

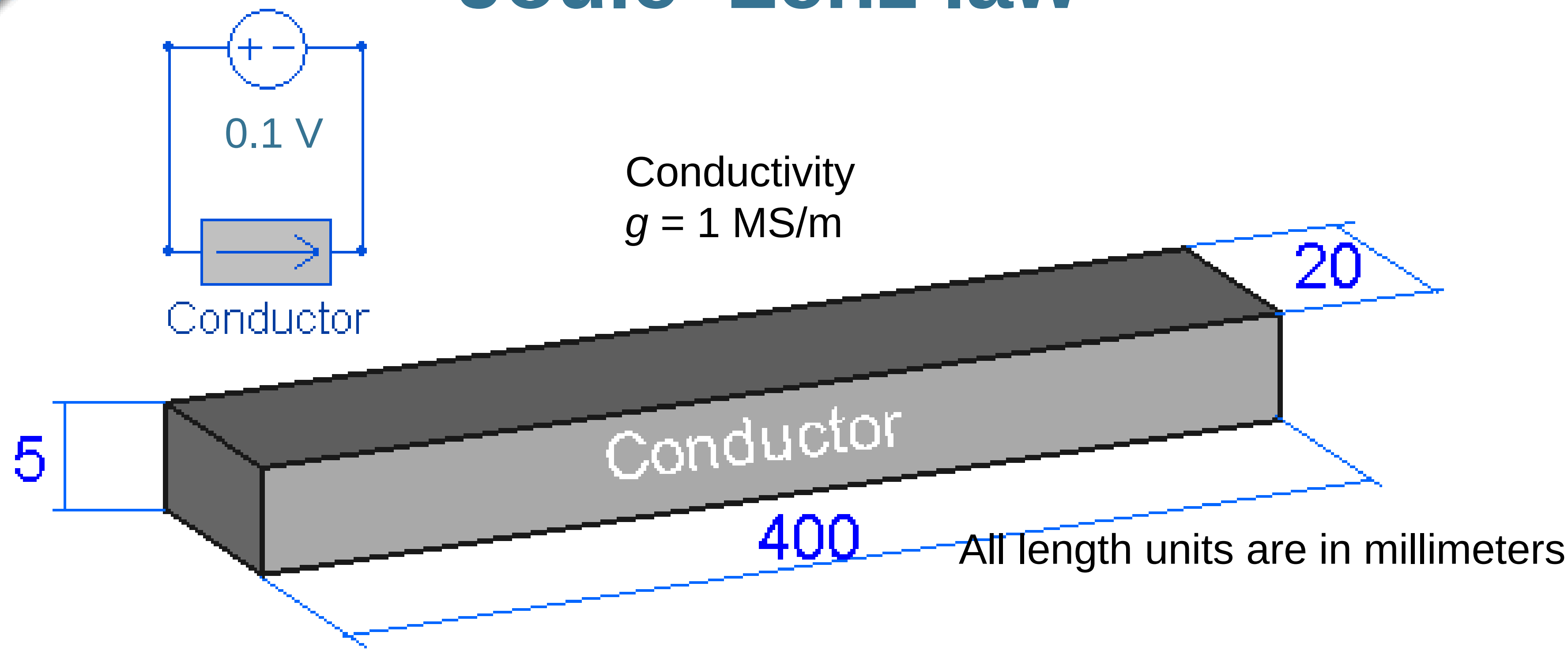
Coulomb's law

$$F = \frac{1}{4\pi\varepsilon_0}\frac{|Q|\cdot|Q|}{r^2}$$

$$F = 2.247\ \text{nN}$$

https://quickfield.com/advanced/coulombs_law.htm

Joule–Lenz law



Task:

Calculate the Joule heat inside the conductor

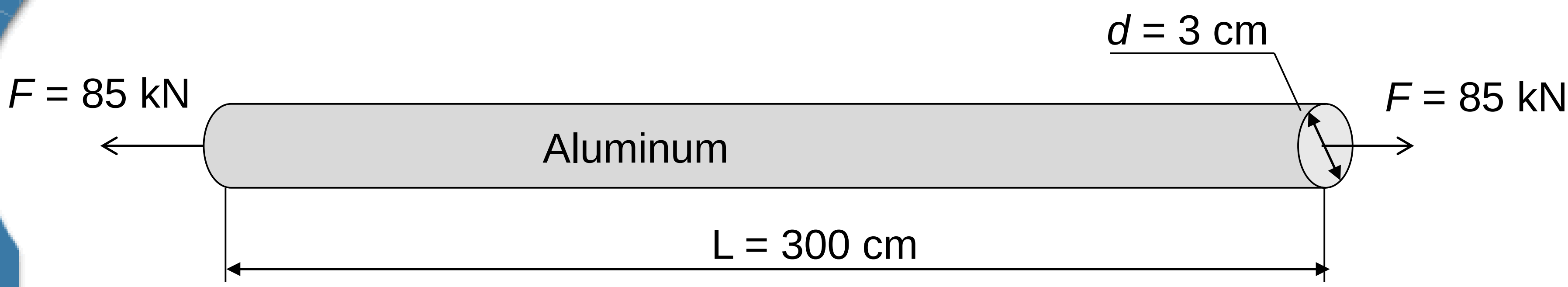
Joule–Lenz law

$$P = \frac{V^2}{R} [W]$$

P = 2.5 [W]

https://quickfield.com/advanced/joule-lenz_law.htm

Hooke's law



Young's modulus E = 70 GPa; Poison's ratio ν = 1/3

Task:

Calculate the bar elongation.

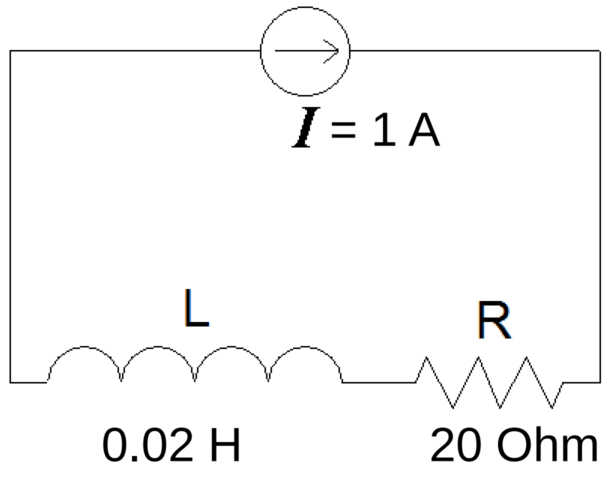
Hooke's law

$$\Delta L = \frac{F \cdot L}{E \cdot Area}$$

$$\Delta L = \frac{85000 \cdot 3}{70 \cdot 10^9 \cdot 0.000707} = 0{,}0052 \text{ m}$$

https://quickfield.com/advanced/cylindrical_bar.htm

Ohm's law



Task:

Find the voltage drops across the circuit elements *L*, *R*

Ohm's law

$$V = I \cdot R$$

Frequency 0 Hz:

Voltages:

V_R = 20 [V], V_L = 0

Frequency f = 50 Hz:

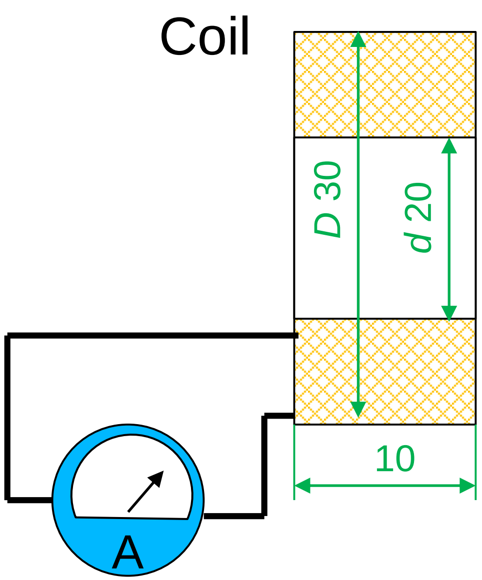
Voltages:

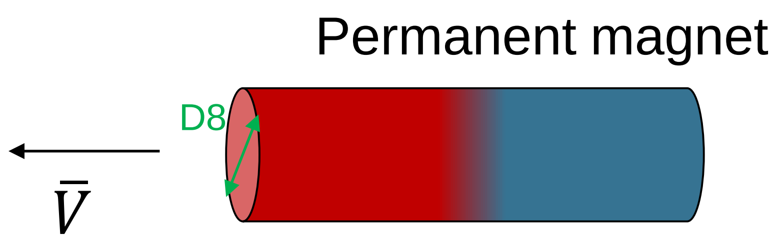
V_R = 20 [V], $V_L = 2 \cdot \pi \cdot f \cdot L \cdot I =$

$= 6.28$ [V]

https://quickfield.com/advanced/ohm_law.htm

Faraday's law of induction





Task:

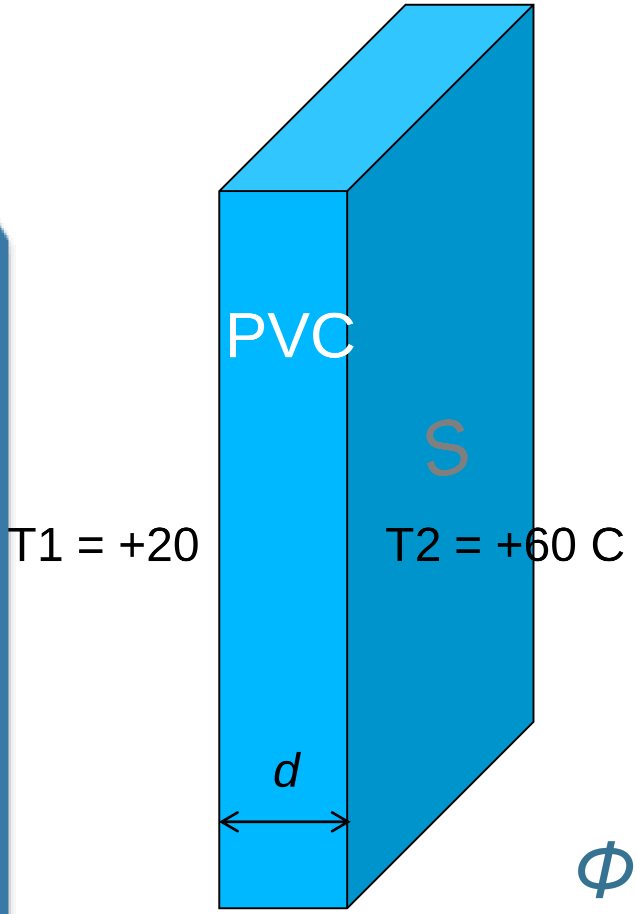
Calculate induced voltage in the coil.
Coil number of turns N = 200
PM speed V = 10 cm/sec
PM relative permeability 1.05

Faraday's law

$$E = -N\frac{d\Phi}{dt} \quad [V]$$

https://quickfield.com/advanced/faraday_law.htm

Thermal conduction Fourier's law



Task:

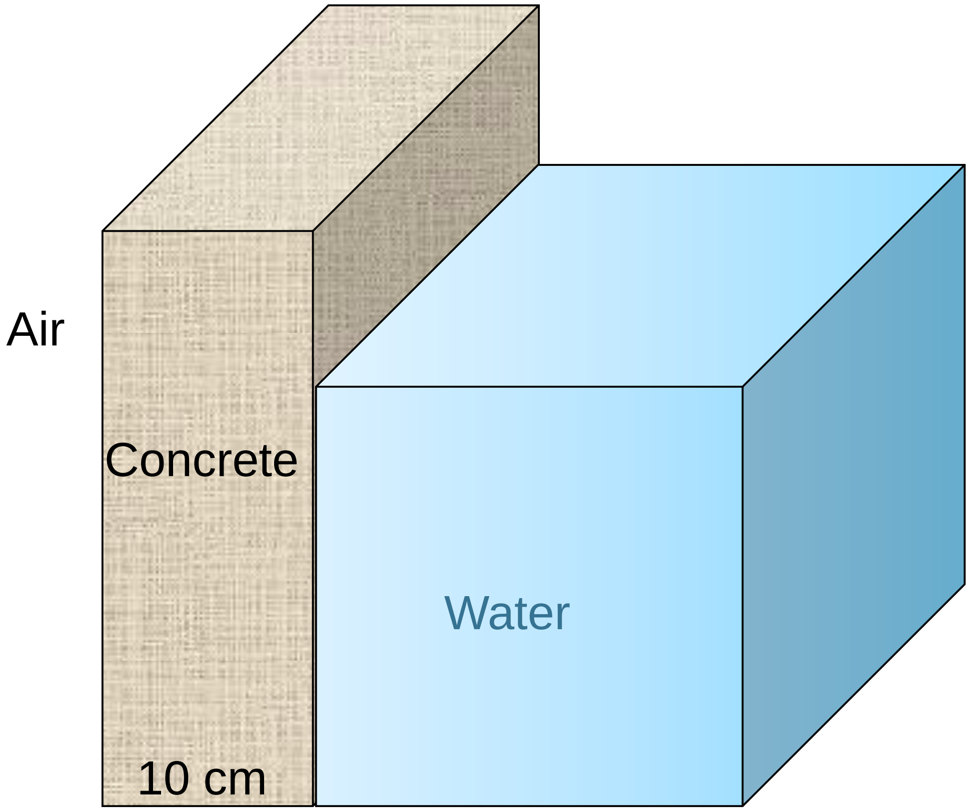
Determine the heat flux passing through the flat wall
d = 1 cm, *S* = 10x10 cm^2,
λ = 0.4 W/K-m

$$\Phi = \lambda * \frac{T2-T1}{d} * S \quad [W]$$

$$\Phi = 0.4*(60-20)/0.01*100*10^{-6} = 16 \text{ W}$$

https://quickfield.com/advanced/fourier_law.htm

Fick's laws of diffusion



Task:

Estimate water penetration into the concrete wall after 5 days exposure.
Initial water conent C_0 = 10%
Diffusion coefficient
D = 0.0001 cm^2/sec

Diffusion equation
$dC/dt = D \cdot d^2C / dx^2$

Heat equation
$dT/dt = a \cdot d^2T / dx^2$

Thermal diffusion $a = \frac{\lambda}{c\rho}$ [m^2/sec]

https://quickfield.com/advanced/ficks_law.htm