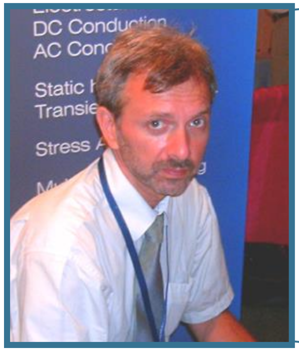
Electric capacitors simulation with QuickField



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Director of Marketing and Support,
Tera Analysis Ltd.

QuickField overview

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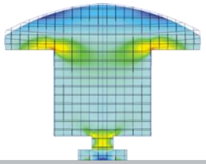
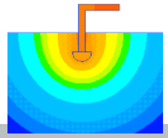
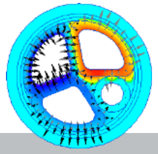
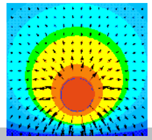
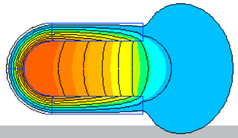
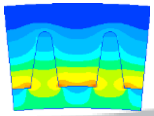
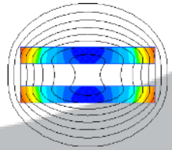
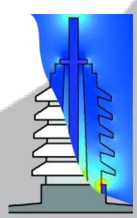
Support Engineer, Tera Analysis Ltd.

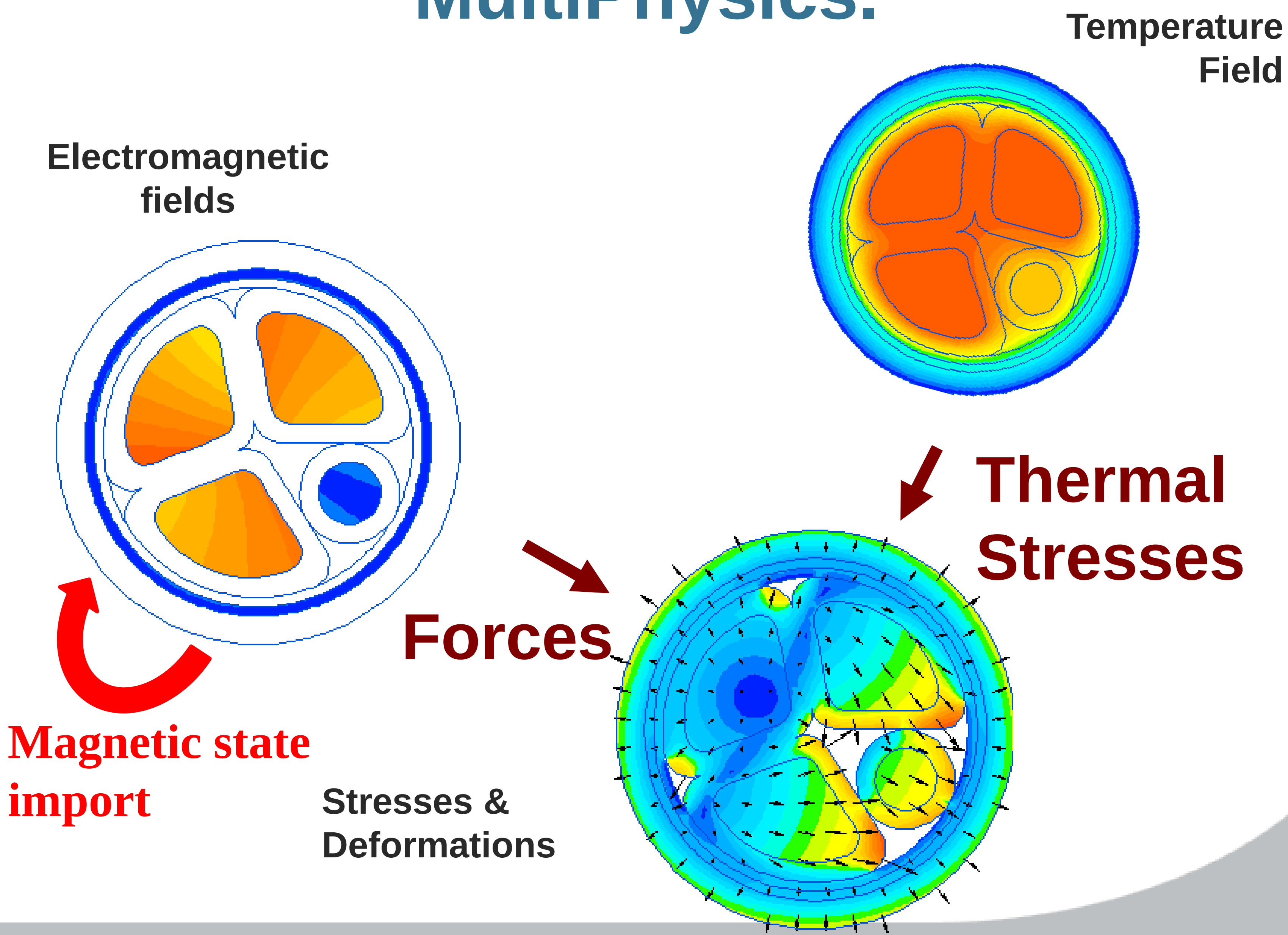
Practice with QuickField

QuickField Analysis Options

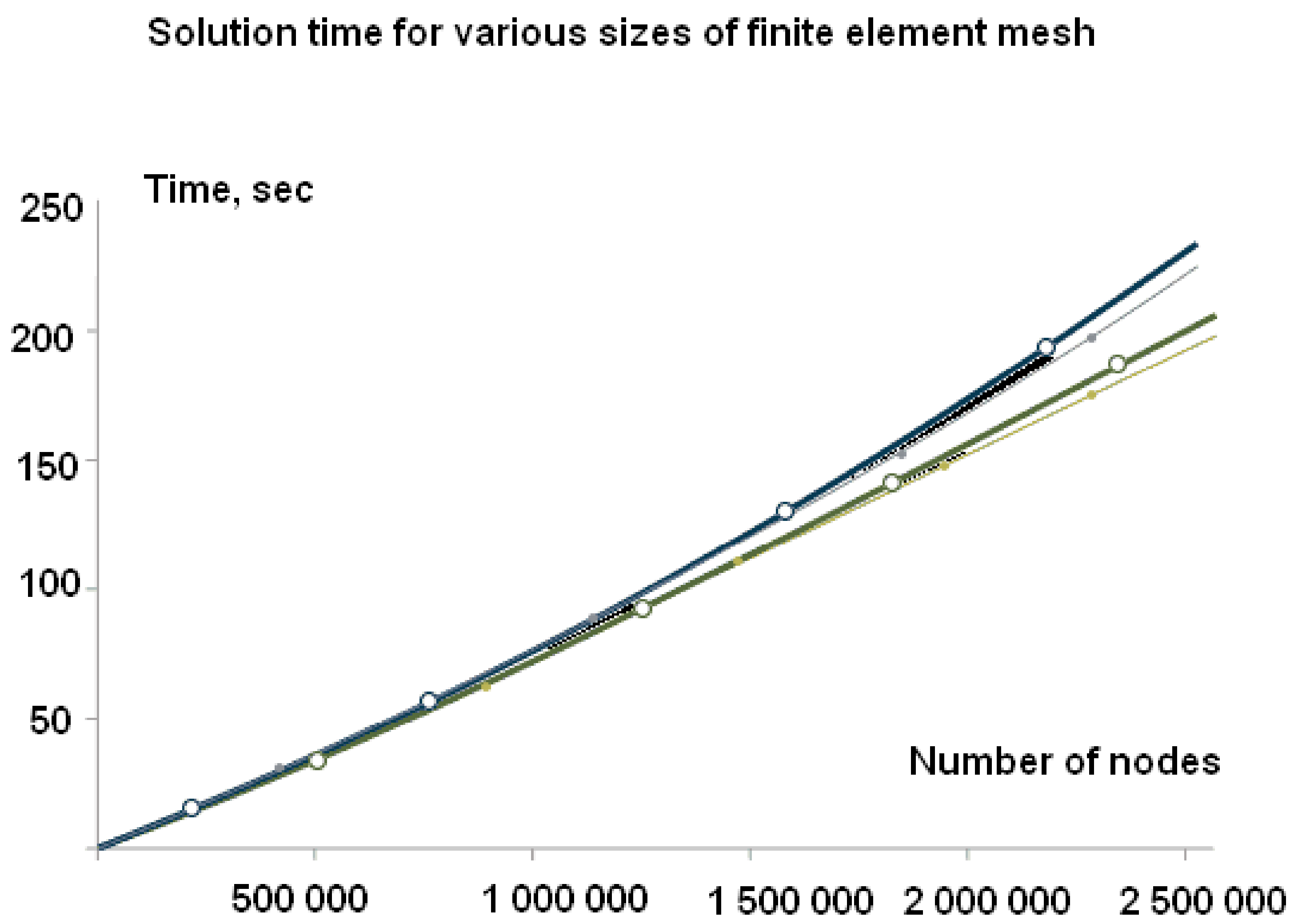
Magnetic analysis suite	
Magnetic Problems	Magnetostatics
	AC Magnetics
	Transient Magnetics
Electric analysis suite	
Electric Problems	Electrostatics and DC Conduction
	AC Conduction
	Transient Electric field
Thermostructural analysis suite	
Thermal and mechanical problems	Steady-State Heat transfer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

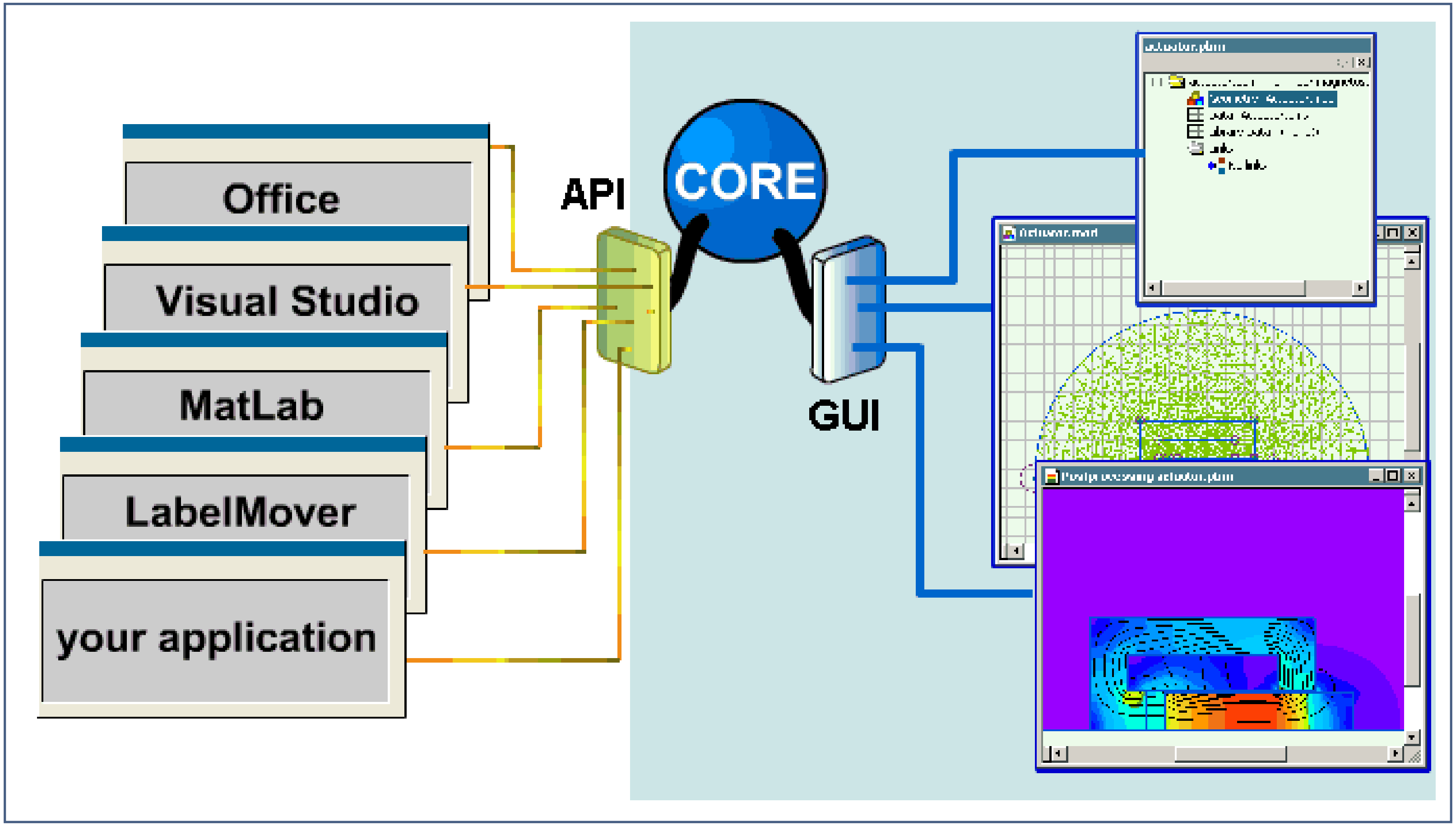
MultiPhysics.



QuickField solvers



Open object interface



ActiveField API object model

ActiveField™ help | Main QuickField Site | Free Downloads | Contacts

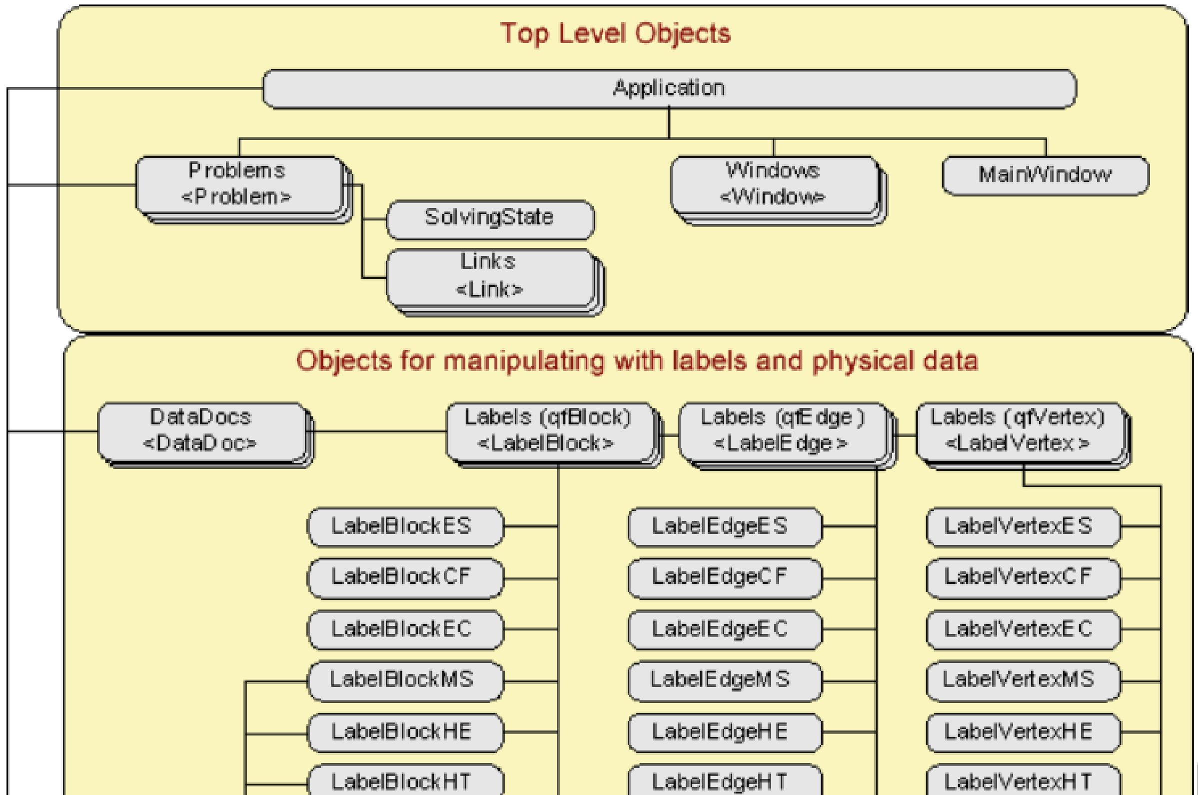
ActiveField Technology
Objects Overview
Hierarchy Chart
How to Start: Application Object
How to work with Problems
How to work with Model
How to work with Data
How to Analyze Results

Objects

Properties

Methods

QuickField Object Model

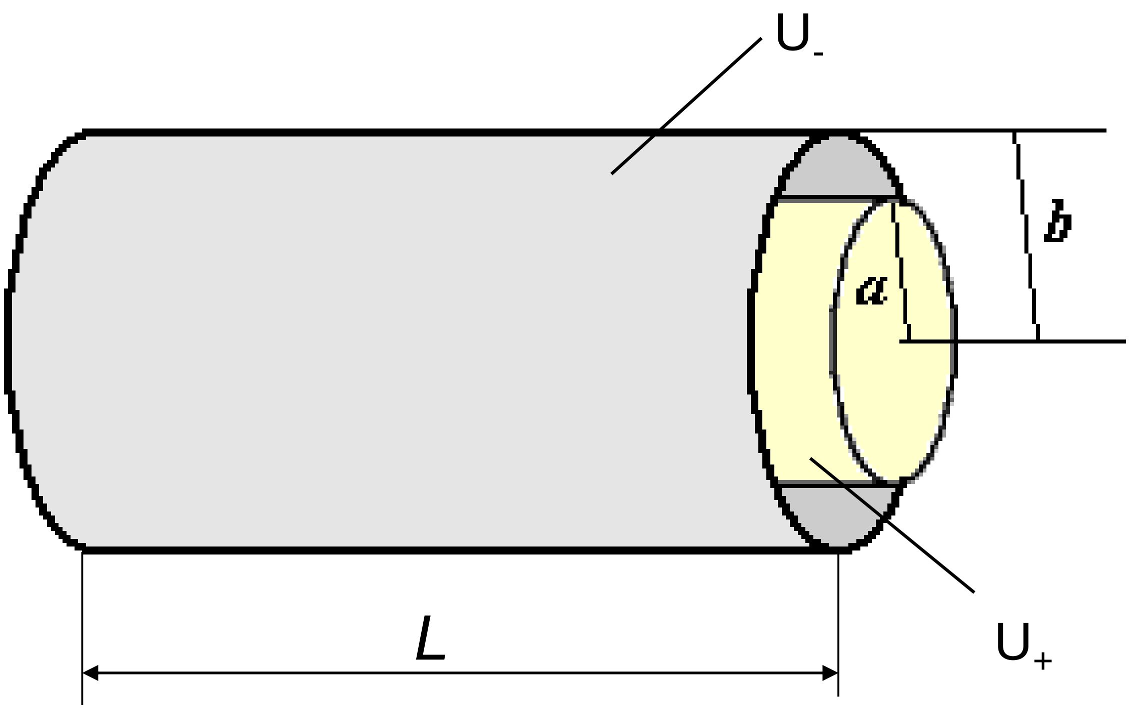


QuickField Difference

Electric capacitors simulation with QuickField

1. Ideal and non-ideal capacitor.
2. Electrolytic capacitor: capacitance, currents, losses heating.
3. Capacitor inductance
4. Capacitive displacement sensor. Calculations automation.
5. Anode plate pitting.

Cylindrical capacitor



Problem specification:

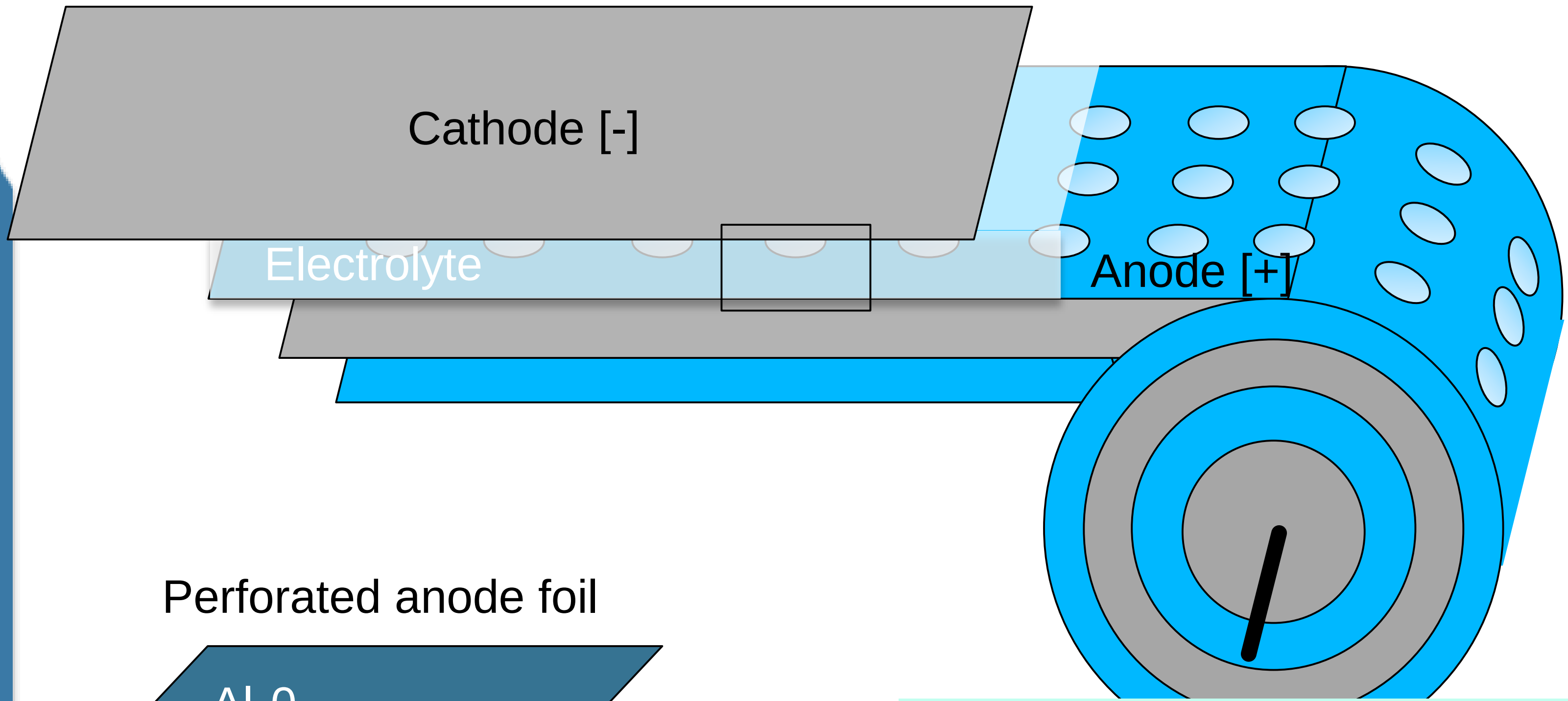
a = 5 mm
b= 6 mm
L = 40 mm

$$C = q / (U_+ - U_-) \text{ [F]}$$

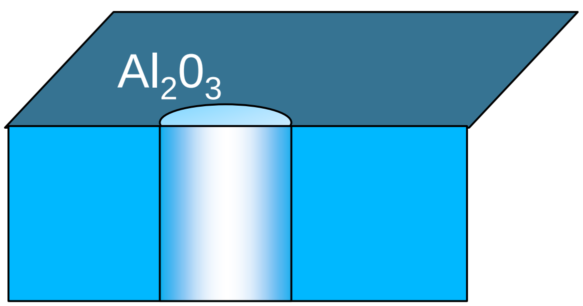
$$C = 2\pi\varepsilon\varepsilon_0 * L \;/\; \ln(b/a) = 12.205 \text{ pF}$$

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

Electrolytic capacitor



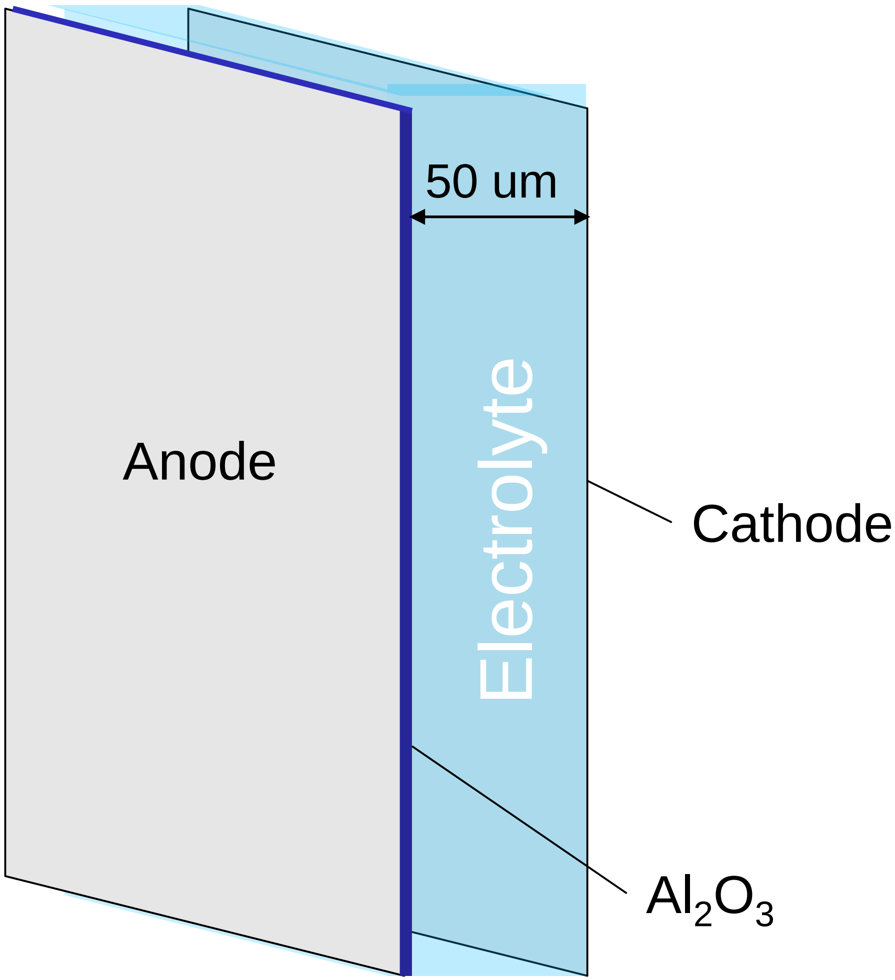
Perforated anode foil



<u>Problem specification:</u>

Oxide film thickness 1 um.
Aluminum foil thickness 100 um.
Electrolyte layer thickness 50 um.

Electrolytic capacitor
Electric capacitance



Problem specification:

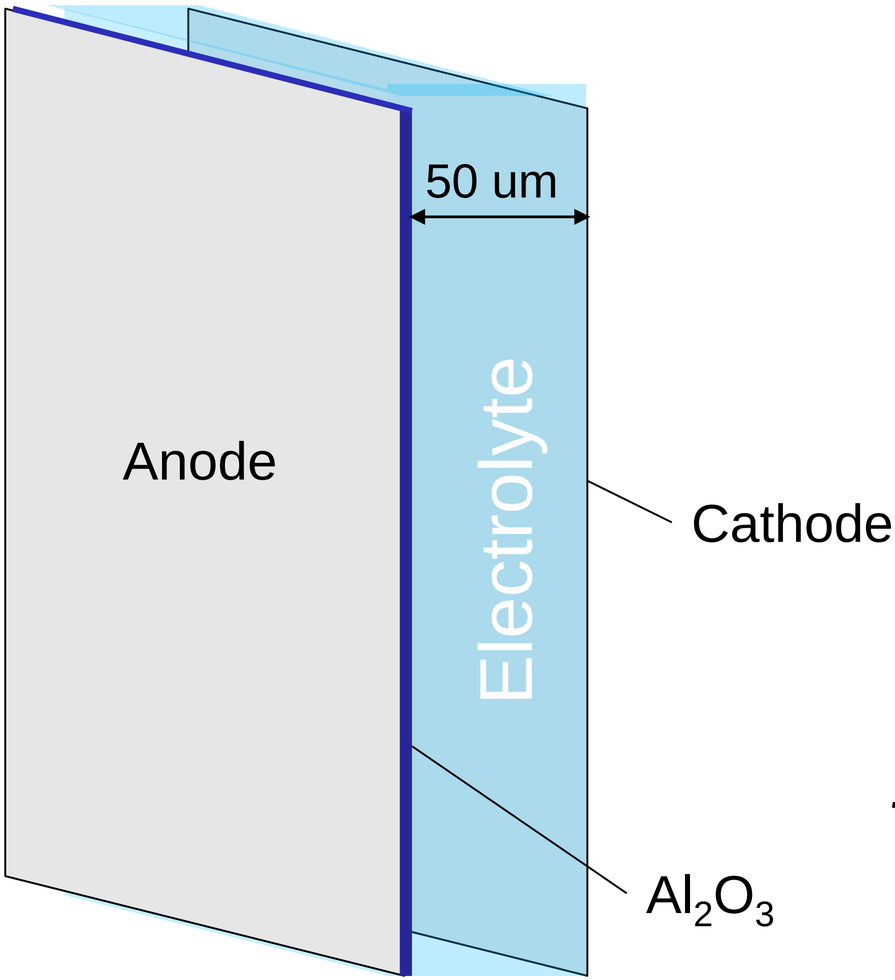
Oxide film (Al_2O_3) thickness 1 um.

Oxide film permittivity $\varepsilon = 10$.

Electric capacitance

$C = q / U$ [F/m^2]

Electrolytic capacitor
Current. Losses



Problem specification:

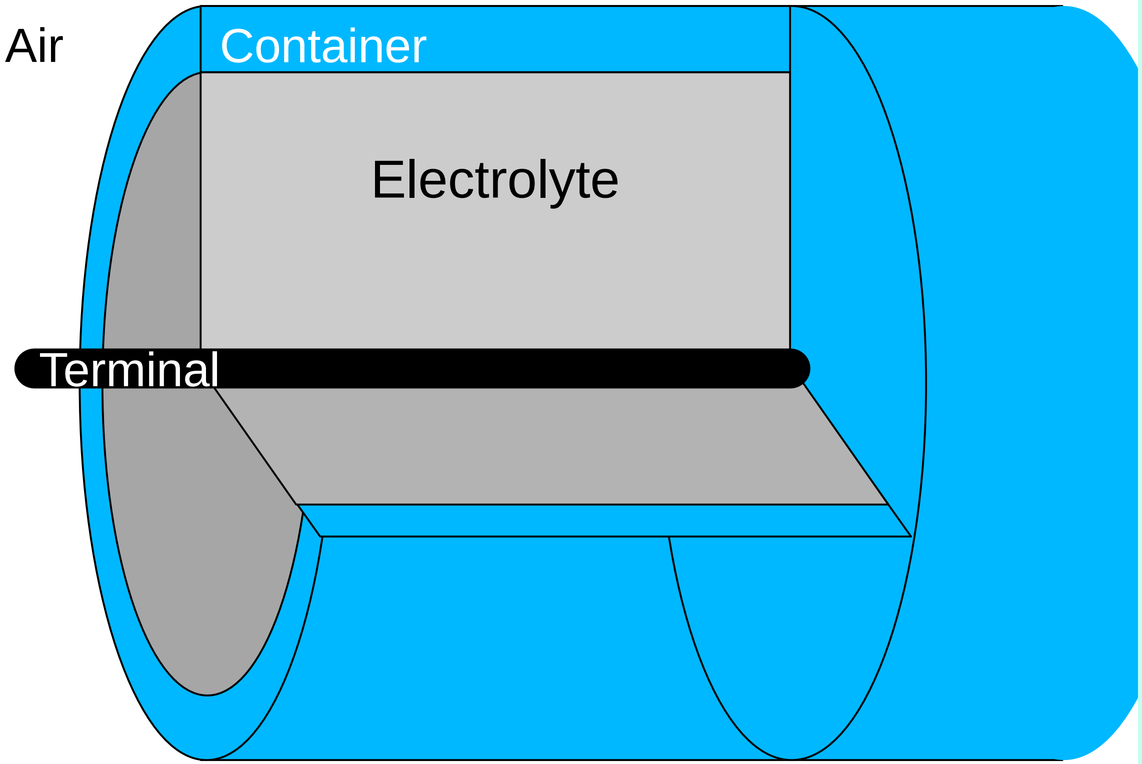
Electrolyte electric conductivity
g = 5 S/m

Voltage U = 40 V
Frequency f = 20 kHz
Capacitance C = 88.5 uF/m^2

Electric current density
$j = U * i\omega C$ [A/m^2]

Volume losses
$Q = j^2 / g$ [W/m^3]

Electrolytic capacitor
Heating



Problem specification:

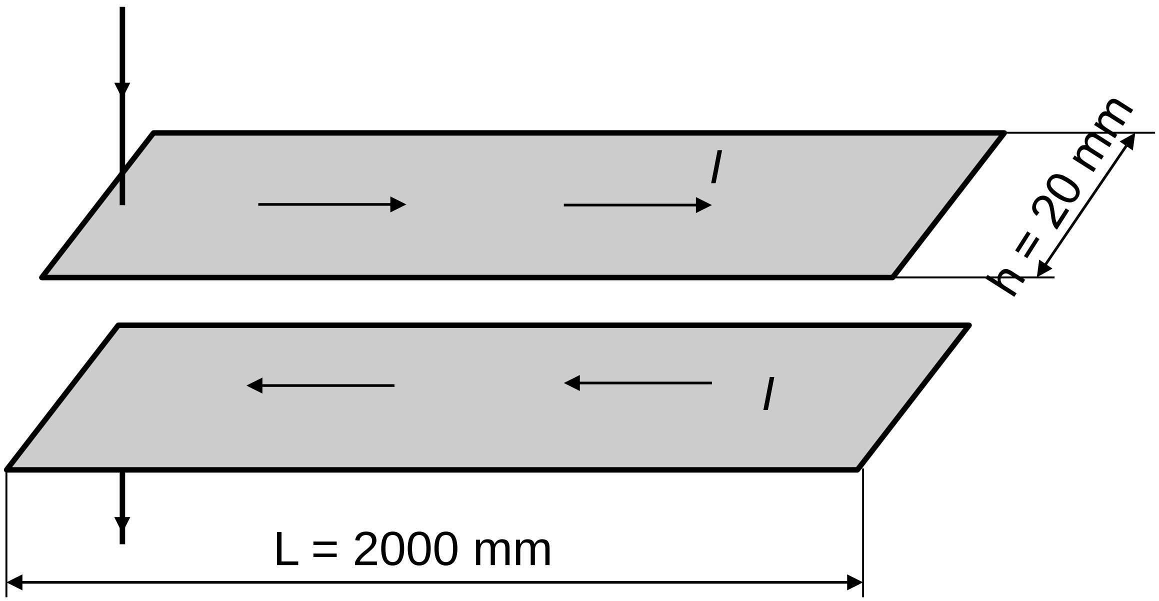
Container (Al) thermal conductivity λ = 200 W/m*K

Electrolyte thermal conductivity λ = 0.5 W/m*K

Losses Q = 19700 W/m^3

Convection coefficient α = 12 W / $K*m^2$

Capacitor inductance



Problem specification:

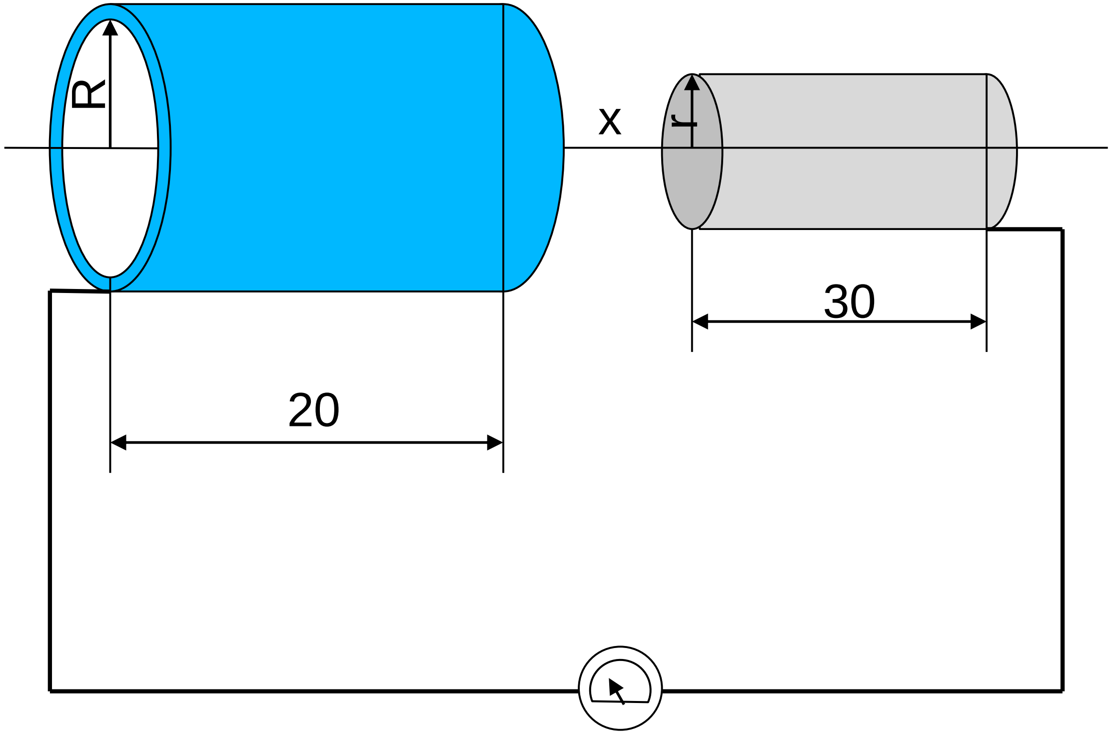
Distance between plates
d = 0.1 mm

Plate surface area
L x *h* = 2000 x 20 mm

Inductance $L = \Psi / I$ [H]

Current layer $\sigma = I / h$ [A/m]

Capacitive displacement sensor. Calculations automation.

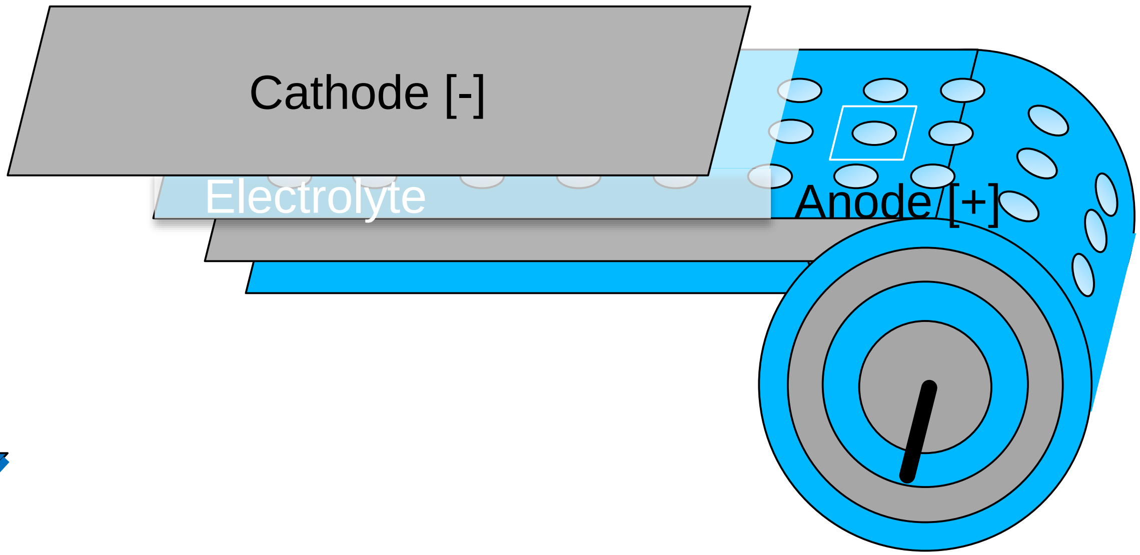


<u>Problem specification:</u>

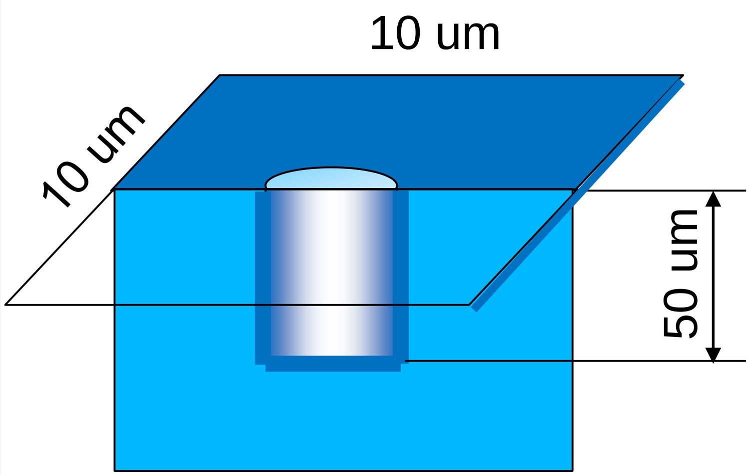
r = 4 mm
R = 5 mm

Capacitance $C(x)$ - ?

Electrolytic capacitor



Anode foil perforation



Problem specification:

Oxide film thickness 1 um.

Pitting diameter 2 um

Pitting depth 50 um

Pitting plate area 10 x 10 um^2