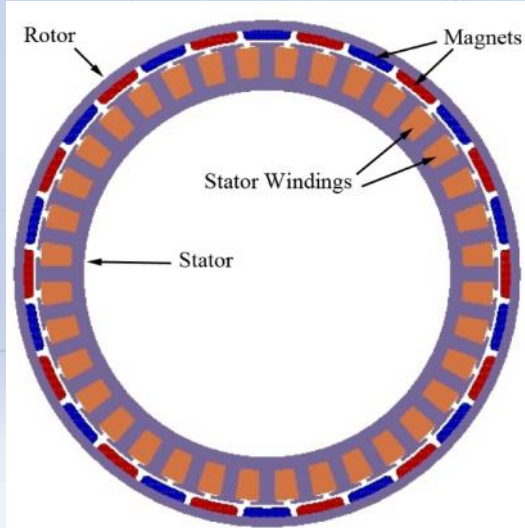
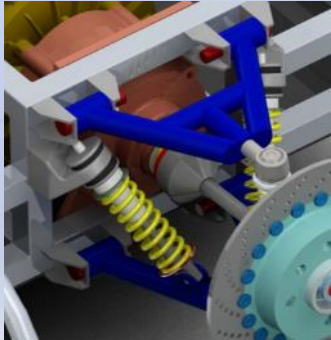


NUMERICAL ELECTROMAGNETIC FIELD ANALYSIS IN ELECTRICAL MACHINE SIMULATION

Prof. Miklós Kuczmann

Cooperation between higher education, research institutes and automotive industry
section

Infolytica and COMSOL Multiphysics



Quantity	Value/Expression	Unit	Description
ϵ_r	n	V	Relative permittivity
μ_r	n	Lenz	Relative permeability
μ_0	$4\pi \times 10^{-7}$	As	Permeability of vacuum
$H = B$	$\mu_0 \mu_r J$		Constitutive relation
σ			Resistivity

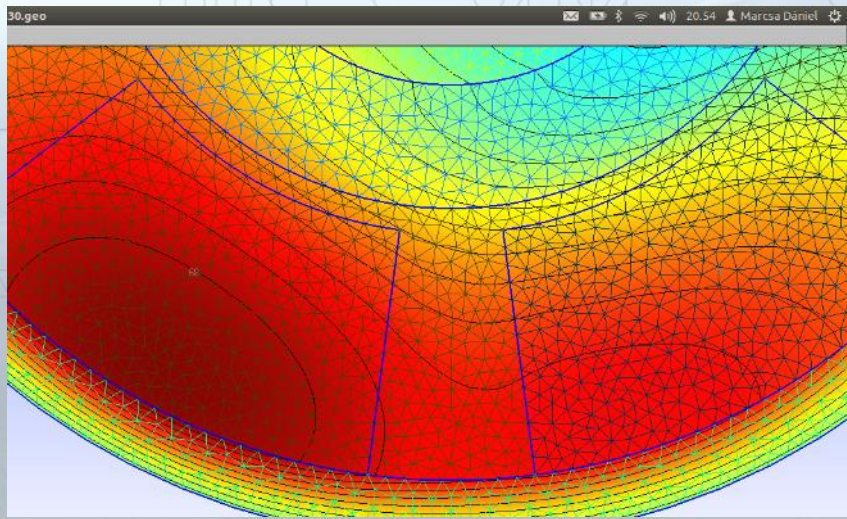
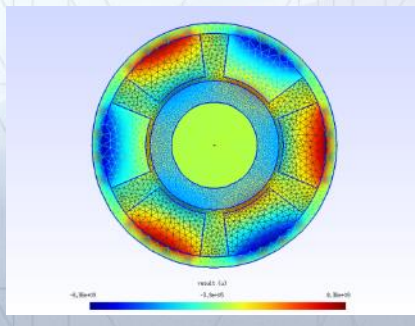
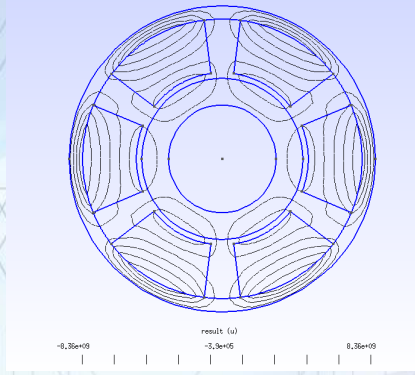
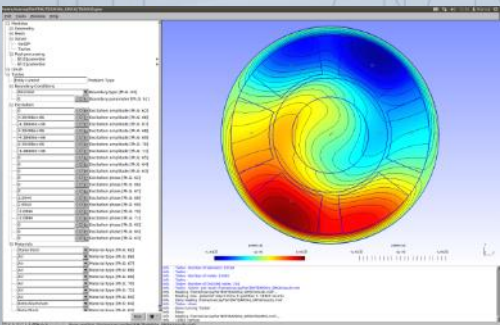
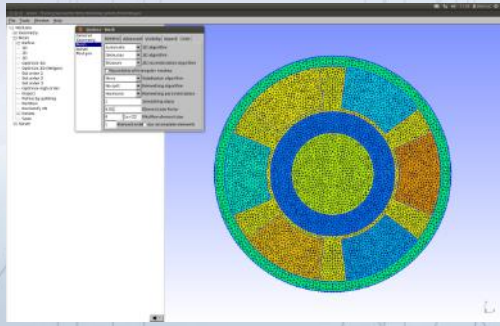
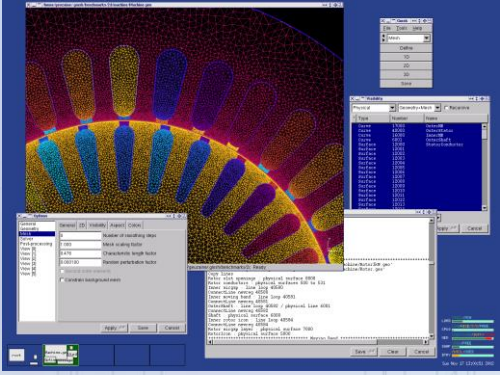
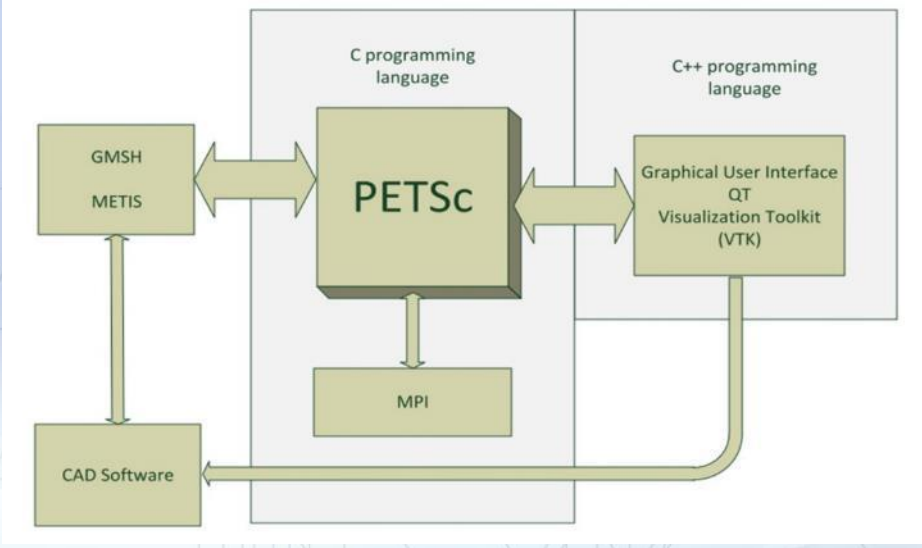
- Square
- Square with cylindrical tangs
- Round
- Parallel tooth
- General square
- General round
- Parallel square
- Parallel round
- Parallel

- Surface mounted with radial magnets
- Surface mounted with two radial magnets per pole
- Surface mounted with three radial magnets per pole
- Surface mounted with four radial magnets per pole
- Surface mounted with parallel magnets

```

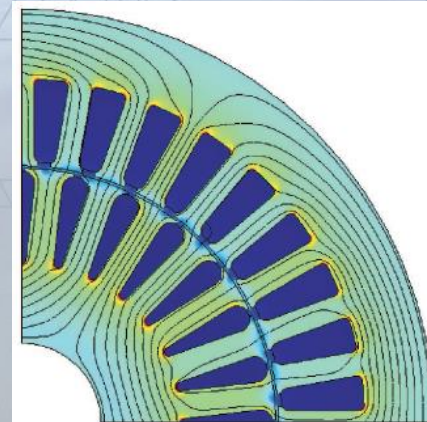
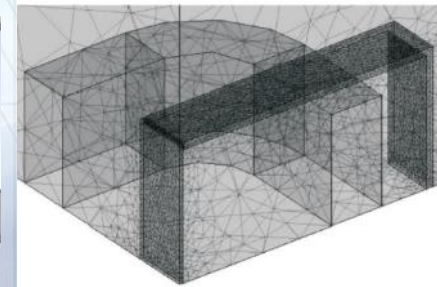
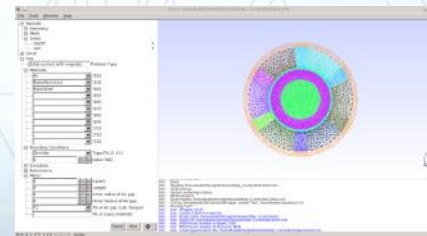
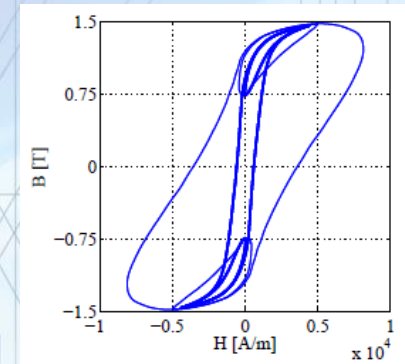
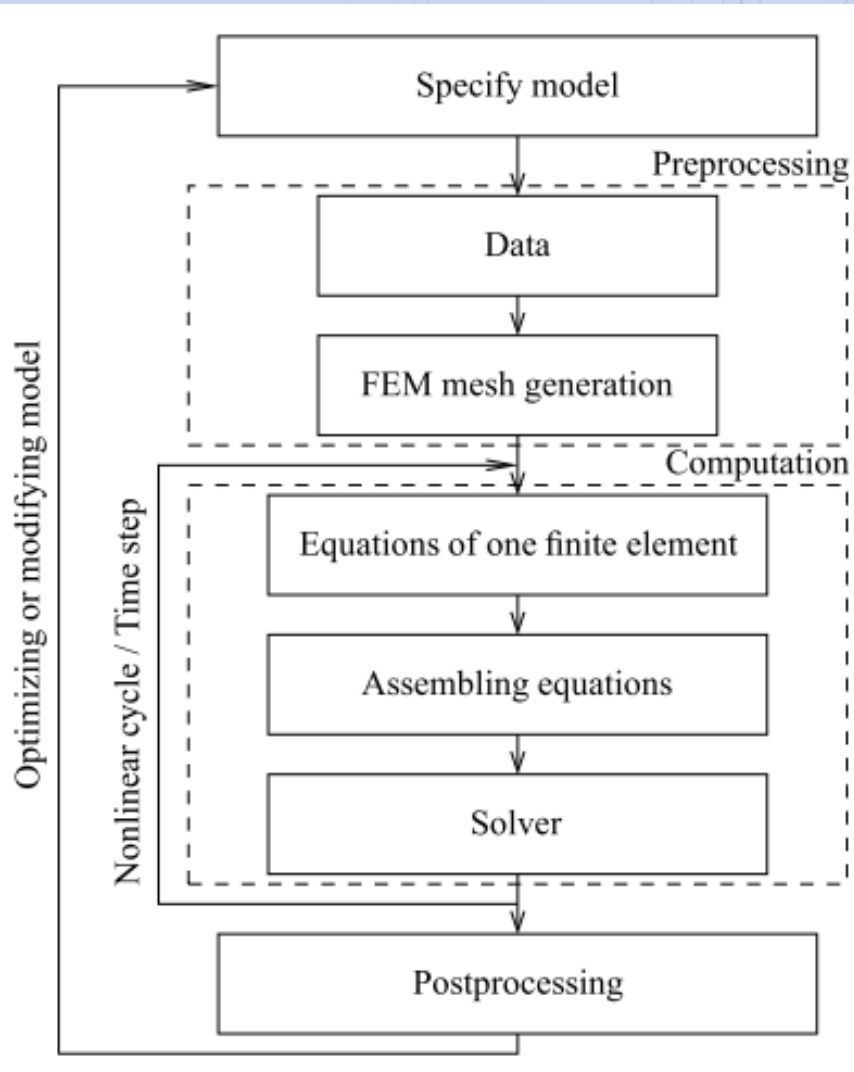
C:\Documents and Settings\Wiktos\My Documents\FI_Hend\linear_solverNR.m
File Edit Text Go Cell Tools Debug Desktop Window Help
Stack: Base
70 while (error>EPS),
71     lepes = lepes + 1;
72
73 % 1.) dFI
74 fem_sol = femstatic(fem, ...
75     'u', fem_sol, ...
76     'solcomp', ('dFI'), ...
77     'outcomp', ('mu4', 'mu1', 'tT0xT0yT0z21', 'tT0xT0yT0z20', 'tT0xT0yT0z10', 'mudx', 'R4z', 'mu
78     'lin solver', 'green', ...
79     'preFun', 'amp'));
80
81 % 2.) alpha
82 alfa = 1;
83 if lepes > 1,
84     alfa = alfa_opt4edfok(fem, muopt, MODEL, rng_FI, rng_dFI, rng_Rx, rng_Ry, rng_Rz, rng_mudx, rng_mudy, r
85 end;
86
87 % 3.) FI update -> fem_sol.u
88 SOL = fem_sol.u;
89 SOL(rng_FI) = SOL(rng_FI) + alfa * SOL(rng_dFI);
90 fem_sol = femsol(SOL);
91
92 % 4.) H, B, R, mud -> fem_sol.u
93 fem = Nonlinear_step(fem, muopt, MODEL, rng_Rx, rng_Ry, rng_Rz, rng_mudx, rng_mudy, rng_muds, xyz_specimen1.x
94
95 % 5.) convergence_error
96 FUN_0 = Energia_egyenuly(fem);
97 error = abs(FUN_0);
98 ERROR(lepes) = error;
99 ALFA(lepes) = alfa;
100 if (alfa==0), error = 0; end;
101 disp([num2str(lepes) ' ' num2str(error) ' ' num2str(alfa)]);
102 end;
  
```

Own FEM Software



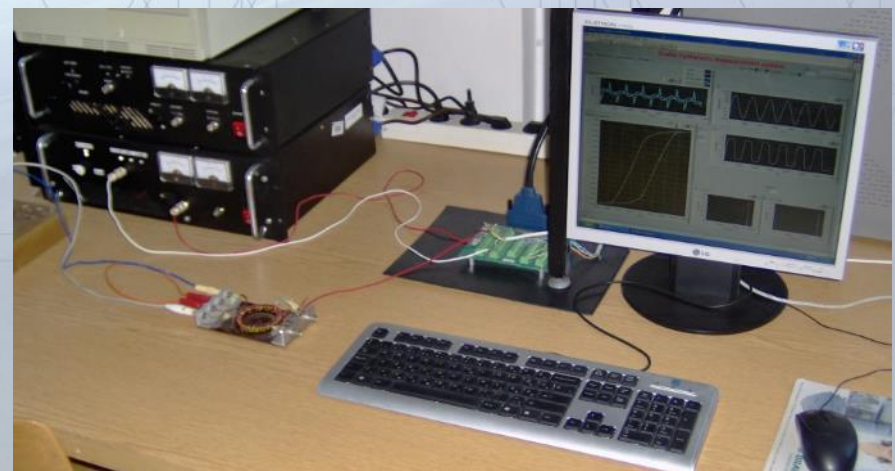
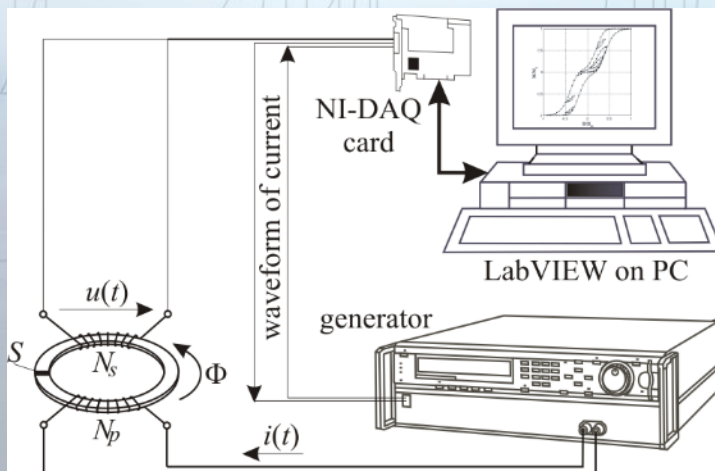
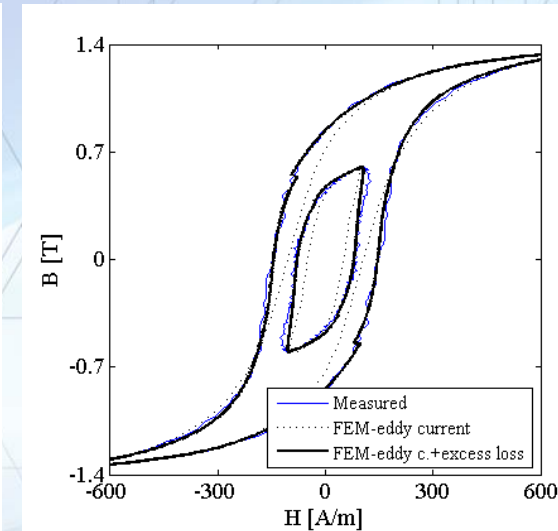
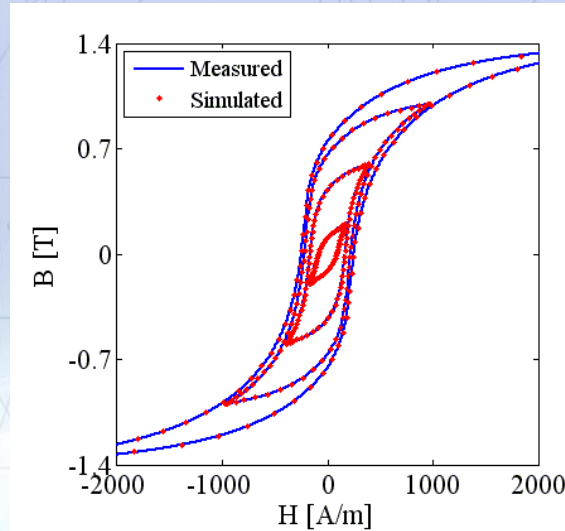
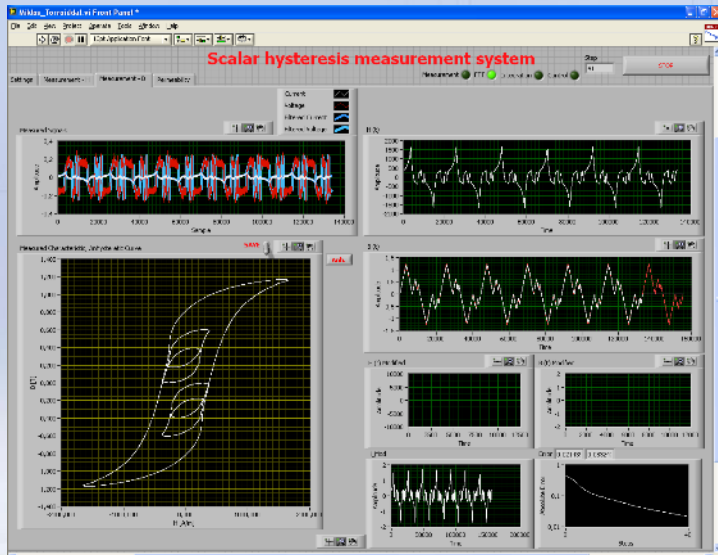
***Budai, Tamás
 Friedl, Gergely
 Kovács, Gergely
 Kuczmann, Miklós
 Marcsa, Dániel
 Unger, Tamás***

Some Words about FEM

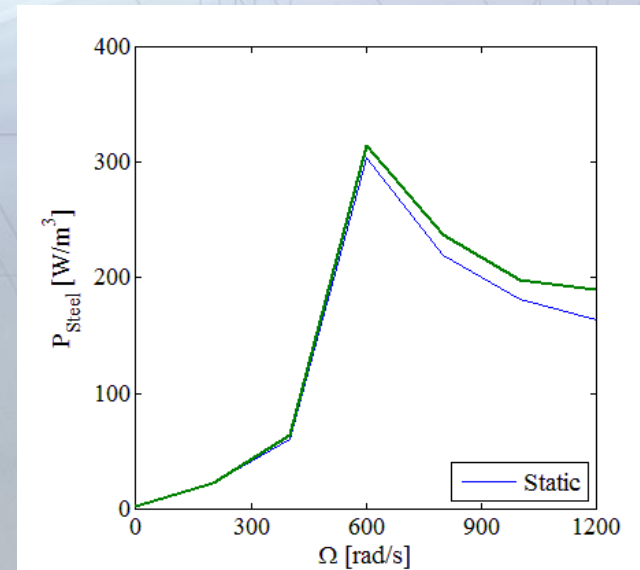
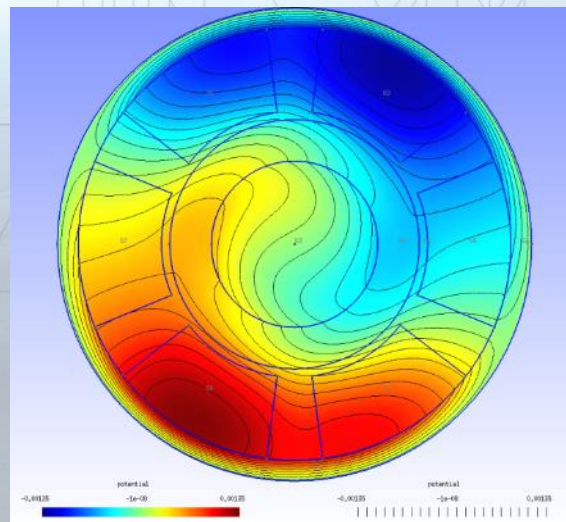
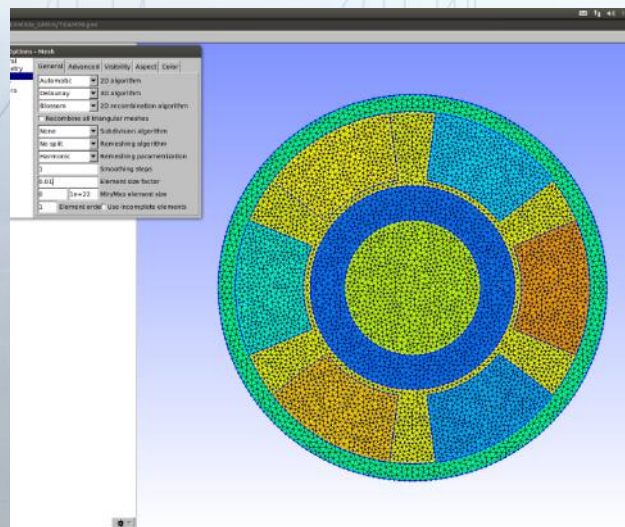
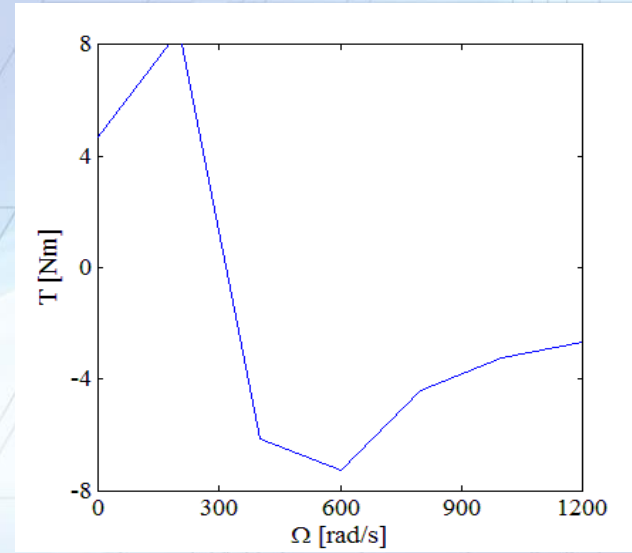
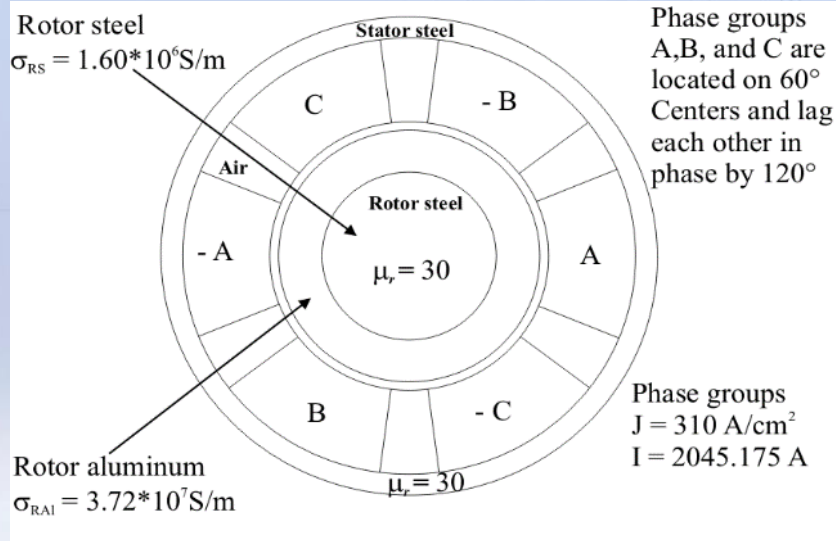


- Loss
- Torque
- etc...

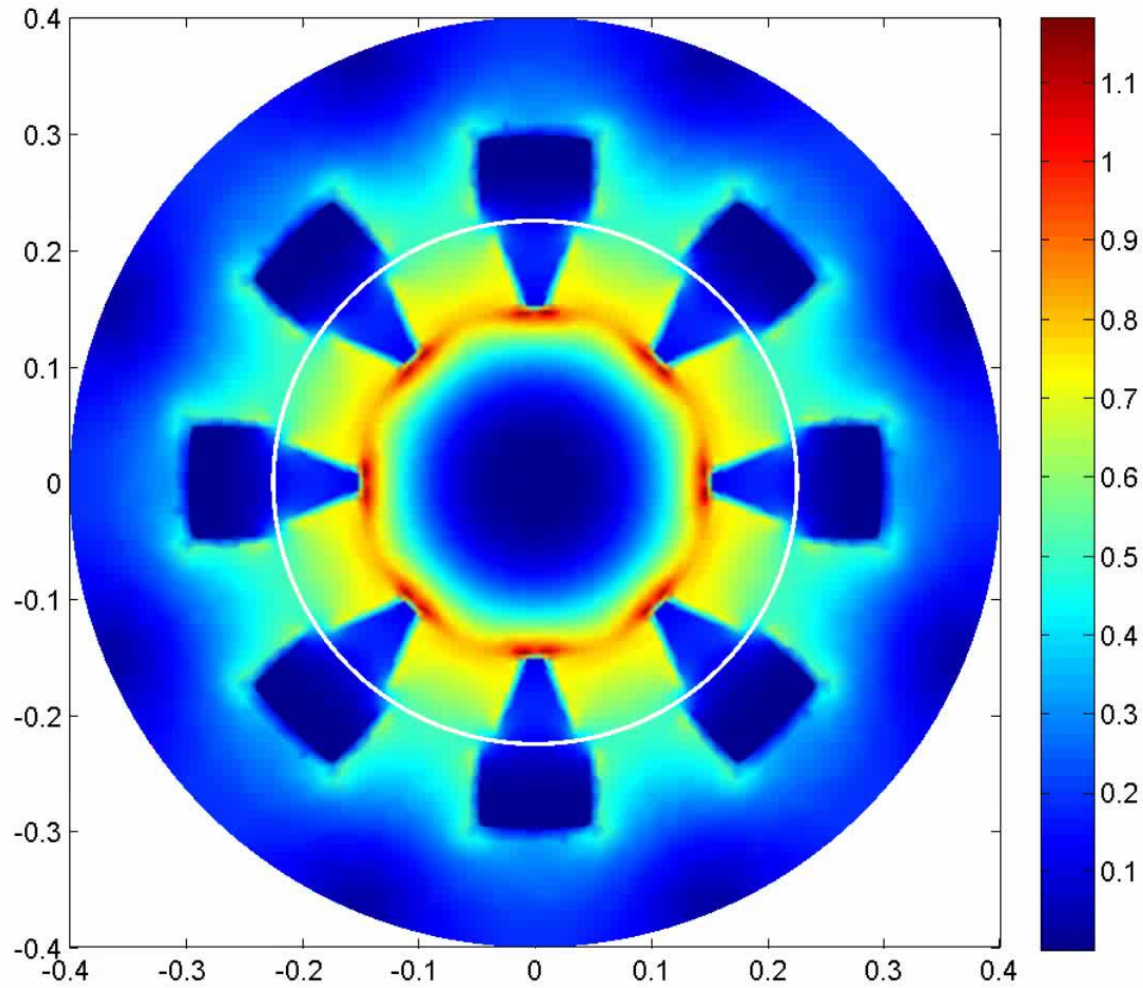
Hysteresis Loss Measurement and Simulation



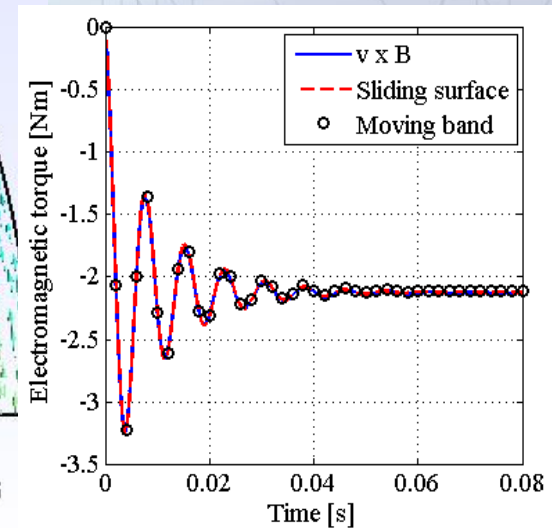
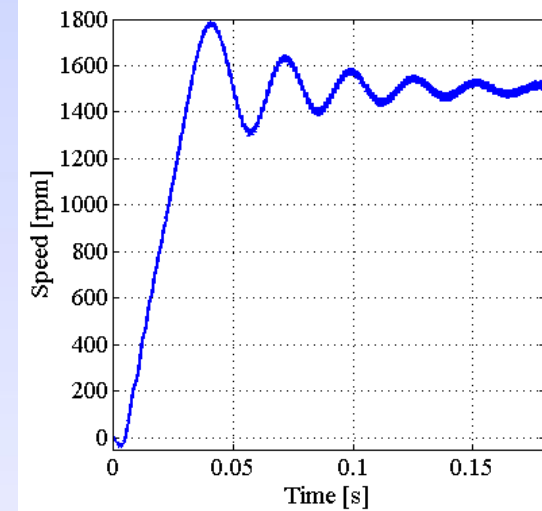
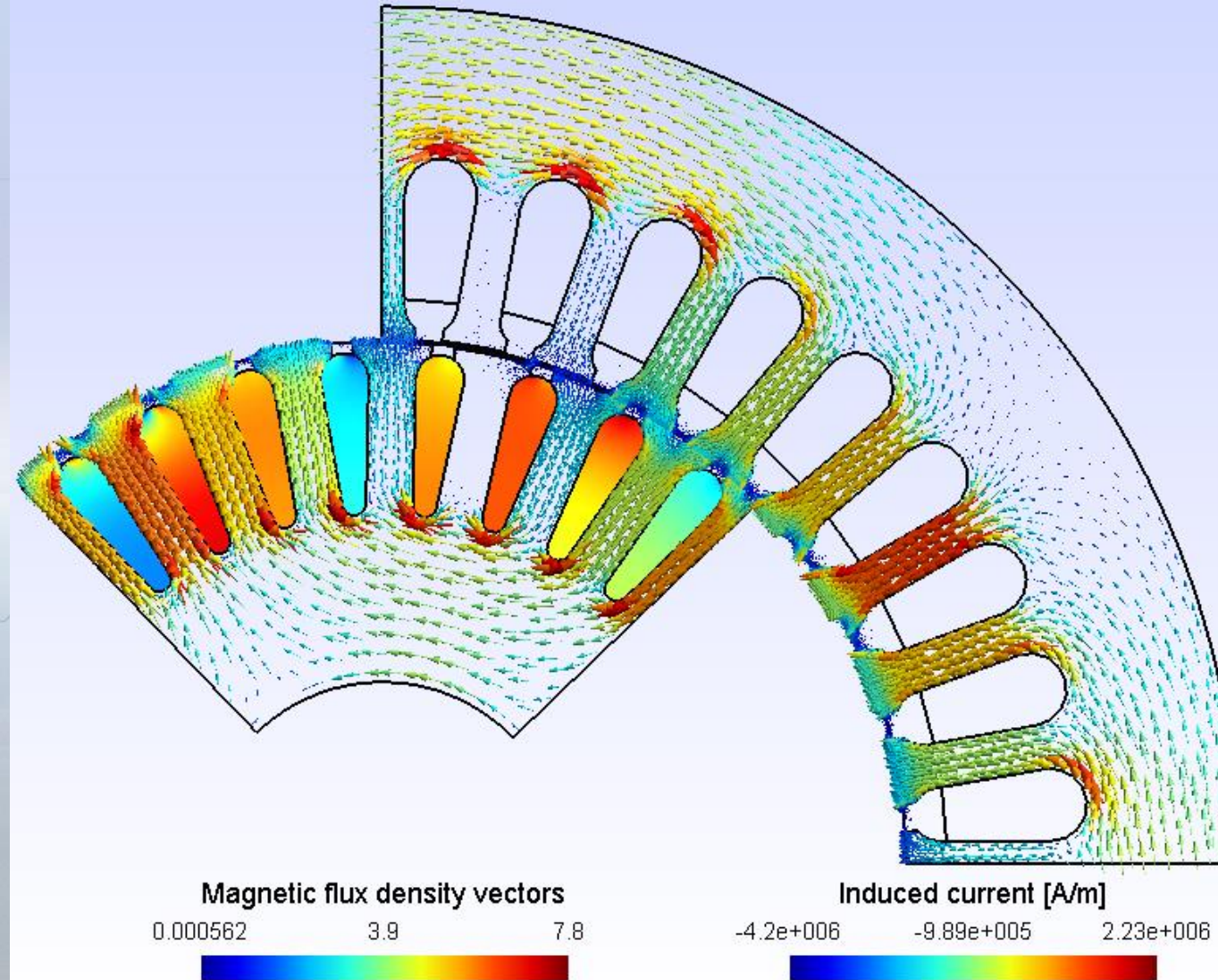
T.E.A.M. Problem No. 30.a. (modified nonlinear version)



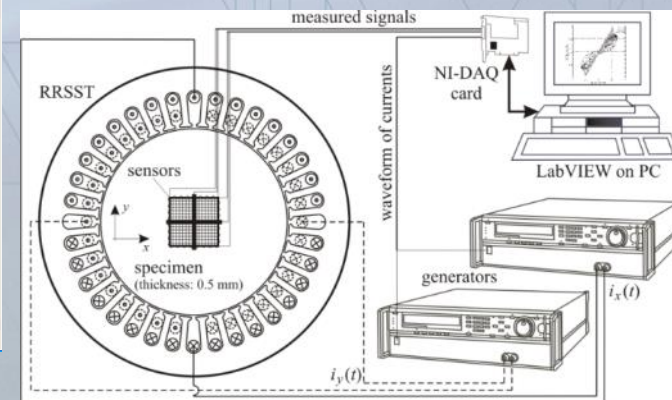
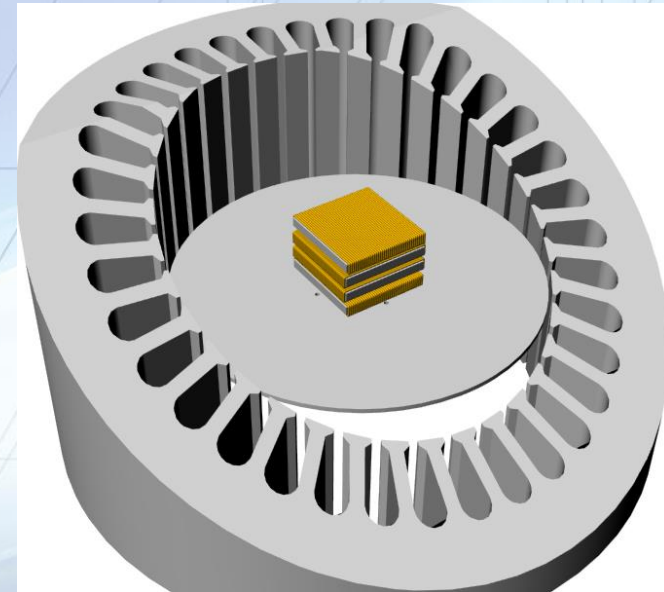
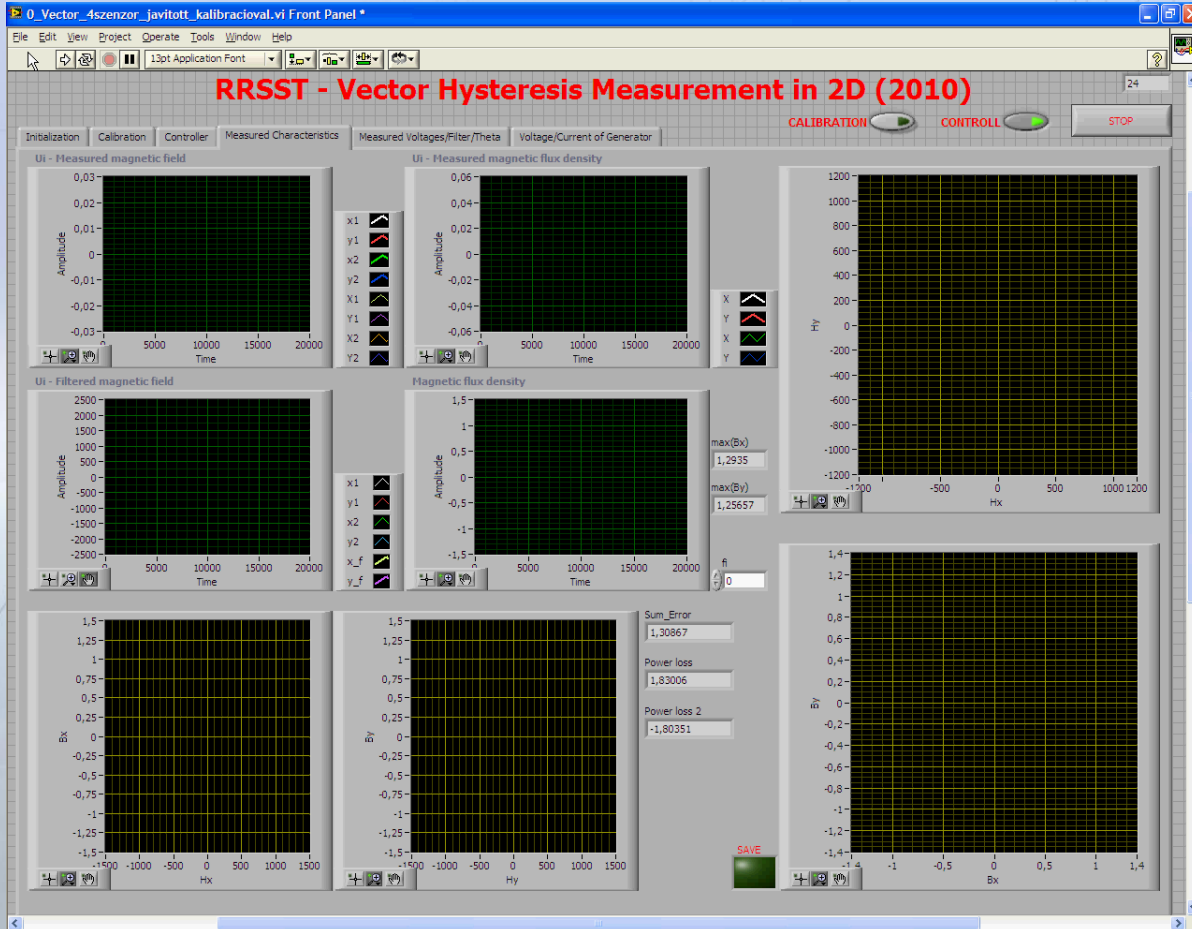
Simulation of Electrical Machines



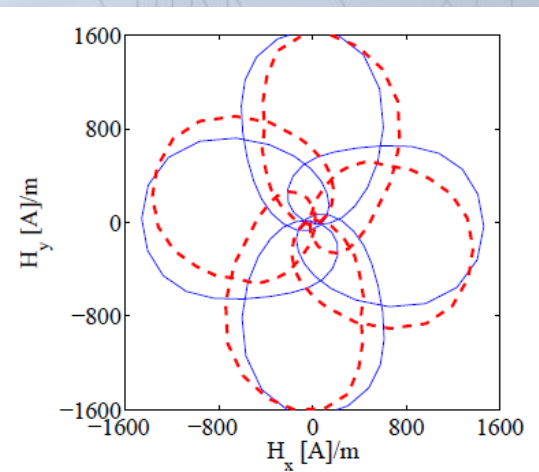
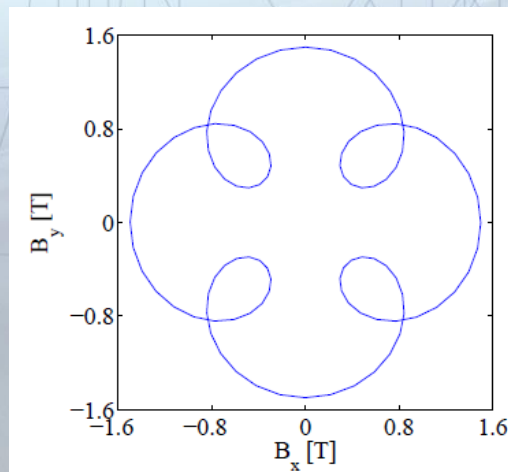
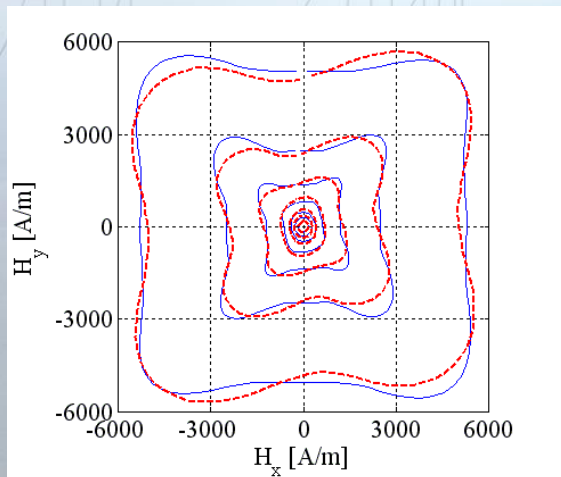
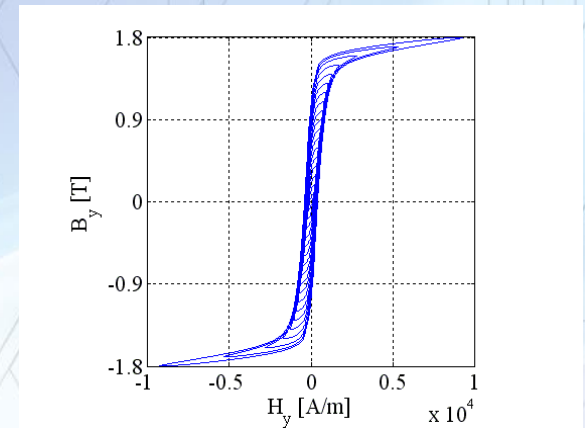
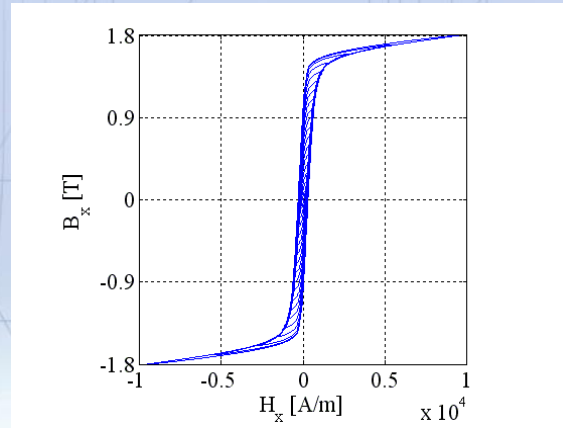
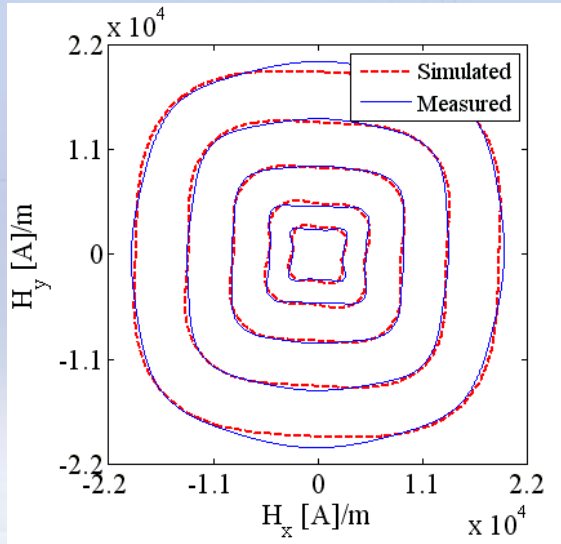
Simulation of Electrical Machines



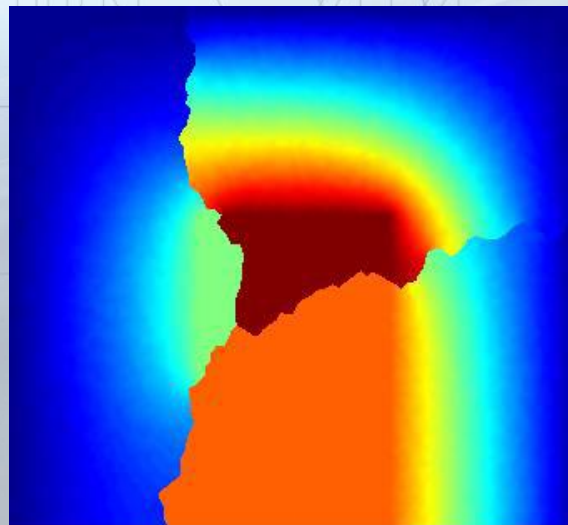
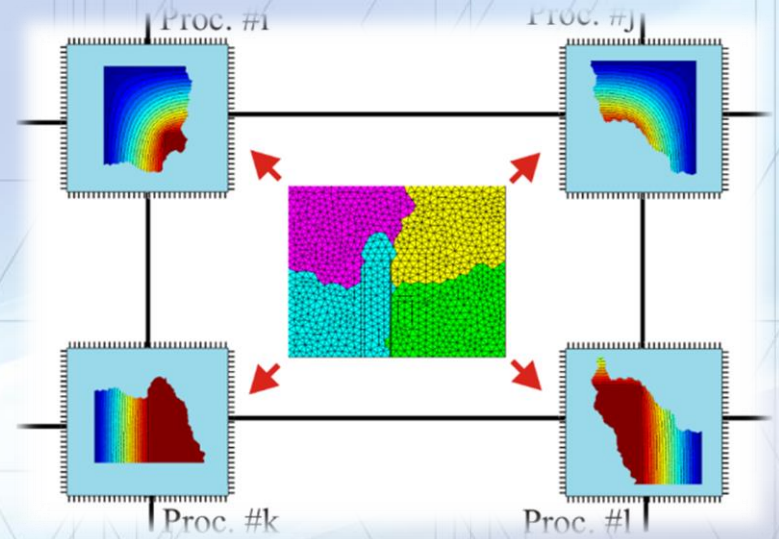
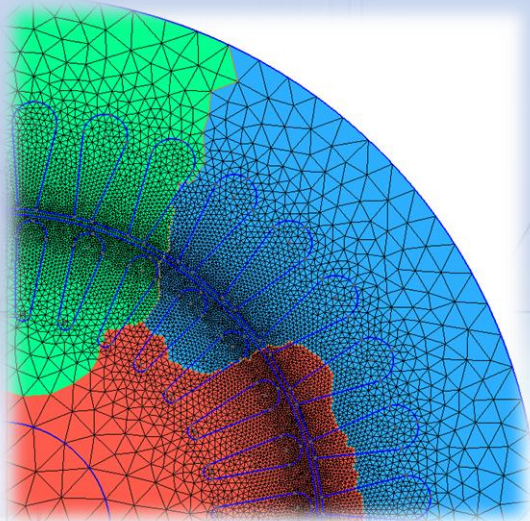
Vector Hysteresis Measurement and Simulation



Vector Hysteresis Measurement and Simulation



Outlook



THANK YOU FOR YOUR ATTENTION.

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Széchenyi István University

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