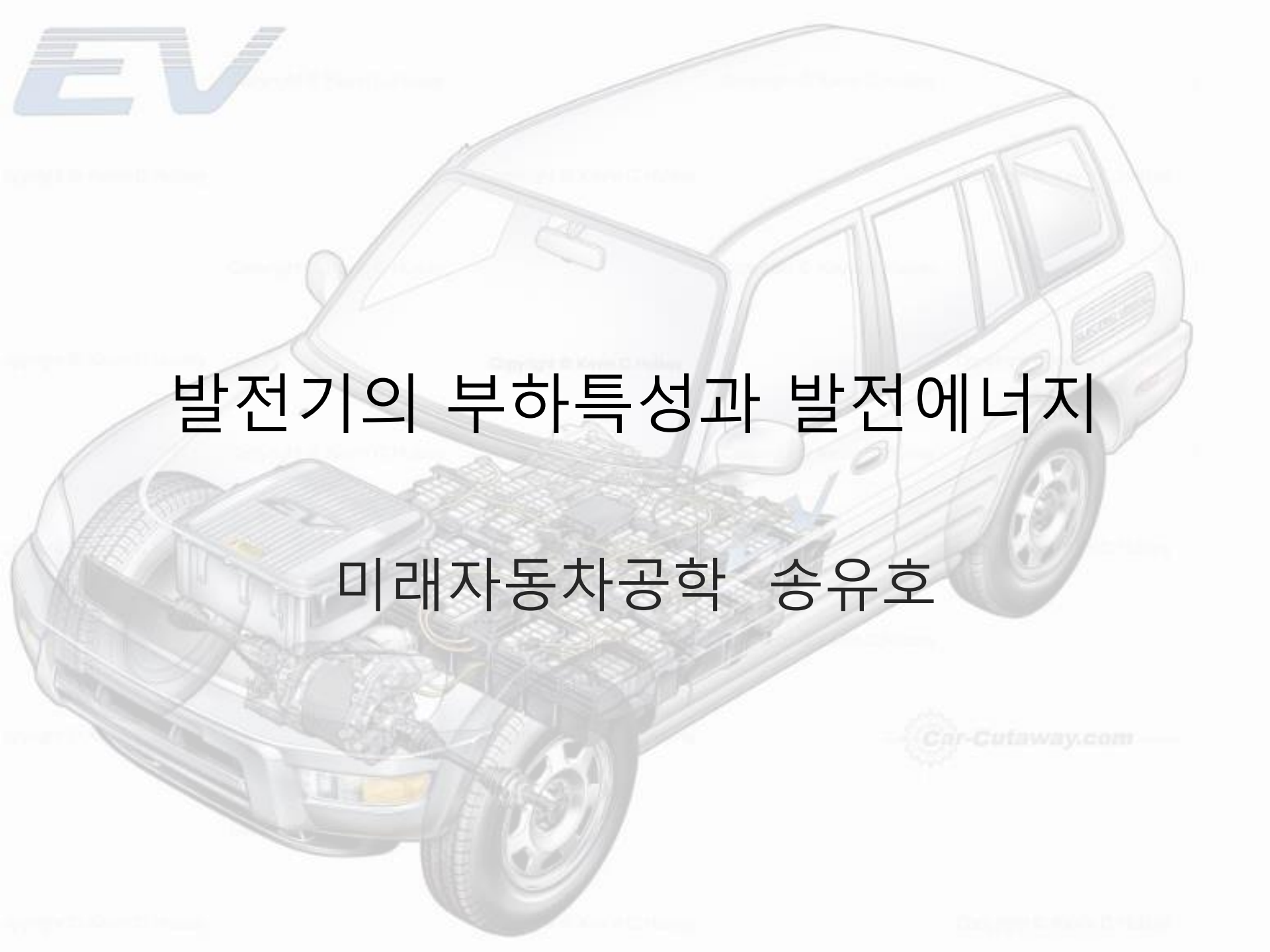
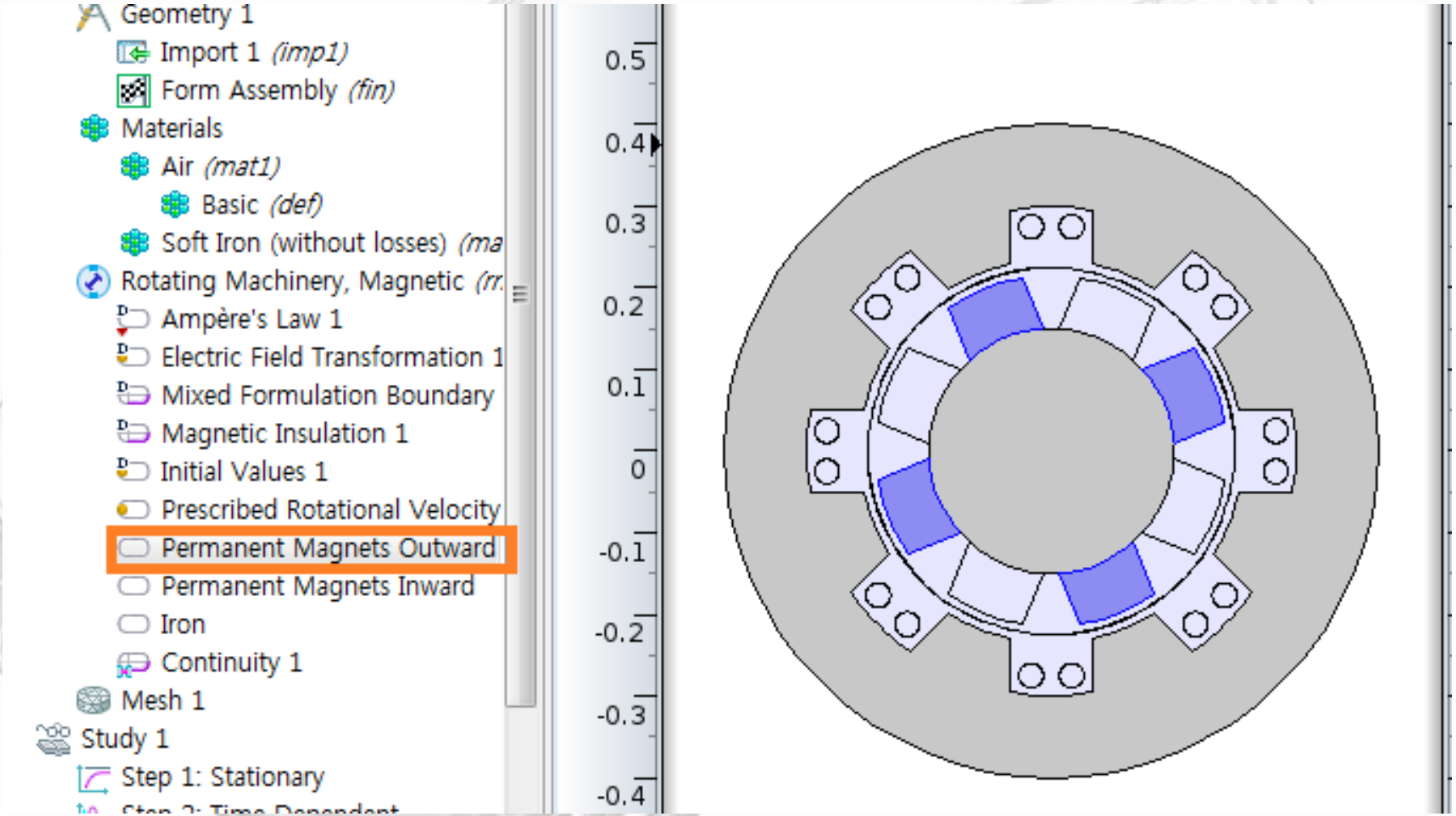
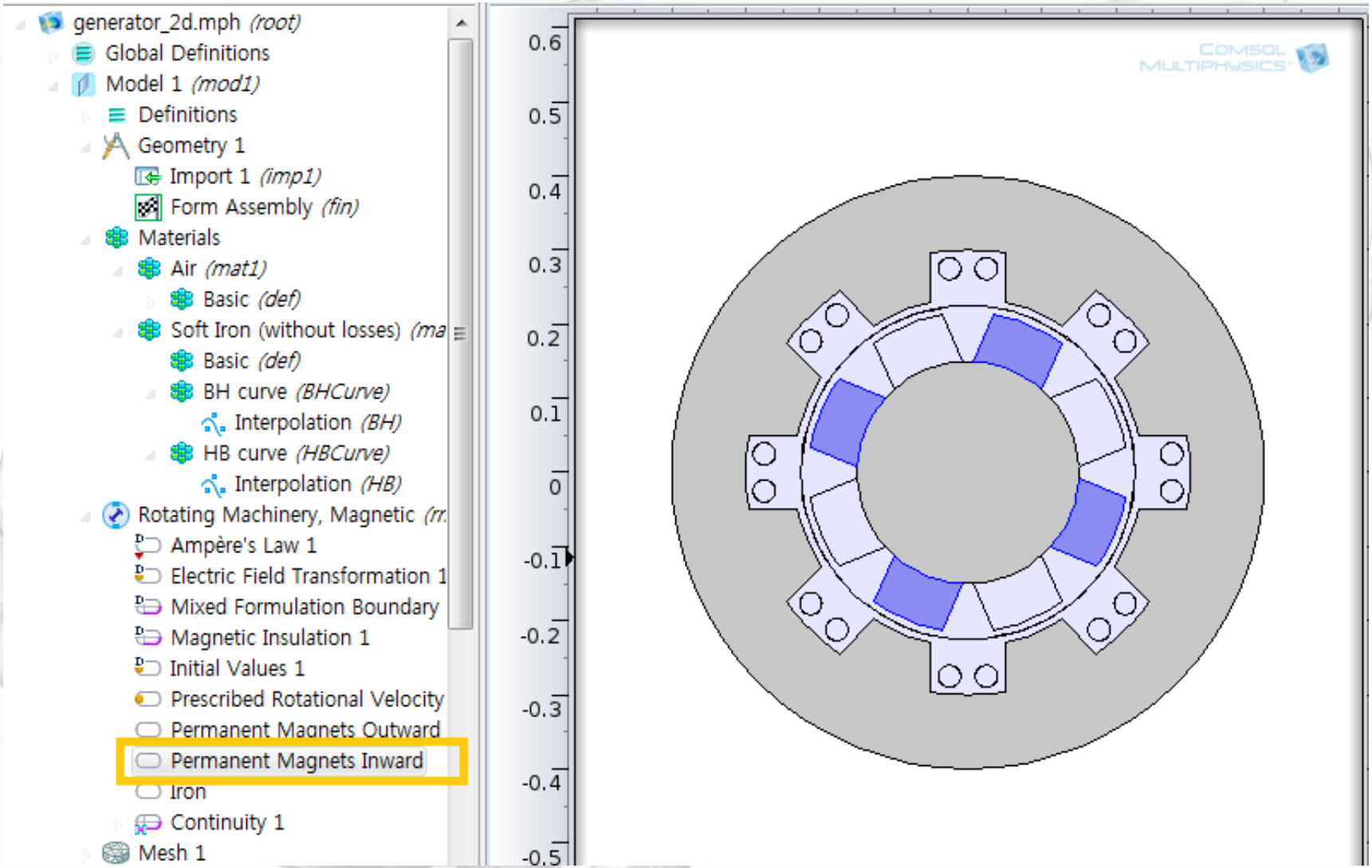


발전기의 부하특성과 발전에너지

미래자동차공학 송유호

Generator

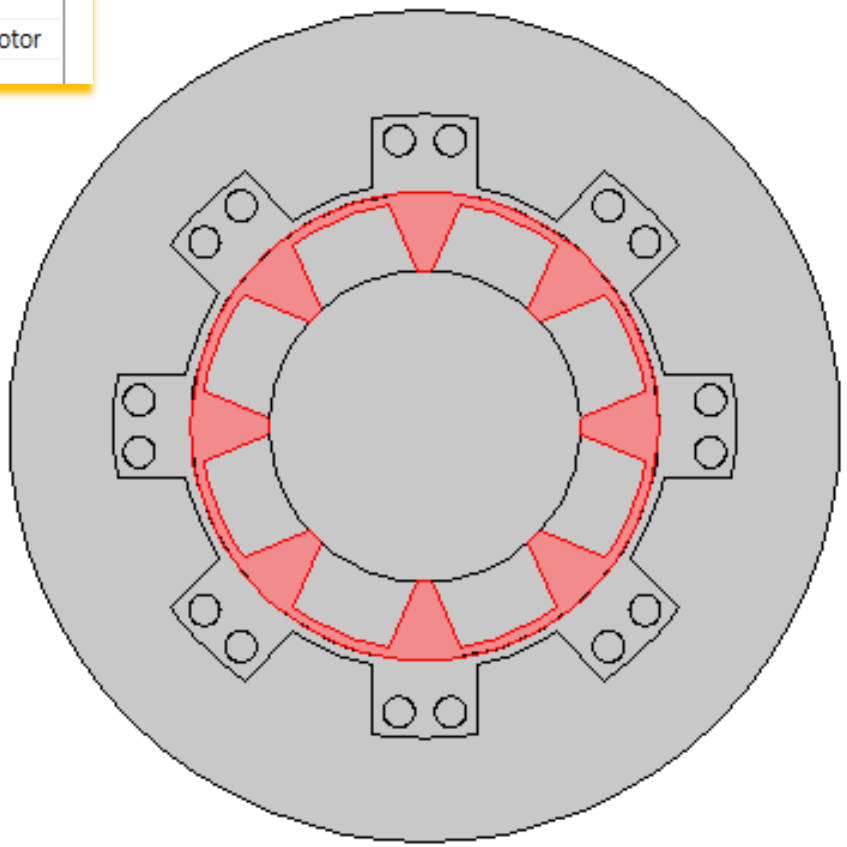

Geometry 1
Import 1 (imp1)
Form Assembly (fin)
Materials
Air (mat1)
Basic (def)
Soft Iron (without losses) (ma
Rotating Machinery, Magnetic (rr
Ampère's Law 1
Electric Field Transformation 1
Mixed Formulation Boundary
Magnetic Insulation 1
Initial Values 1
Prescribed Rotational Velocity
Permanent Magnets Outward
Permanent Magnets Inward
Iron
Continuity 1
Mesh 1
Study 1
Step 1: Stationary
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4

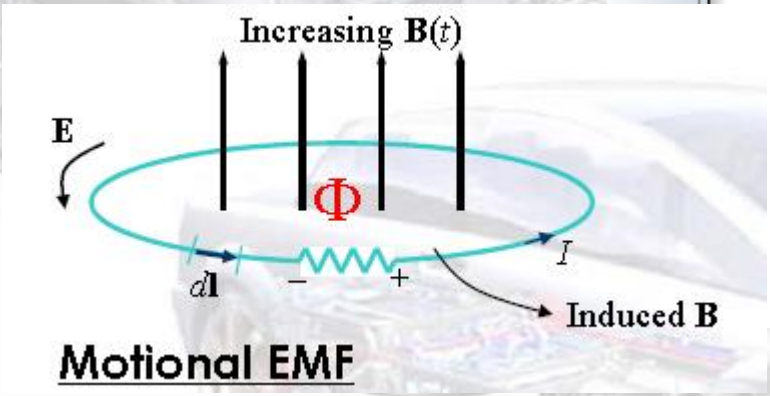

generator_2d.mph (root)
Global Definitions
Model 1 (mod1)
Definitions
Geometry 1
Import 1 (imp1)
Form Assembly (fin)
Materials
Air (mat1)
Basic (def)
Soft Iron (without losses) (ma
Basic (def)
BH curve (BHCurve)
Interpolation (BH)
HB curve (HBCurve)
Interpolation (HB)
Rotating Machinery, Magnetic (rr
Ampère's Law 1
Electric Field Transformation 1
Mixed Formulation Boundary
Magnetic Insulation 1
Initial Values 1
Prescribed Rotational Velocity
Permanent Magnets Outward
Permanent Magnets Inward
Iron
Continuity 1
Mesh 1
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
COMSOL MULTIPHYSICS

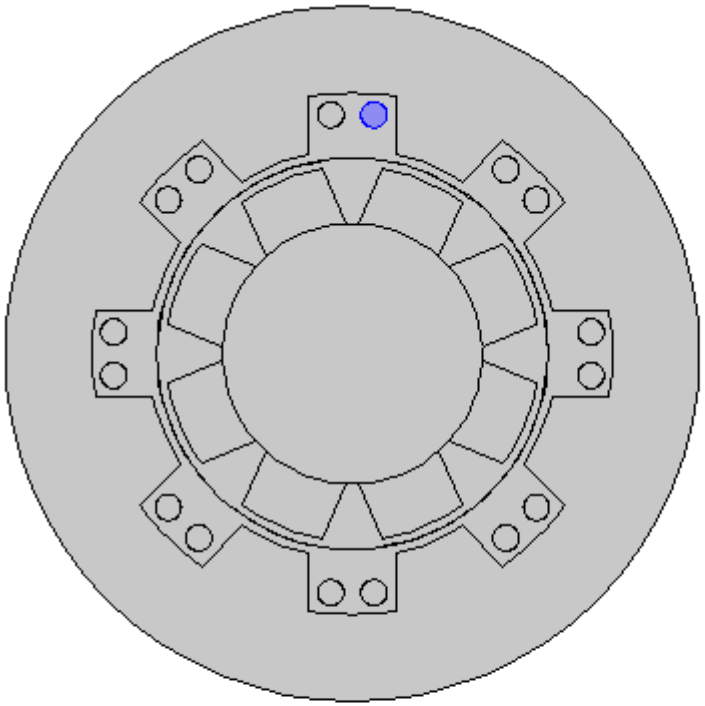
Parameters

Name	Expression	Value	Description
L	0.4[m]	0.40000 m	Length of generator
rpm	60[1/min]	1.0000 1/s	Rotational speed of rotor

회전자





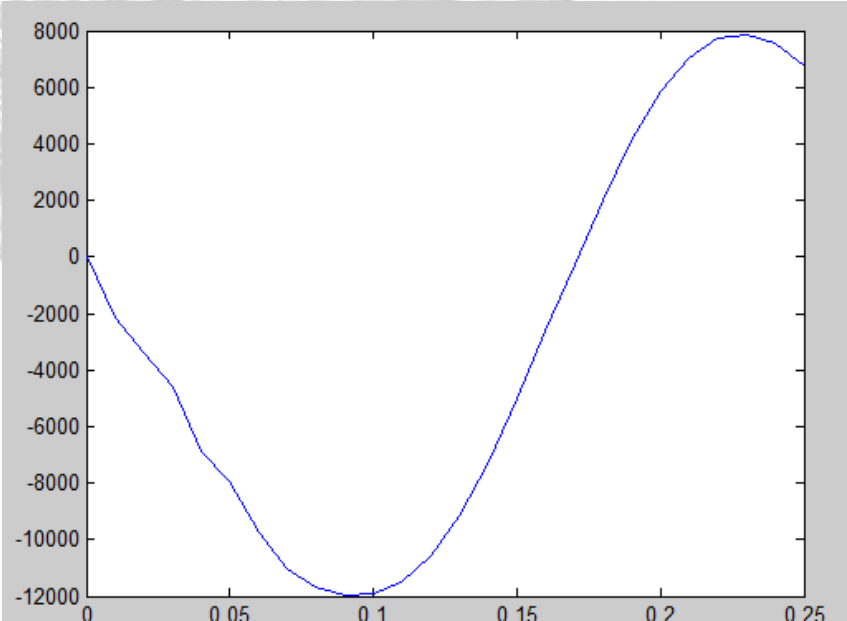


Induced current
-0.00849
-2153.8362
-3402.68208
-4596.0269
-6890.90336
-7953.11237
-9751.95203
-11058.92908
-11684.33442
-11982.80648
-11916.43435
-11493.12444
-10575.3503
-9147.11842
-7232.79097
-4996.59917
-2622.0062
-272.97284
2002.74661
4100.85058
5841.86313
7052.67614
7713.47678
7879.88233
7589.16112
6762.91092

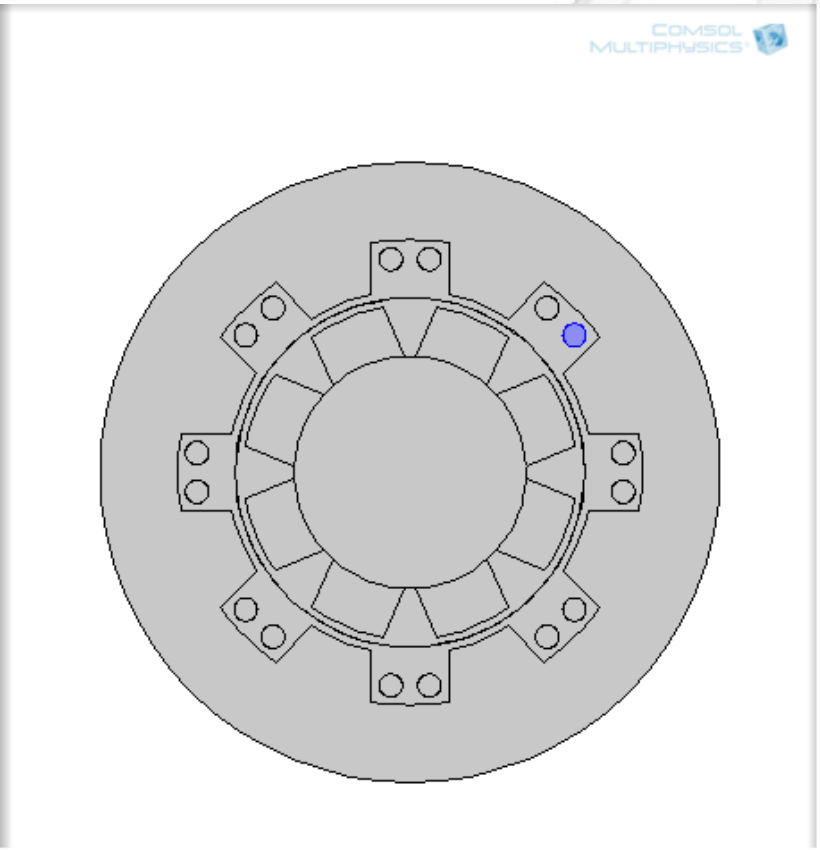
1번코일

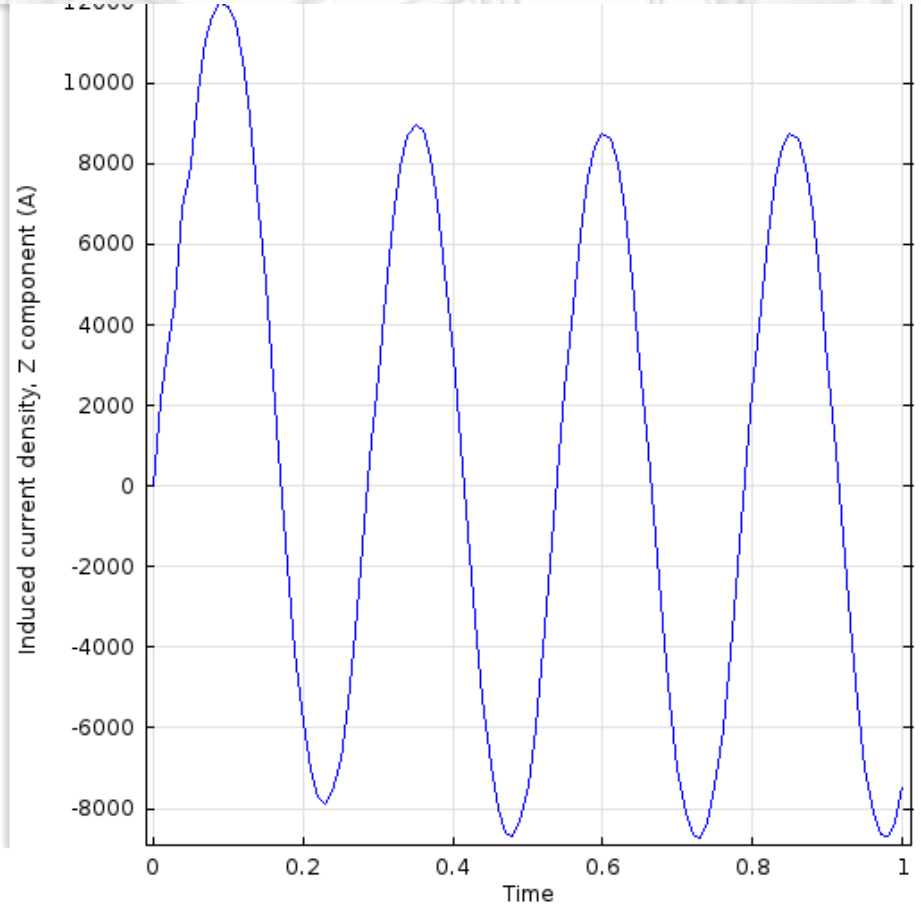
$$e = \oint_L \mathbf{E} \cdot d\mathbf{l} = -\frac{d}{dt}\int_S \mathbf{B} \cdot d\mathbf{S}$$

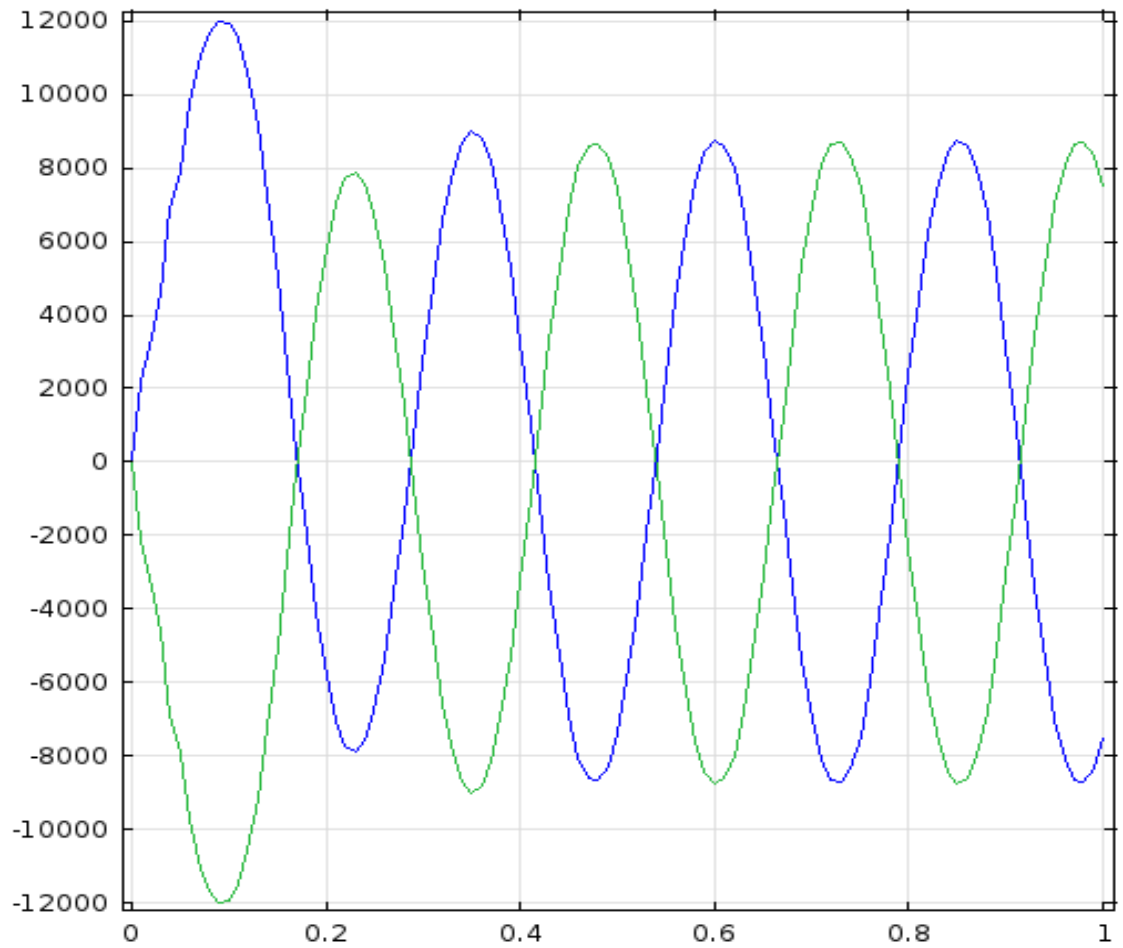
유기전압에 의한 전류



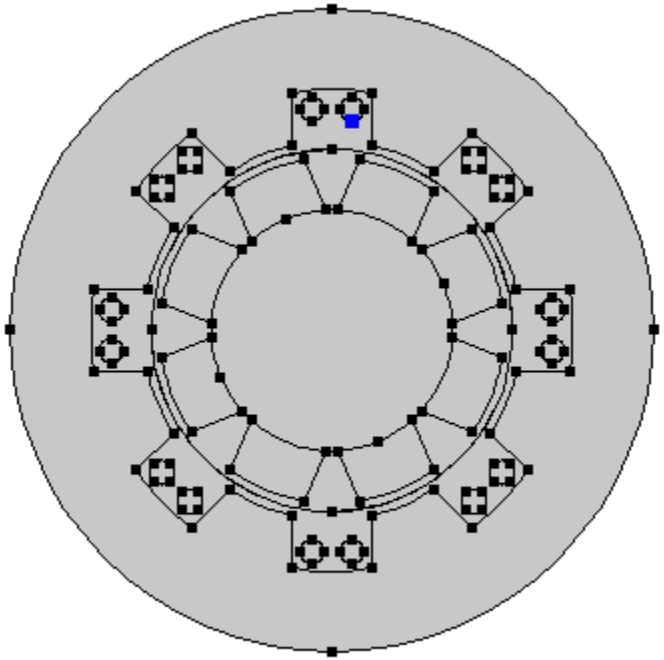
1번 코일에 기계각 45도위상차가 나는 코일





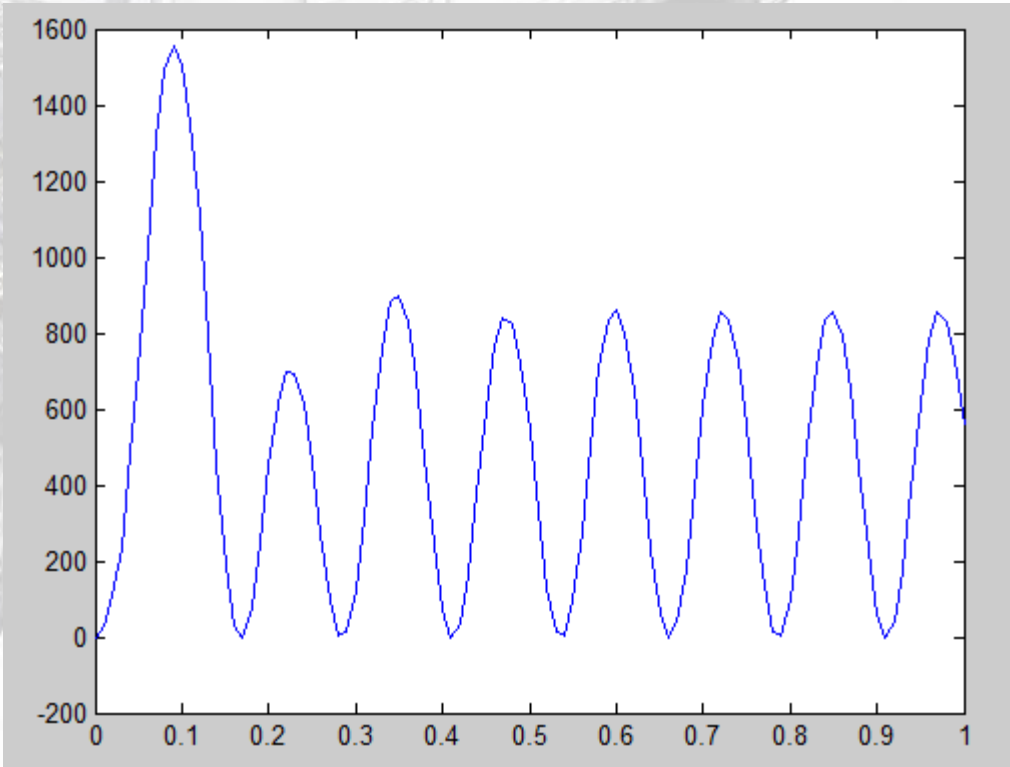


전기각과 기계각의 관계
전기각=기계각*극수/2



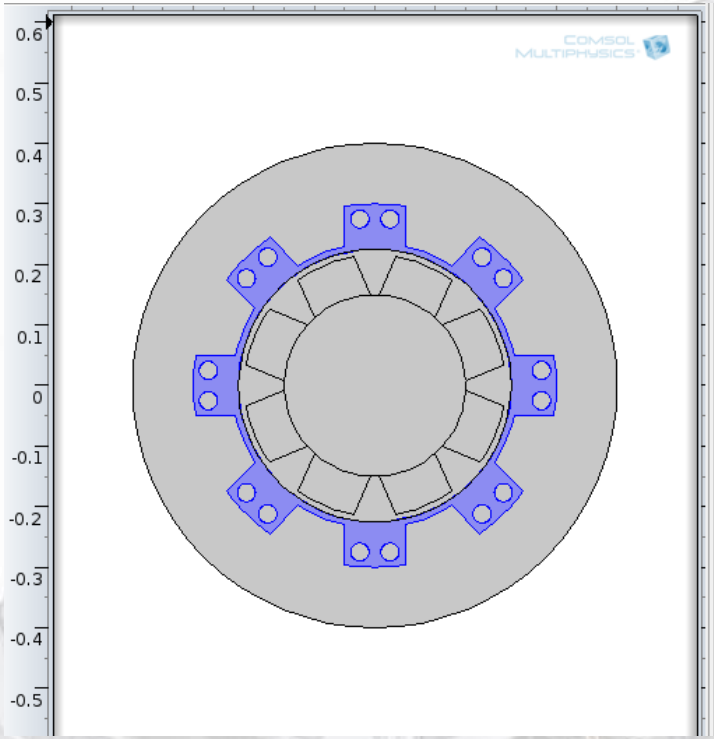
Torque = B*I*length*radius(플레밍의 왼손법칙)

한 도체에 대한 Torque 그래프



B필드의 세기가 매번 바뀌므로 T/I 값이 토크상수가 아닌 변하는 값

자기 에너지 해석



Time	Magnetic energy density (J/m)	Cross-sectional area
0	842.94312	3.91979e-5
0.01	865.16008	3.91979e-5
0.02	931.49609	3.91979e-5
0.03	1015.7975	3.91979e-5
0.04	1103.6372	3.91979e-5
0.05	1176.19268	3.91979e-5
0.06	1213.51869	3.91979e-5
0.07	1199.83476	3.91979e-5
0.08	1142.8672	3.91979e-5
0.09	1061.01859	3.91979e-5
0.1	972.57703	3.91979e-5
0.11	895.60151	3.91979e-5
0.12	849.29098	3.91979e-5
0.13	849.55765	3.91979e-5
0.14	896.40073	3.91979e-5
0.15	972.9793	3.91979e-5
0.16	1060.79713	3.91979e-5
0.17	1143.14013	3.91979e-5
0.18	1199.22482	3.91979e-5
0.19	1212.33796	3.91979e-5
0.2	1175.9259	3.91979e-5
0.21	1103.43752	3.91979e-5
0.22	1016.27484	3.91979e-5
0.23	931.91143	3.91979e-5
0.24	867.72381	3.91979e-5
0.25	843.01348	3.91979e-5

1주기 동안 발전량
sum(Energy_density-min(Energy_density))*0.01
= 431.1885 J