

华中科技大学

轴向磁通直驱电机的 设计与分析

李健

2013.11.13



创新电机技术研究中心

Innovative Research Center on Electric Machines

个人简介

- 大连理工大学 学士
- 韩国东亚大学 硕士、博士、博士后
- 华中科技大学特殊引进人才, 副研究员
- 韩国现代重工兼职研究员
- IEEE会员、国际计算电磁学会会员



主要成果

- 国家自费优秀留学生奖学金
- SCI检索论文13篇, 第一作者10篇
- 永磁、开关磁阻等新型电机
- 径向、轴向拓扑, 旋转、直线结构
- 新能源发电、牵引及特种用途用电机

个人简介

- 大连理工大学 学士
- 韩国东亚大学 硕士、博士、博士后
- 华中科技大学特殊引进人才, 副研究员
- 韩国现代重工兼职研究员
- IEEE会员、国际计算电磁学会会员

主要成果

- 国家自费优秀留学生奖学金
- SCI检索论文13篇, 第一作者10篇
- 永磁、开关磁阻等新型电机
- 径向、轴向拓扑, 旋转、直线结构
- 新能源发电、牵引及特种用途用电机

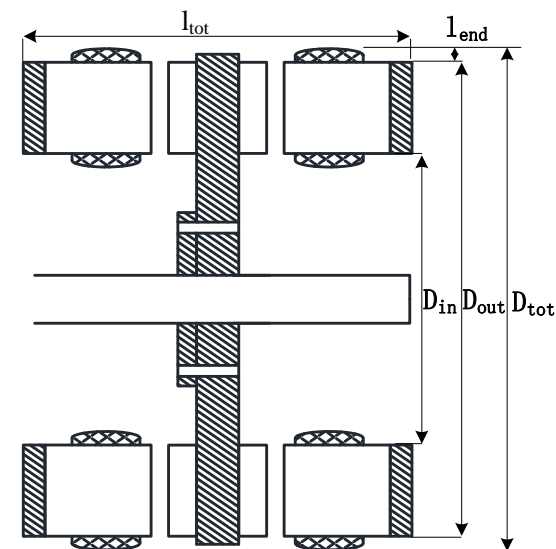
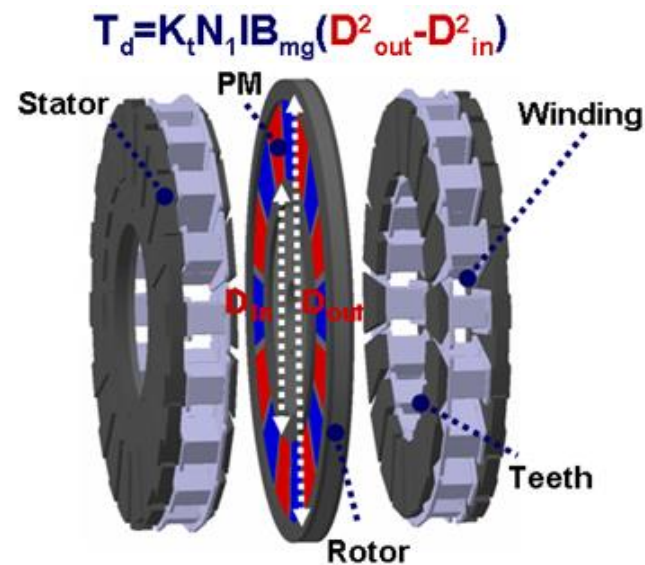
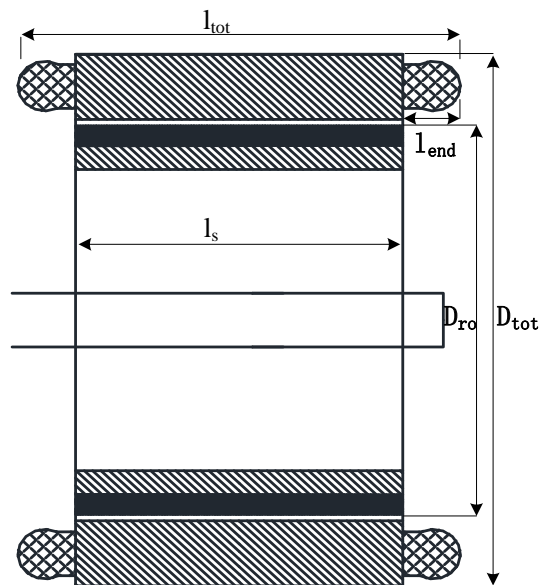
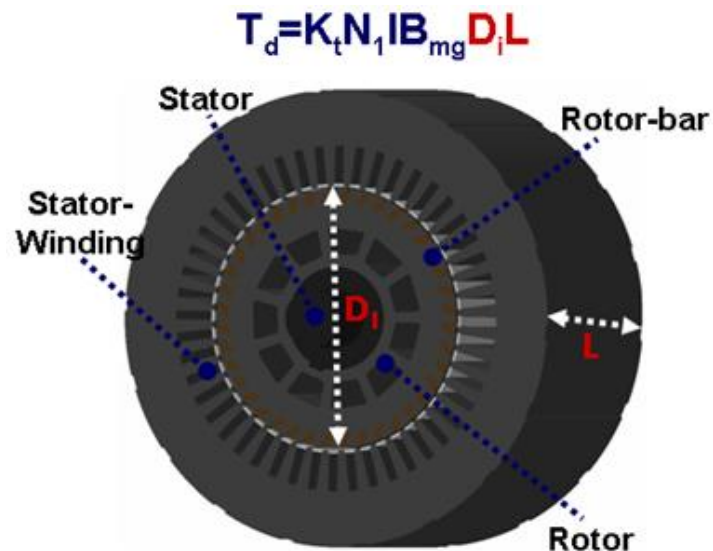
联系方式

TEL: 1 8 6 0 2 7 0 9 8 8 2

Email: jianli@hust.edu.cn

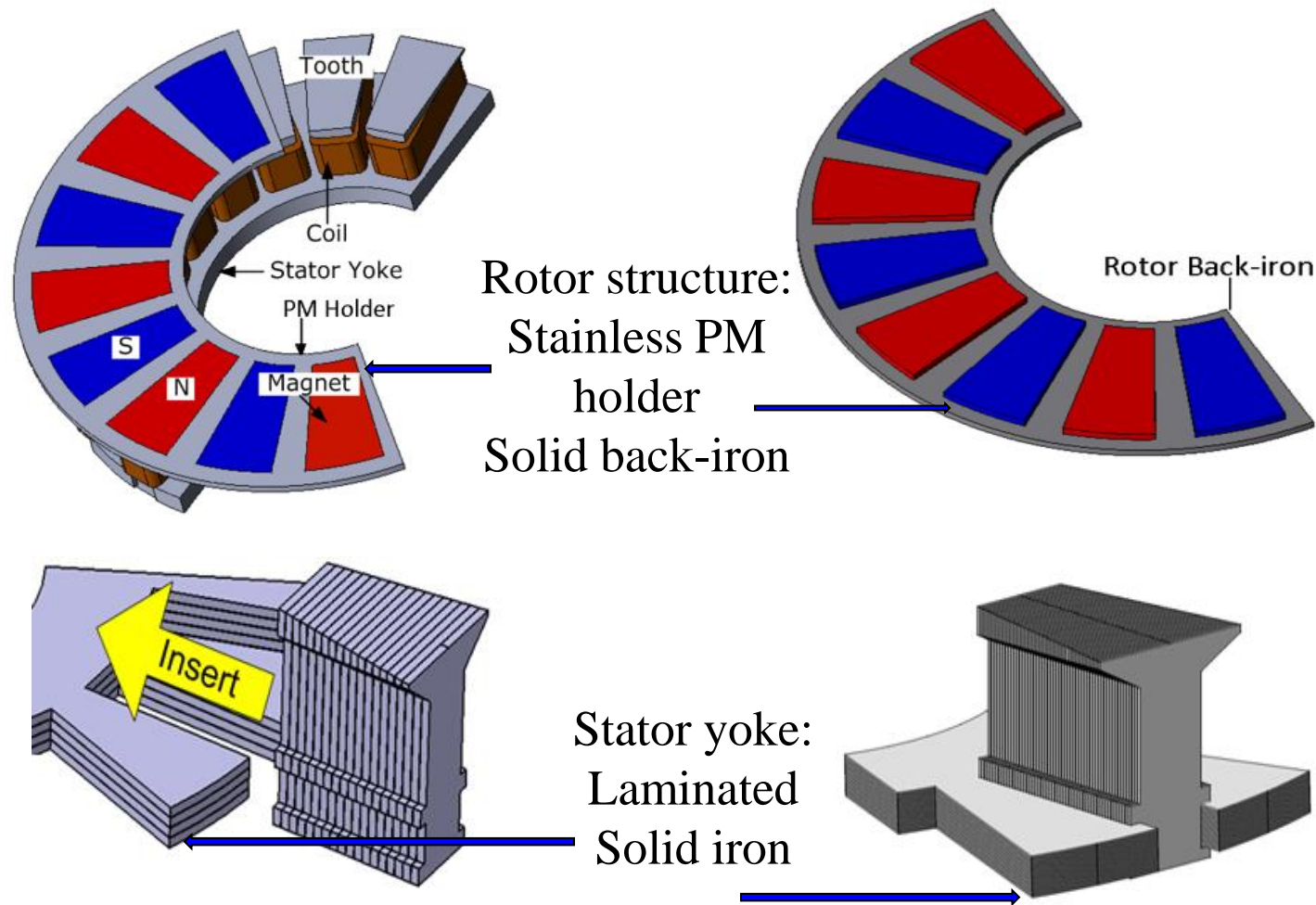


I. Comparison of Radial and Axial PM Machine

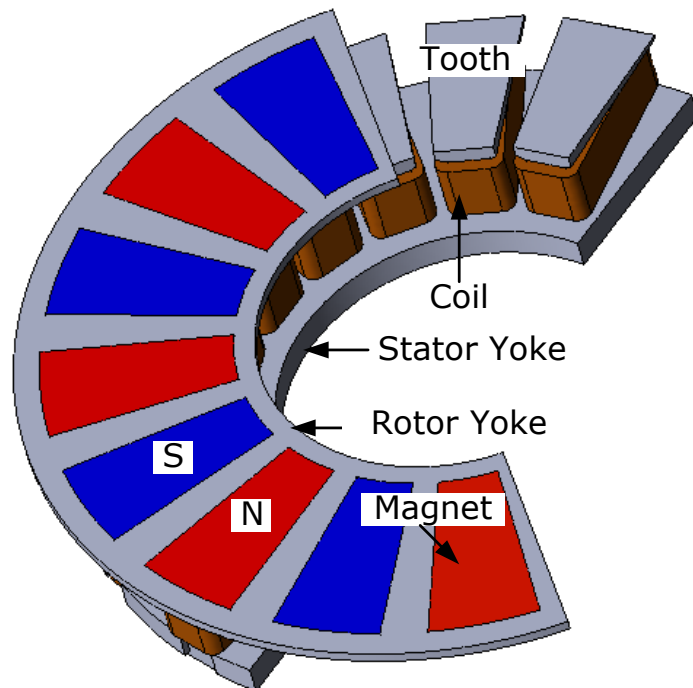


II. Structure and specification of AFPM

Target: Calculation of Eddy current losses in stator yoke and rotor



A) Motor Specifications

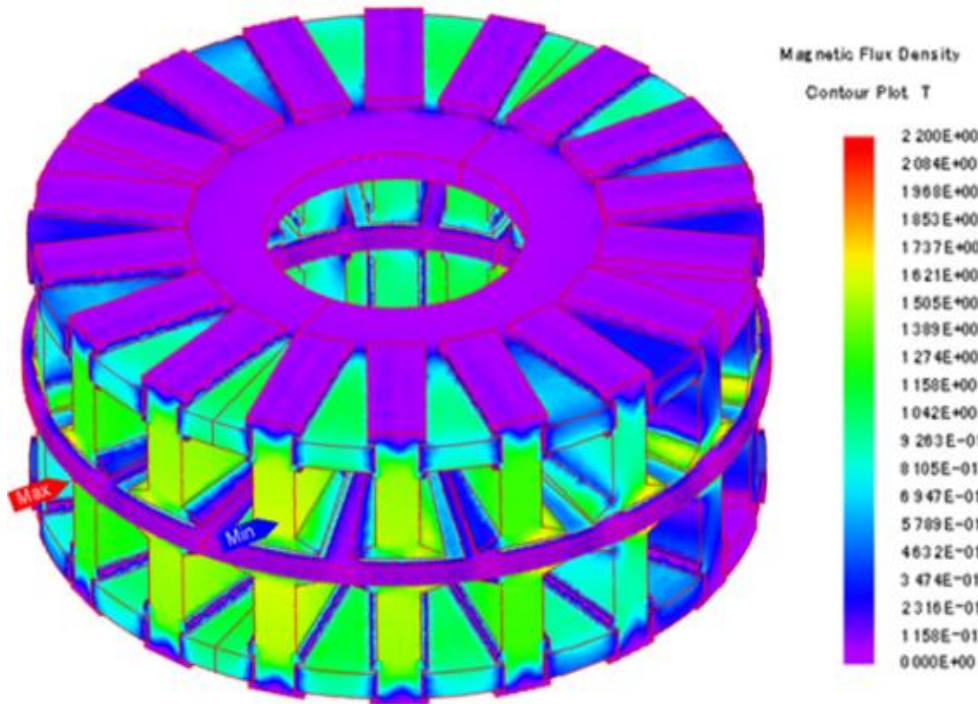


Structure of AFPM

Table I Design Specifications and Dimensions

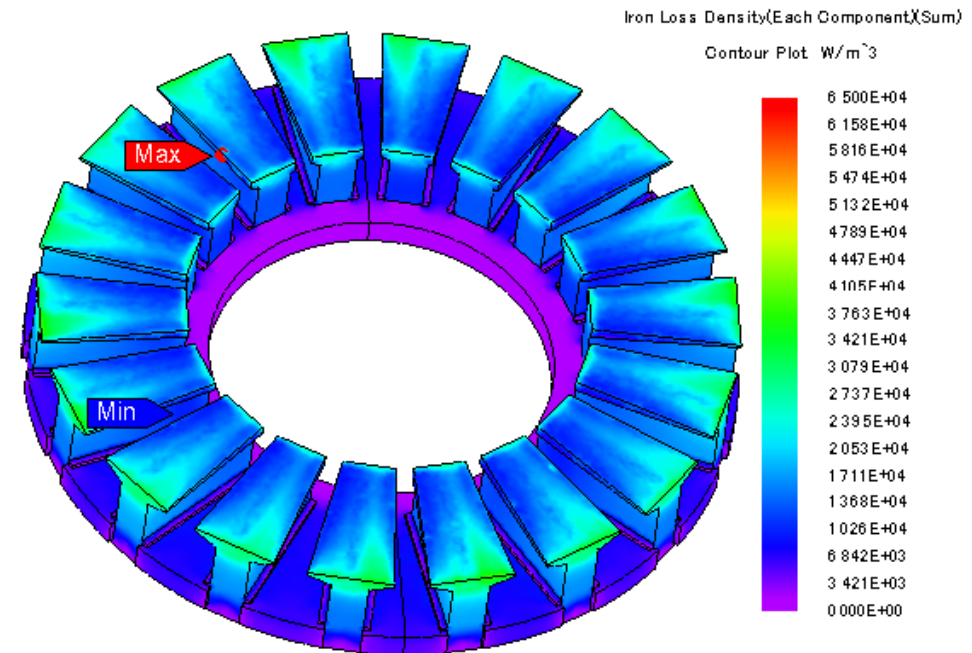
Specifications		PM specification	
Rated output power	3.5 kW	Material	Nd-Fe-B
Rated voltage	250V	Coercivity	970k A/m
Frequency	32Hz	Remnant flux density	1.2T
Speed	240rpm	Winding connection	2-Y

Flux density distribution



(a)

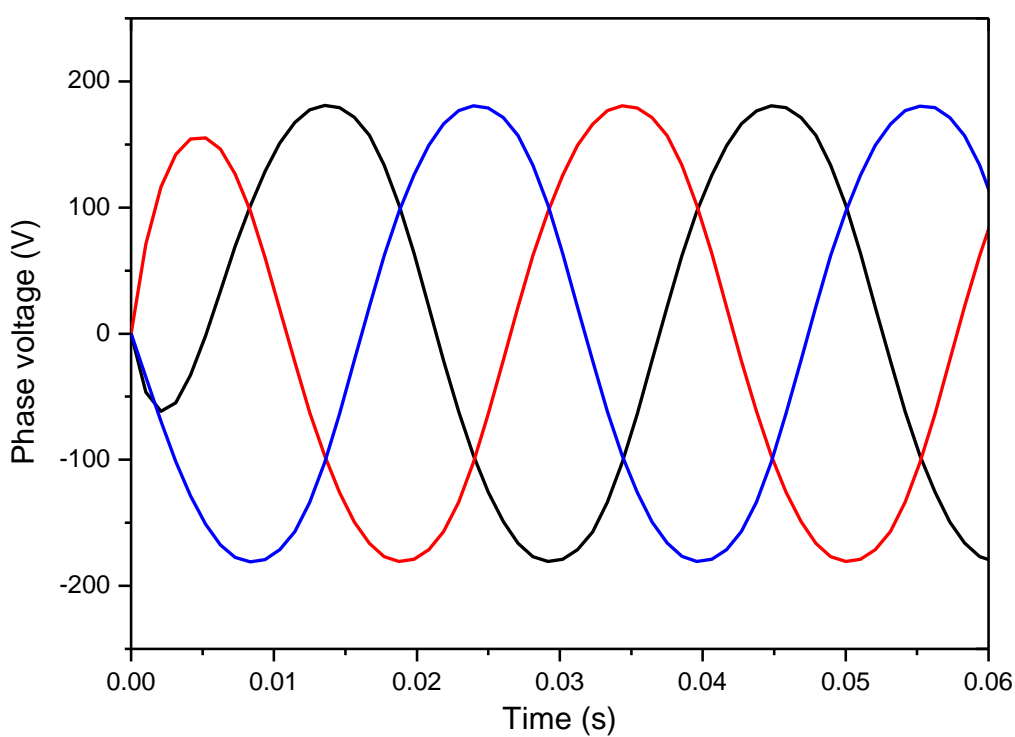
Iron loss density



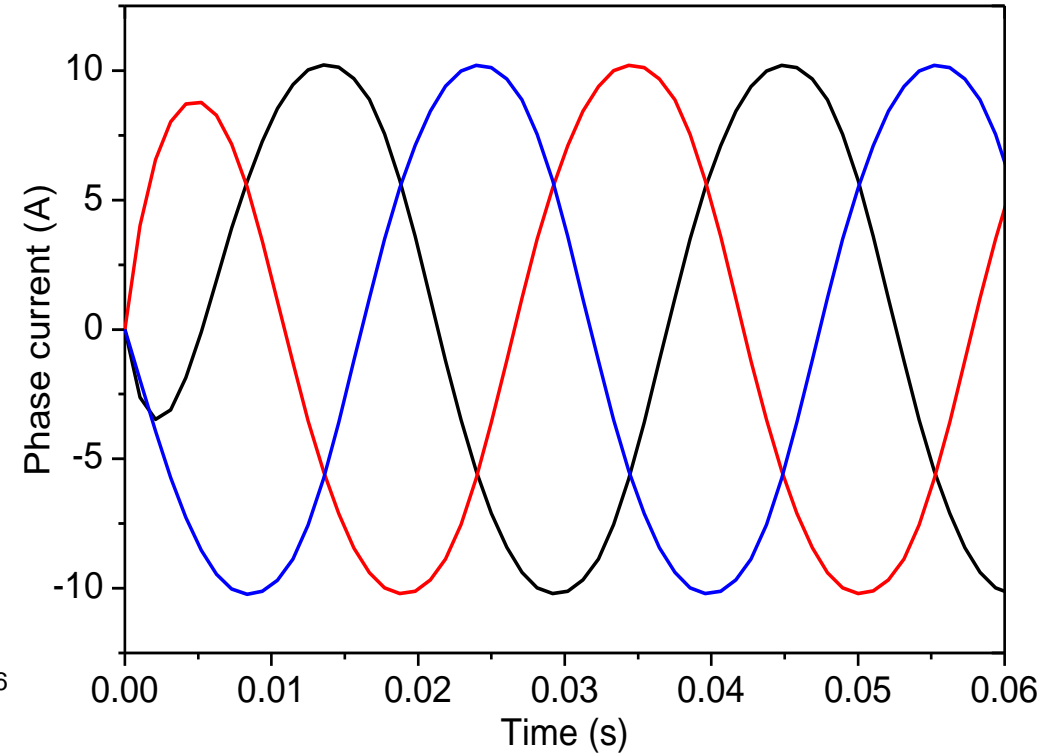
(b)

(a) Flux density distribution of stator core, (b) plot of iron loss density.

Performance analysis



(a)

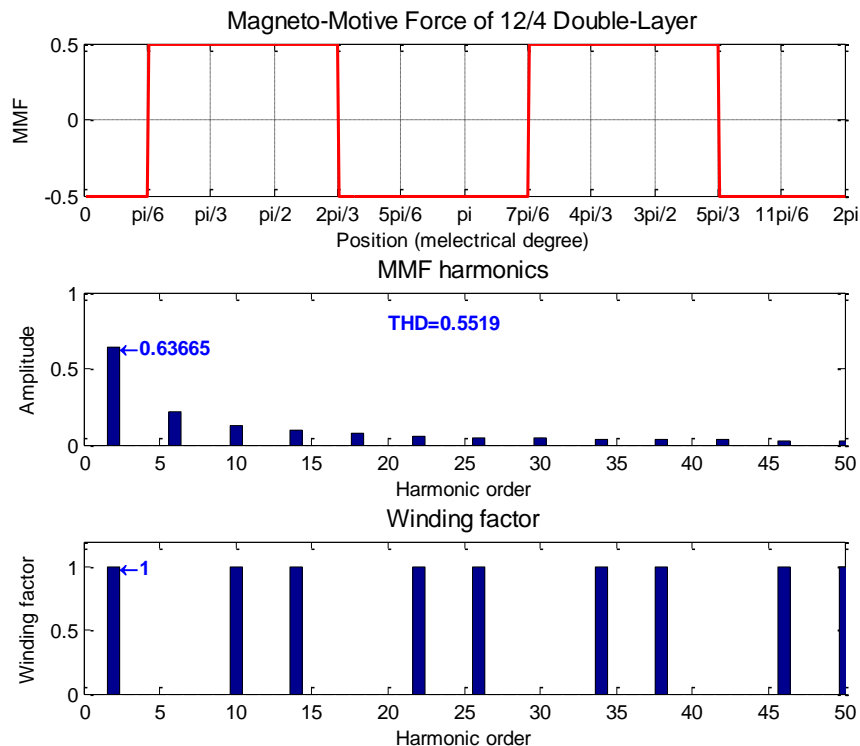


(b)

(a) Phase voltage under full load, (b) Phase current under full load

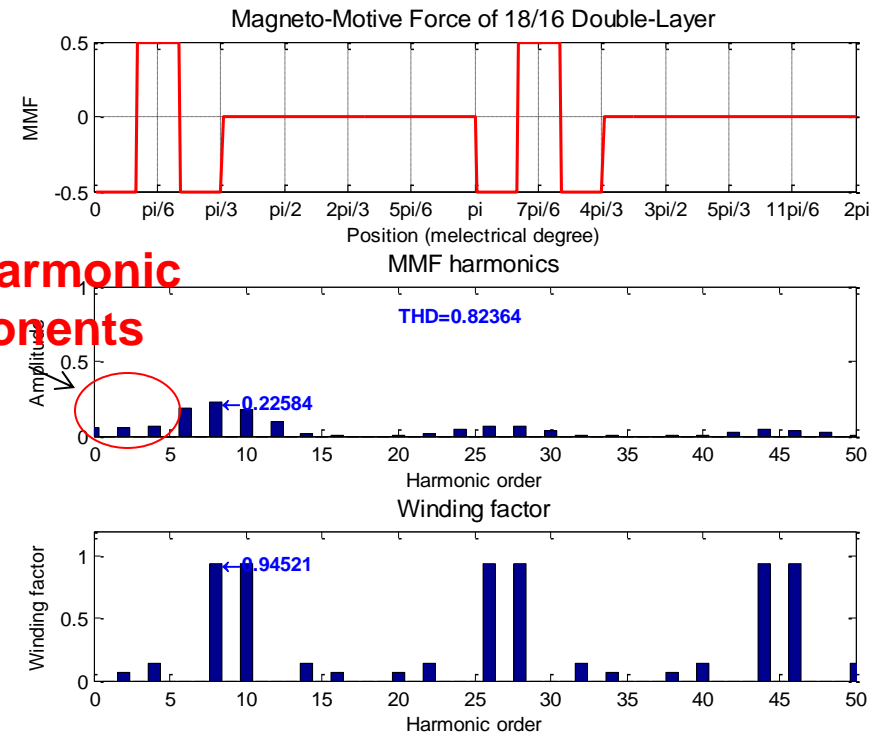
IV. Calculation of eddy-current losses

A) Comparison of MMF in integral slot and fractional slot winding



12 slot / 4 pole

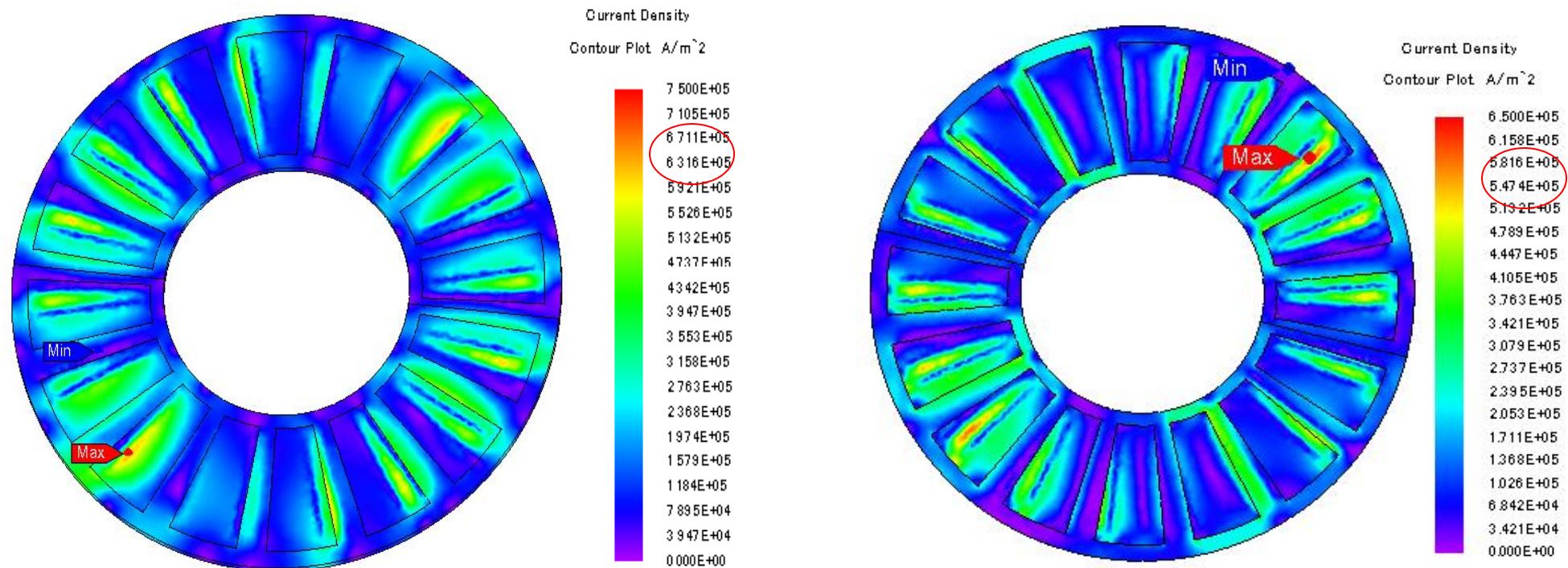
Sub-harmonic components



18 slot / 16 pole

IV. Calculation of eddy-current losses

B) Eddy current distribution of rotor at full-load with stainless steel PM holder



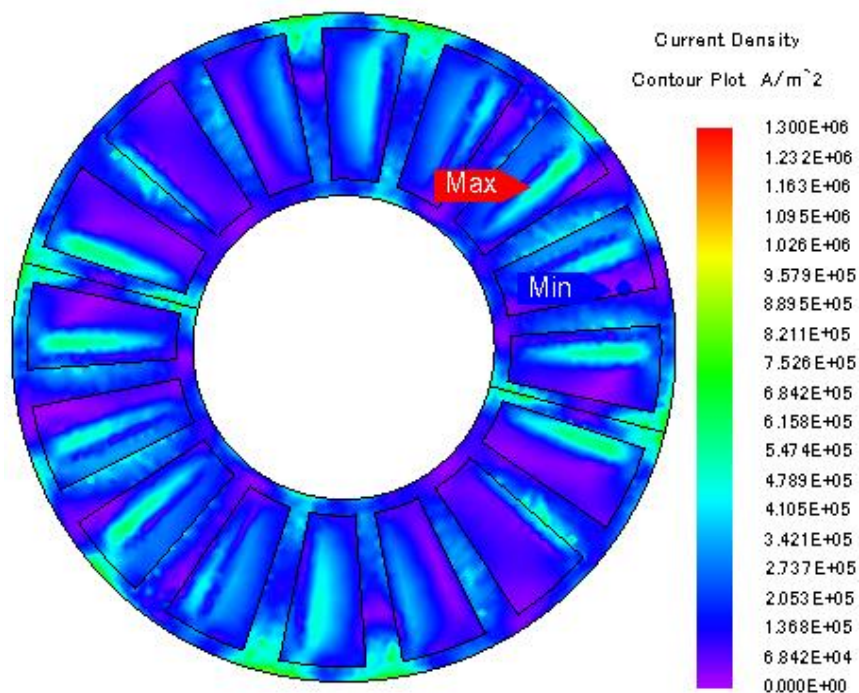
(a)

(b)

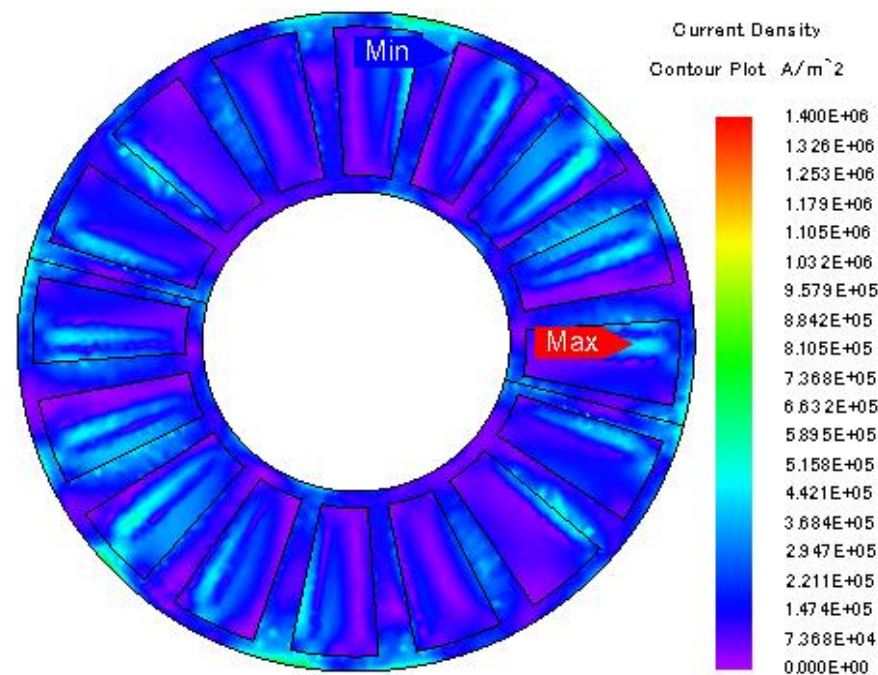
Plot of eddy-current density of rotor at full-load with **stainless steel PM holder**,
(a) PMs non-insulated, (b) PMs insulated.

IV. Calculation of eddy-current losses

C) Eddy current distribution of rotor at full-load with rotor back-iron



(a)

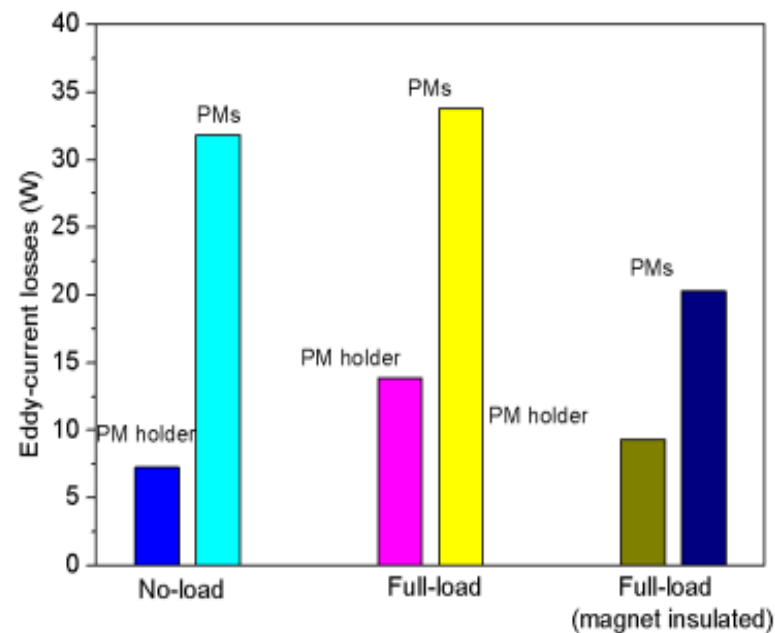


(b)

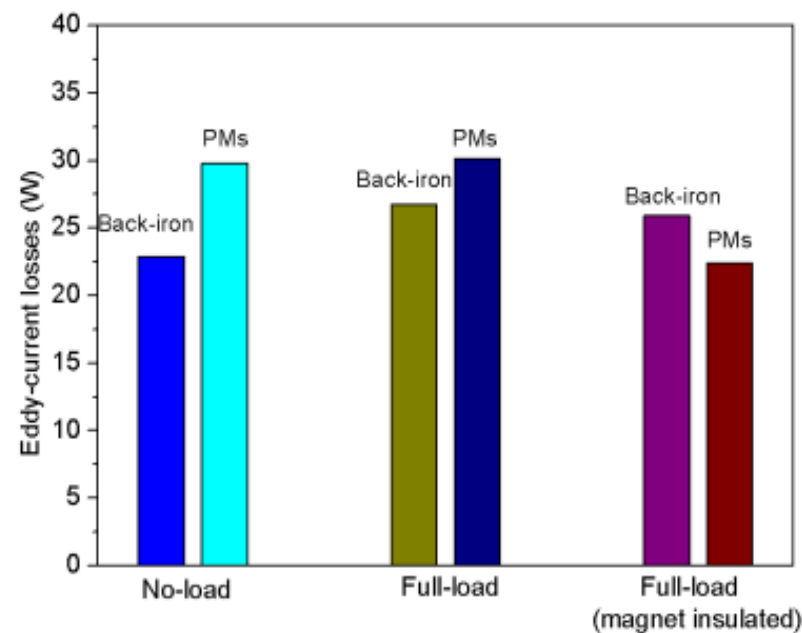
Plot of eddy-current density of rotor at full-load with **rotor back-iron**,
(a) PMs non-insulated, (b) PMs insulated.

IV. Calculation of eddy-current losses

D) Comparison of eddy-current losses on rotor at no-load and full-load



(a)

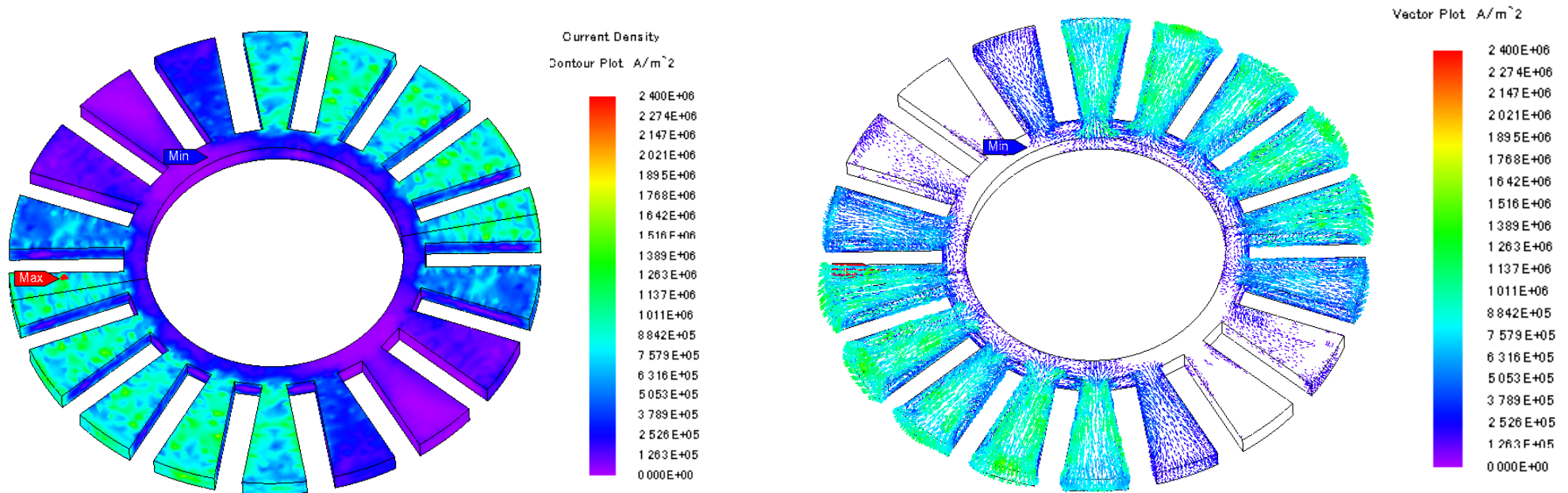


(b)

Comparison of eddy-current losses on rotor at no-load and full-load ,
(a) rotor with stainless steel PM holder; (b) rotor with back-iron .

IV. Calculation of eddy-current losses

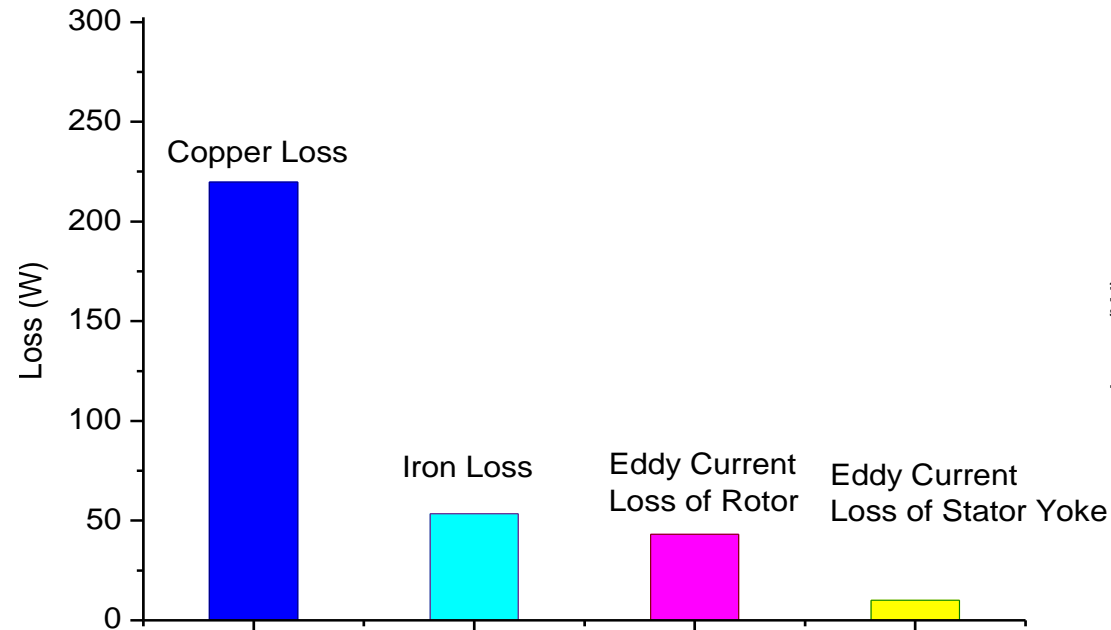
E) Eddy current distribution in solid stator yoke



Distribution of eddy current in solid stator yoke.

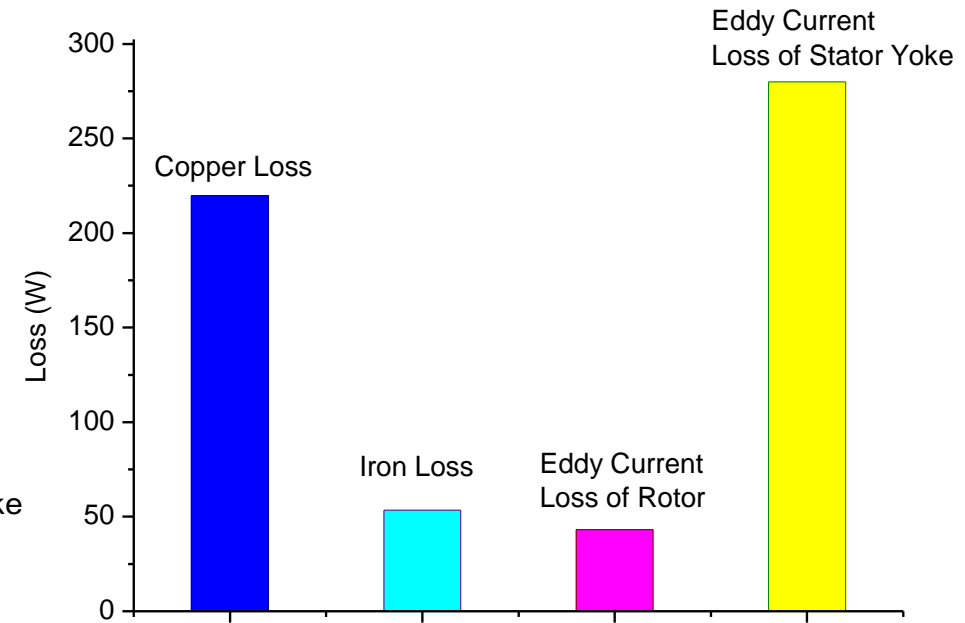
IV. Calculation of eddy-current losses

F) Comparison of losses with solid stator yoke and laminated stator yoke



(a)

Losses with laminated stator yoke.



(b)

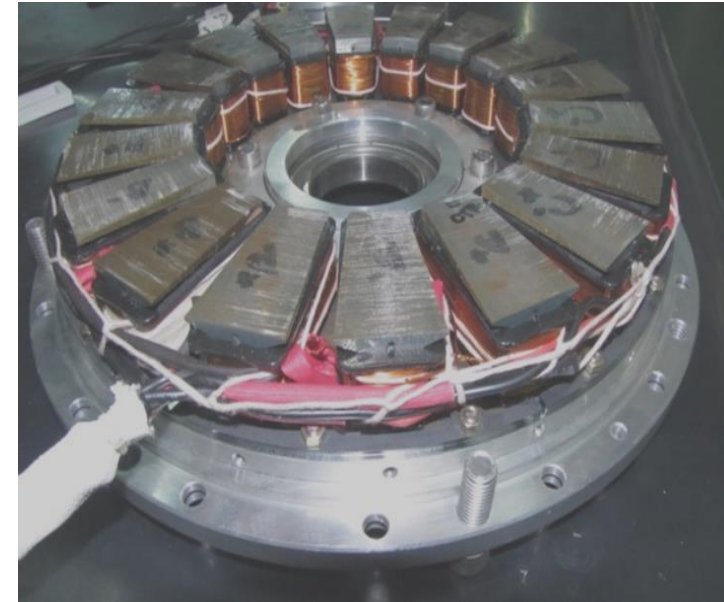
Losses with solid stator yoke.



(a)

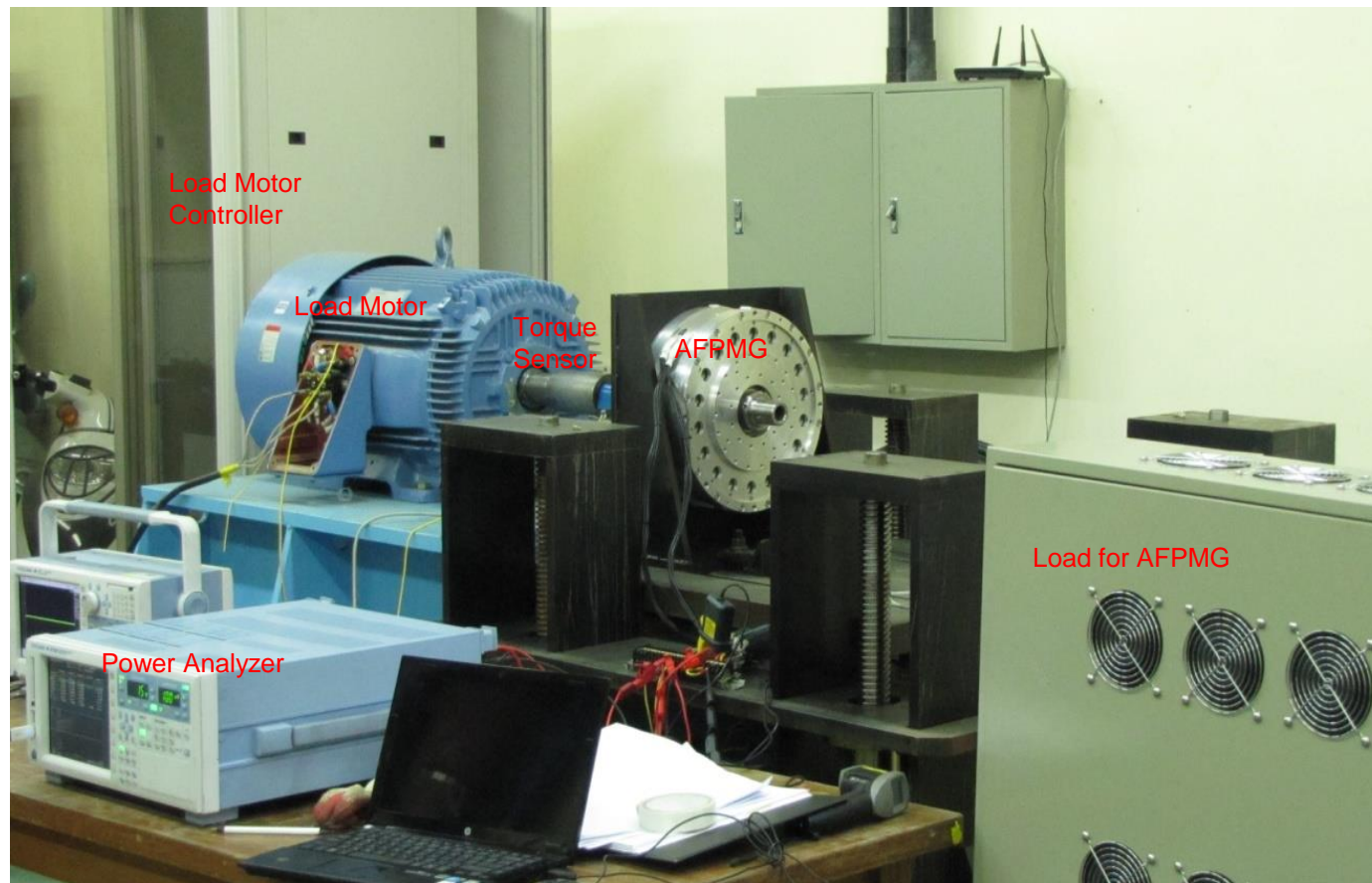


(b)

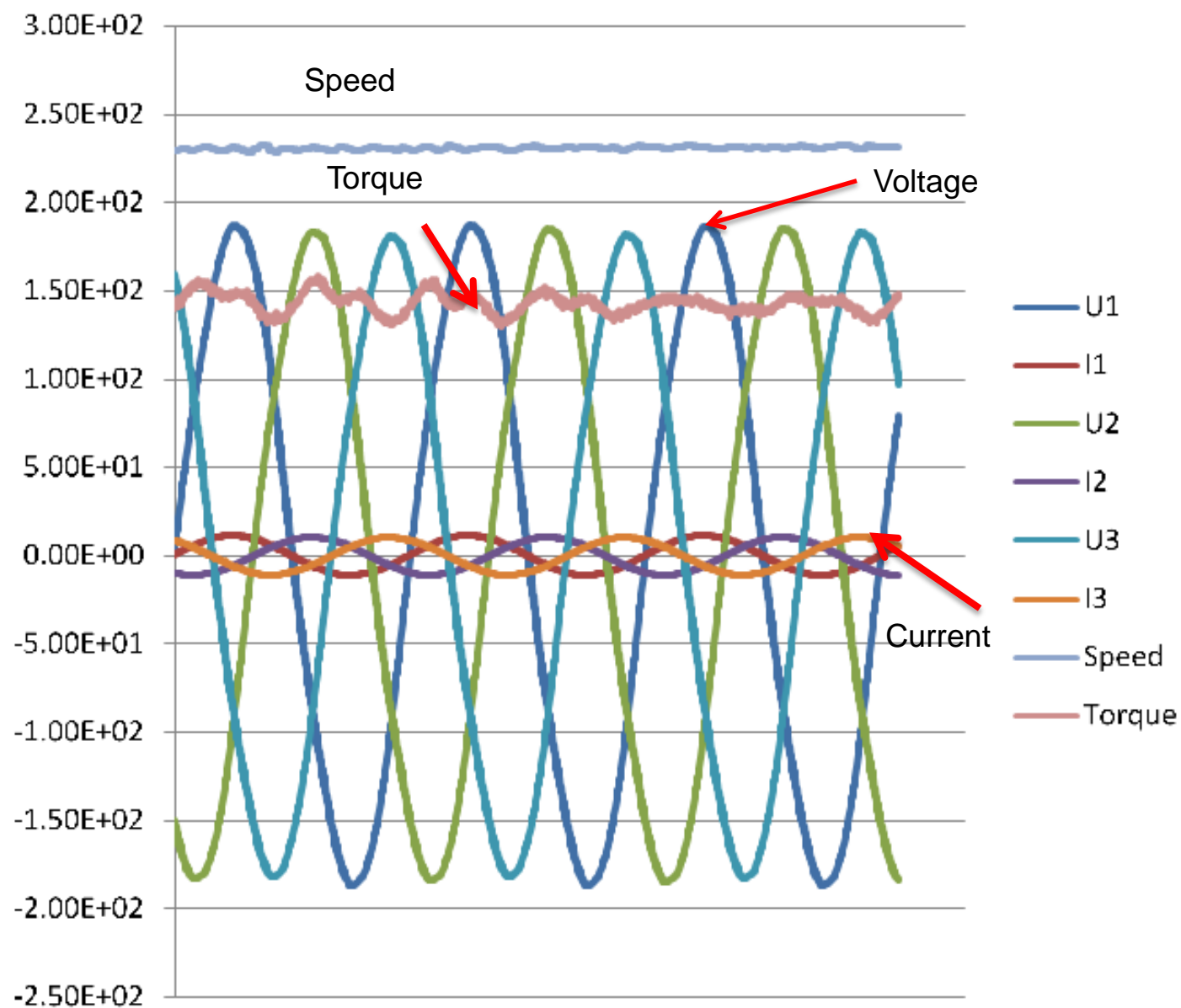


(c)

Efficiency of machine at full-load was 88.1% and total loss was 384 W.
Various losses in III F) a summed up to be 336 W.



Efficiency of machine at full-load was 88.1% and total loss was 384 W.
Various losses in III F) summed up to be 336 W.



Thank you!