THE UNIVERSITY OF TOKYO

Recent progress of Wireless In-Wheel Motors for dynamic charging

Feb. 11th , 2020
Park City, UT

Toshiyuki Fujita,
Hiroshi Fujimoto
(the university of Tokyo)

GRADUATE SCHOOL OF FRONTIER SCIENCES
THE UNIVERSITY OF TOKYO

THE UNIVERSITY OF TOKYO

Hori-Fujimoto Lab

Graduate School of Frontier Science
Department of Advanced Energy

Graduate School of Engineering
Department of Electrical Engineering
and Information Systems

Field of research

- Control Engineering
- Motion Control
- Power Electronics

Robotics Servomotor

Spacecraft / electric aircraft

Nano-scale Servomotor

Electric Vehicle

Motor Control

Wireless Power Transfer

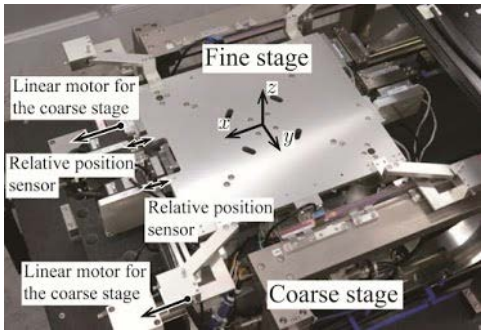
Members

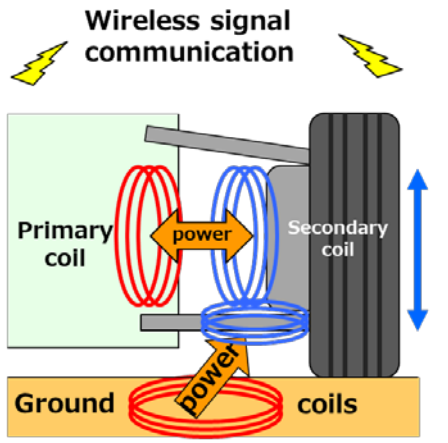
Staff:8

- Professor
- Associate professor
- Project assistant professor : 3
- Engineer
- Secretary : 2

Students : 29

- Doctral course : 6
- Master's course : 19
- Under graduate : 4





GRADUATE SCHOOL OF FRONTIER SCIENCES
THE UNIVERSITY OF TOKYO

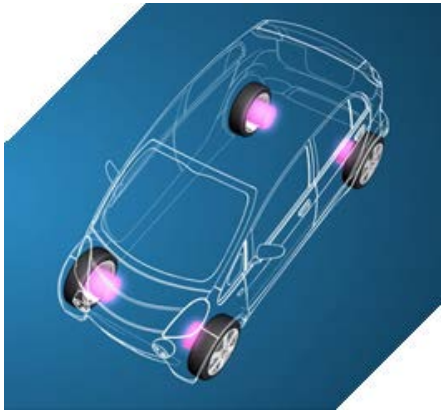
THE UNIVERSITY OF TOKYO

Wireless In-Wheel Motor

Concept

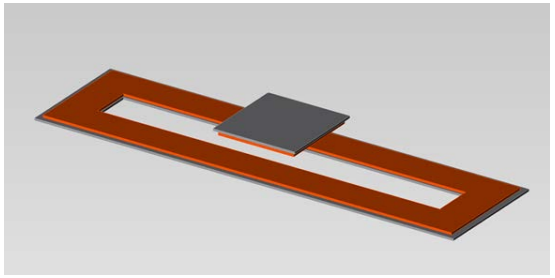
- ✓ **Inductive Wireless Power Transfer**
- ✓ Interoperable frequency with Stationary WPT (85 kHz)
- ✓ **In-Wheel Motor**
- ✓ Direct to drive (Road to Motor + Battery)
- ✓ All Components in Wheel

In-Wheel Motor



+

Inductive WPT



=

Wireless In-Wheel Motor

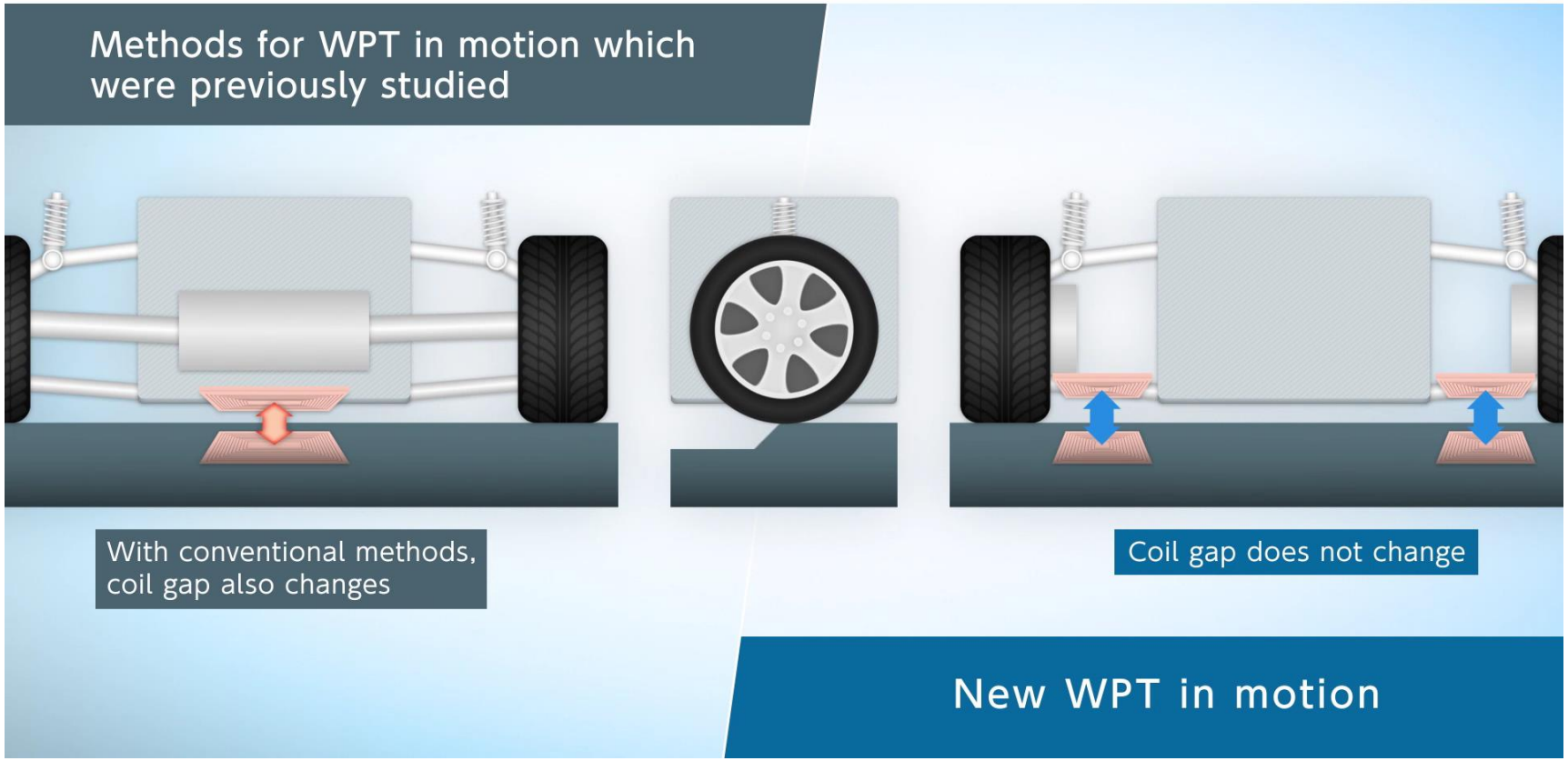
- ➢ High efficiency (Direct drive, small air gap)
- ➢ Low EMCs (small air gap)
- ➢ Independent control 4 motors, Free design

GRADUATE SCHOOL OF FRONTIER SCIENCES
THE UNIVERSITY OF TOKYO

THE UNIVERSITY OF TOKYO

Minimize air gap

Benefits related to coil gaps for WPT

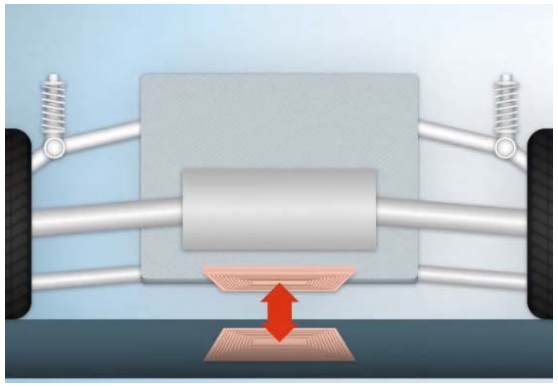


GRADUATE SCHOOL OF FRONTIER SCIENCES
THE UNIVERSITY OF TOKYO

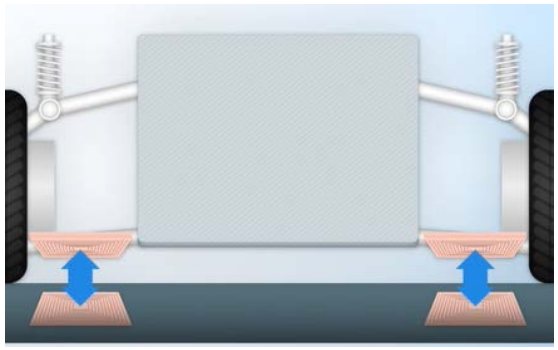
THE UNIVERSITY OF TOKYO

Wireless Wheel-side Charging

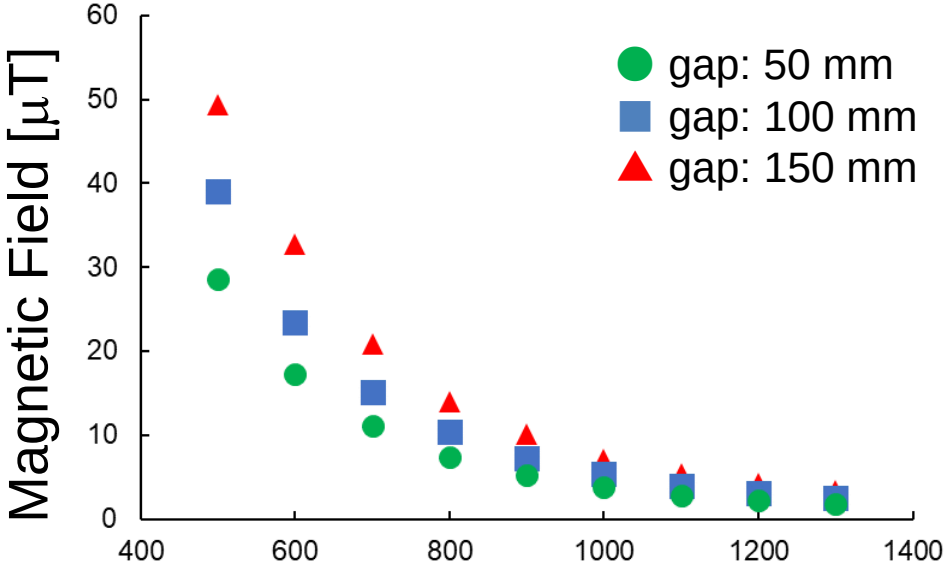
On-Boad Charging



Wheel-side Charging



Minimum Air Gap

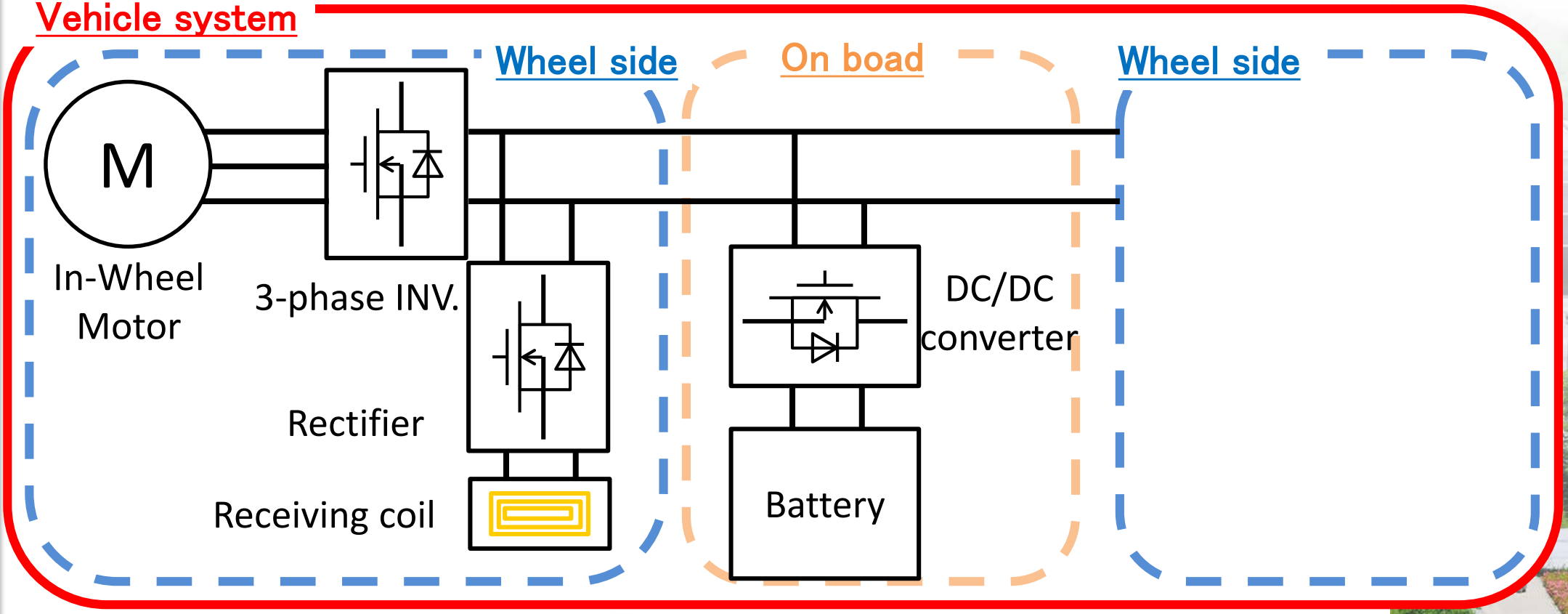


- High efficiency for small air gap
- Low EMCs for small air gap

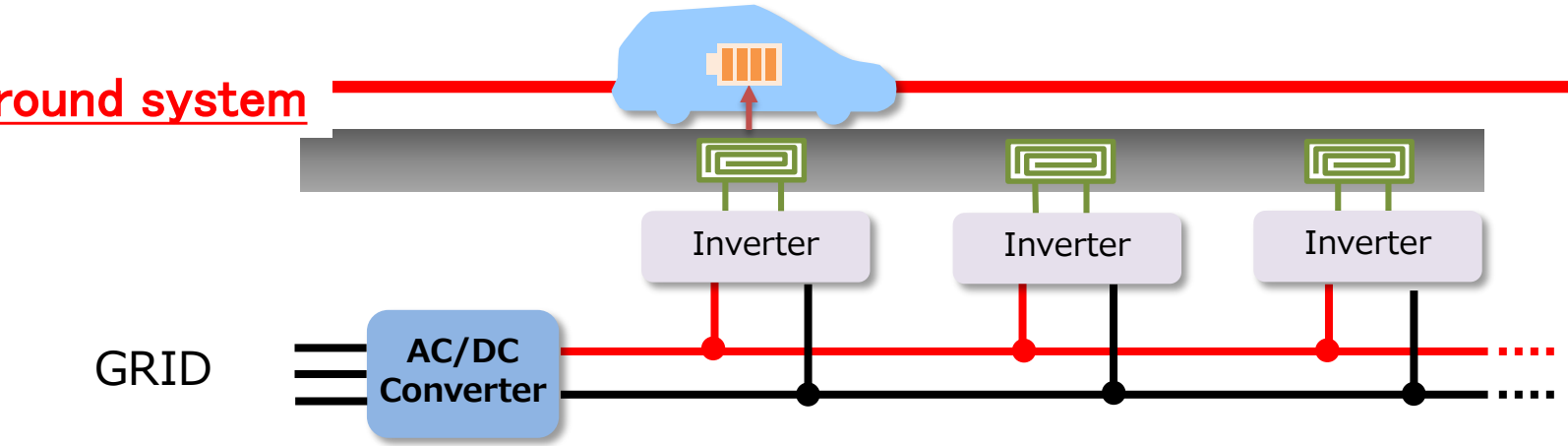
GRADUATE SCHOOL OF FRONTIER SCIENCES
THE UNIVERSITY OF TOKYO

System configuration

Vehicle system



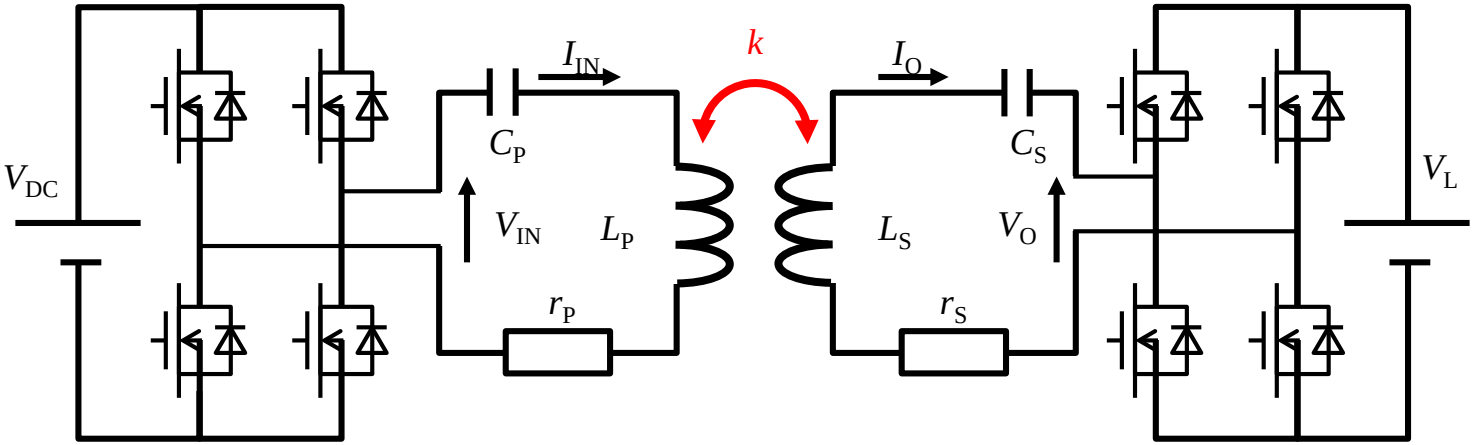
Ground system

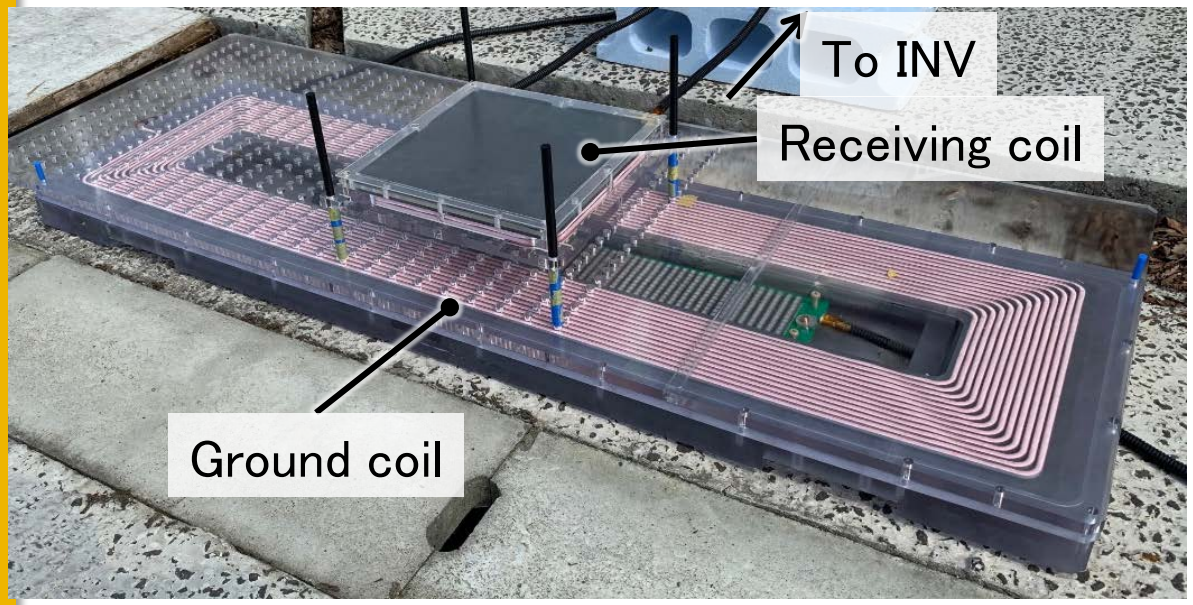


THE UNIVERSITY OF TOKYO

Stationary performance

System configuration





- Steady state condition
- Air gap : 50 mm
- dc-dc efficiency : 92.5% @20 kW input power

GRADUATE SCHOOL OF FRONTIER SCIENCES
THE UNIVERSITY OF TOKYO

THE UNIVERSITY OF TOKYO

Charging movies

GRADUATE SCHOOL OF FRONTIER SCIENCES
THE UNIVERSITY OF TOKYO

THE UNIVERSITY OF TOKYO

Acknowledgement

This work was
supported by Council for Science, Technology and Innovation (CSTI),
Cross-ministerial Strategic Innovation Promotion Program (SIP),
“Energy systems of an Internet of Energy (IoE) society”
(Funding agency:JST).

This work was partly supported by JST-Mirai Program
Grant Number JPMJMI17EM, Japan.

GRADUATE SCHOOL OF
FRONTIER SCIENCES
THE UNIVERSITY OF TOKYO