



THE UNIVERSITY OF
AUCKLAND
Te Whare Wananga o Tamaki Makaurau
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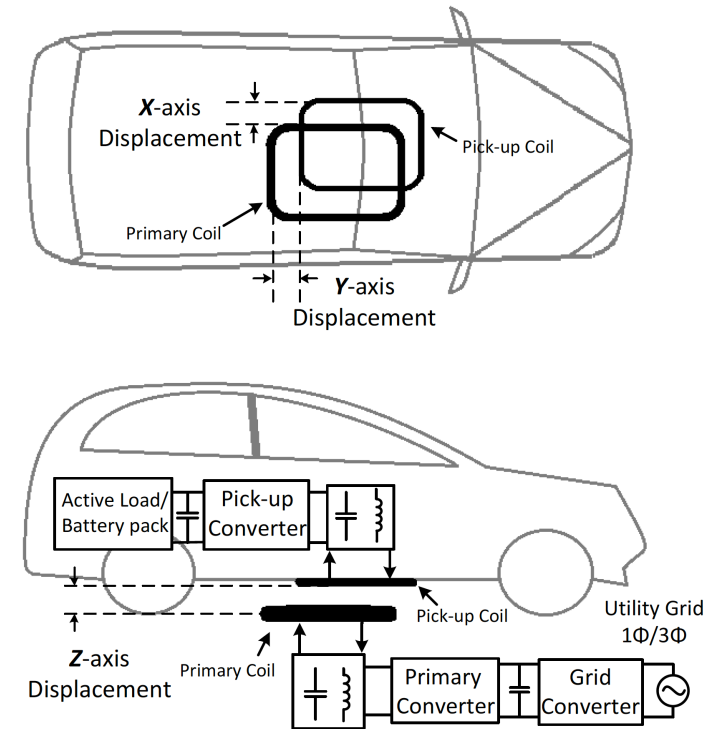
Design of Wireless EV Chargers

Status and Challenges

Duleepa J Thrimawithana

Key Design Challenges

- Catering for a coupling (k) change of about x3
 - For example, between about 0.1 and 0.3
- Catering for an EV battery voltage (V_{ev}) change of about x1.5
 - For example, between about 280V and 420V
- Limited control over primary DC-link voltage
 - Typically limited to x1.5 to x2
- Restrictions on thermal management
 - Specially for flush mount or buried systems
- Restrictions on leakage, surface flux and E-field
 - Limits the ability to drive the couplers
- EMC, THD, PF, FOD, LOP, etc.



Impact on the Design

- Catering for a large variation in k increases stresses
 - As examples, consider the two most commonly used tuning networks

	Dual-Side Control		Single-Side Control	
	LCL-LCL	Series-Series	LCL-LCL	Series-Series
k	0.1 → 0.3		0.1 → 0.3	
Coil VA	3VA → 1VA		9VA → 1VA	
Coil Current	1.7A → 1A		3A → 1A	
Converter Voltage	1V → 0.6V	0.6V → 1V	1V → 0.3V	0.3V → 1V
Converter Current	1A → 1.7A	1.7A → 1A	1A → 3A	3A → 1A

- Modulating the converter to regulate power flow significantly increases switching and conduction losses
 - As per the above example, modulation can be as severe as 40%-70%
- Catering for changes in EV battery voltage increases the modulation depth further
 - Can be assisted by controlling DC-link voltage or using alternative techniques

Progress at UoA



- Investigating thermal and mechanical behaviour of flush-mount and buried coils
 - Including coils with embedded electronics
- Developing detailed loss models of components used in a wireless EV charger
 - Experimental validation under different operating scenarios
- Exploring new converter, compensation and control techniques
 - Help lower converter stress and cost
- Improving reliability
 - New construction techniques and materials

Thank you