Title: EV charging systems and infrastructure

Abstract: EVs play an important role in decarbonization policies of different countries. The expansion and reliability of the charging network has been identified as an important item in engagement of owners in the electrification programs. In addition, the charging demand of an EV is much larger than other electric equipment; thus, unmanaged charging can lead to disruptions to the local grid. Despite the massive demand increase due to charging, EVs are considered flexible loads, and can be managed by smart charging algorithms using effective tariff structures, incentives, and smart scheduling. Smart green charging algorithms can move the charging demand to daytime to maximise the use of generation from photovoltaic solar panels. This special session reviews recent advances in this field.

Rationale:

Global emissions, mainly from fossil fuels, are known as the leading cause of irreversible climate change and the transport sector is placed among significant contributors to emissions. Deloitte predicts EVs to have approximately 30% of the global light-duty vehicle sales by 2030. In addition, a significant uptake of heavy-duty EVs in the fleet sector has started in the form of e-busses and e-trucks. Bloomberg reported on April 2022 that "*The world's EV fleet will soon surpass 20 million*". This level of EV penetration is well supported by the strategic original equipment manufacturers (OEMs) target for EVs. These all mean that power system operators should be ready for a significant increase in the EV charging demand by 2030.

Countries have different plans to implement their EV charging network before the mass EV uptake. For example, in the US announced the Bipartisan Infrastructure Law Investments to build out the first-ever national network of 500,000 electric vehicle chargers along America's highways and in communities. In the residential area, a UK study shows that the upgrade costs about £65 billion is required by 2050 to accommodate electrification process, including EVs. In the case of fleet charging, both the capital and operational costs should be reduced for fleet owners. To this end, the EV charging facilities should be well integrated in photovoltaic solar and battery energy storage systems using smart algorithms. Vehicle-to-grid services can be also applied to make smart charging systems economically viable. For a successful EV smart charging solution several challenges should be addressed including the intermittence and rather unpredictable EV charging behaviour, different requirements of EV users and fleet, uncertainty in PV generation and local demand, and regulatory issues and business cases. A lot of research activities have been undertaken in academia and industry to provide solution for these challenges in different scenarios.

Topics to cover:

This session covers the following research area (but is not limited to them):

- Implementation of the charging network
- Residential and fleet charging networks
- Reliability of the charging infrastructure
- Green EV charging
- Charging infrastructure for public transport
- implementation and operation of the Vehicle-to-grid technology
- Modelling of the charging demand
- EV charging in microgrids and islanded networks

- Applications of AI and Machine learning in EV charging
- Smart EV charging and scheduling
- EV-grid integration
- Optimal location and sizing of charging systems
- EV charging at scale
- Wireless EV charging
- Cybersecurity of EV charging network

Proposed speakers:

Mahdi Jalili is a Professor of AI and Electrical Engineering at RMIT. He was an Australian Research Council DECRA Fellow and RMIT VC Research Fellow. He is a prolific researcher in the areas of complex systems, electric vehicles, machine learning and sustainable energy systems. He has extensively published in the area and his articles have received over 6,300 citations with an h-index of 47 (Google Scholar). He is the founder and director of the electric vehicle living laboratory at RMIT university which is a unique research facility in Australia to study the EV-grid integration issues. Jalili has received numerous prizes including the Neville Thiele Eminence Award (2021), ITEE College of Engineers Australia, the peak engineering body in Australia. This is the most prestigious award of the College, awarded to Jalili in recognition of his extensive industry engagement and contributions to the sector.

Biographies:

Dr Ali Moradi Amani, has Bachelor, Master and PhD degrees all in control engineering. He is now a research fellow at RMIT University, Australia. He is the technical manager of the RMIS's EV living laboratory and has been deeply engaged with transport electrification industry in Australia. His field of research includes control system, complex networks, and smart EV charging. He has received the RMIT research team award and the STEM college research excellence award in 2022.

Prof. Mahdi Jalili (biography mentioned above)

(We are seeking to identify a local collaborator who is interested to join us in running this special session)