Powering the Future of Electric Mobility: Next-Gen Bidirectional Electric Vehicle Chargers Using Innovative Power Electronics and Magnetic Design

A Data Management Plan created using DMPonline.be

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Project abstract:

The widespread adoption of electric vehicles (EVs) has become pivotal in the energy transition towards a sustainable future. However, as battery technologies have made enormous progress, charging solutions have become the critical bottleneck for EV adoption. Therefore, this research aims to develop the next generation of electric vehicle on-board chargers. Ultra-compact and ultra-efficient bidirectional on-board charger prototypes will be developed, in which innovative power electronics are implemented and demonstrated such as 800V batteries, 1.2kV wide-bandgap switches, and powertrain integration. Advanced magnetic design, interconnected with the general converter design, will push the converter beyond the state-of-the-art. Furthermore, the bidirectional charger will enable smart charging methods such as vehicle-to-home (V2H) and vehicle-to-grid (V2G). Hereby, the EV can be charged at low demand or when renewable energy production is high. Then, at peak demand, EV owners can use excess energy, increasing their self-consumption and decreasing energy costs. The expected research outcome is an 11kW bidirectional on-board charger for 800V batteries with 4.5kW/l power density and a 98% efficiency. Furthermore, extensive models and characterisation of the next-generation charger will be used to support the implementation of bidirectional chargers into future smart charging algorithms and infrastructure.

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FWO DMP (Flemish Standard DMP)

1. Research Data Summary

List and describe all datasets or research materials that you plan to generate/collect or reuse during your research project. For each dataset or data type (observational, experimental etc.), provide a short name & description (sufficient for yourself to know what data it is about), indicate whether the data are newly generated/collected or reused, digital or physical, also indicate the type of the data (the kind of content), its technical format (file extension), and an estimate of the upper limit of the volume of the data.

				Only for digital data	Only for digital data	Only for digital data	Only for physical data
Dataset Name	Description	New or reused	Digital or Physical	Digital Data Type	Digital Data format	Digital data volume (MB/GB/TB)	Physical volume
LitRev OBC table	Table of all publications on OBCs	Generate new data	Digital	Observational	.xlsx and .csv	<100MB	/
LitRev calculations	Compiled data for LitRev	Generate new data	Digital	Compiled/aggregated data	.m	<100MB	/
Magnetic models with digital twin	Modelling a digital twin of magnetic components	Generate new data	Digital	Software	.m	<1GB	/
Digital twin data	Modelling data from digital twins	Generate new data	Digital	Simulation data	.csv	<100GB	/
Magnetic simulation models	FEA simulation models in Ansys	Generate new data	Digital	Software	.aedt	<100GB	/
Magnetic simulation data	FEA simulation data from Ansys	Generate new data	Digital	Simulation data	.csv	<1GB	/
CAD models	3D CAD models for magnetic components	Generate new data	Digital	Software	.iam, .ipt, .dwg	>100GB	/
Converter control	CCS converter control code	Generate new data	Digital	Software	.ccxml	<1GB	/
PCB layouts	Altium Designer PCB layout	Generate new data	Digital	Software	.PrjPcb	<100GB	/
Data logbook	Powerpoint logbook of data and analyses	Generate new data	Digital	Software	.pptx	<1TB	/
Converter scope waveforms	Experimental waveforms of converter performance in a scope	Generate new data	Digital	Experimental	.csv and .png	<100GB	/
Impendance analyser data	Experimental data from impedance analyzer	Generate new data	Digital	Experimental	.csv and .png	<100GB	/
Charging datasets	Experimental converter datasets	Generate new data	Digital	Experimental and Other	.xlsx, .csv and .txt	<100GB	/

If you reuse existing data, please specify the source, preferably by using a persistent identifier (e.g. DOI, Handle, URL etc.) per dataset or data type:

N/A

Are there any ethical issues concerning the creation and/or use of the data (e.g. experiments on humans or animals, dual use)? Describe these issues in the comment section. Please refer to specific datasets or data types when appropriate.

- No

N/A

Will you process personal data? If so, briefly describe the kind of personal data you will use in the comment section. Please refer to specific datasets or data types when appropriate.

- No

N/A

Does your work have potential for commercial valorization (e.g. tech transfer, for example spin-offs, commercial exploitation, …)? If so, please comment per dataset or data type where appropriate.

- Yes

The obtained data will not be directly viable for tech transfer and valorisation as they mainly consist of measuring results. However, processing the data will lead to the design of patentable products. Therefore, these measurement results will be regarded as IP.

Do existing 3rd party agreements restrict exploitation or dissemination of the data you (re)use (e.g. Material/Data transfer agreements/ research collaboration agreements)? If so, please explain in

the comment section to what data they relate and what restrictions are in place.

- No

N/A

Are there any other legal issues, such as intellectual property rights and ownership, to be managed related to the data you (re)use? If so, please explain in the comment section to what data they relate and which restrictions will be asserted.

- No

N/A

2. Documentation and Metadata

Clearly describe what approach will be followed to capture the accompanying information necessary to keep data understandable and usable, for yourself and others, now and in the future (e.g., in terms of documentation levels and types required, procedures used, Electronic Lab Notebooks, README.txt files, Codebook.tsv etc. where this information is recorded).

1. Raw simulation and testing data will be collected per simulation test, including a txt file with a clear description of what the data represent and how they were generated. The input files used for the simulation will be kept inside the same folder. The folder's name will contain the parameters used during the tests/ simulation (A .txt file explaining the naming will be maintained).
2. A Word document will specify the rationale for executing the measurements and describe the preliminary conclusions.
3. Commented simulation code improves the understanding and enables future changes to the code.
4. 4. A PDF tutorial for running the simulation file will be stored with the simulation code.

Will a metadata standard be used to make it easier to find and reuse the data? If so, please specify (where appropriate per dataset or data type) which metadata standard will be used. If not, please specify (where appropriate per dataset or data type) which metadata will be created to make the data easier to find and reuse.

- No

No, metadata standards will not be used. Custom metadata detailing data type, creation date, parameters, and dataset description will be created for easy identification and use.

3. Data storage & back-up during the research project

Where will the data be stored?

During the research:
1) All project files are stored in the KU Leuven SharePoint server.
2) Files are also stored on the ESAT-department server.
3) Published datasets are stored in a KUL Research Data Repository (RDR).
4) Coding is saved on secure Github repositories and the Sharepoint server.
5) Frequent back-ups are performed.
After the research:
1) Relevant data on personal storage will be transferred to the group account.
2) All remaining outcomes will be stored in the KU Leuven RDR.

How will the data be backed up?

All KU Leuven internal data storage is backed up both by physical means (using multiple backup hard drives) as well as making use of cloud storage. No data will be stored on a personal drive only. Github repositories are stored locally and on their respective servers.

Is there currently sufficient storage & backup capacity during the project? If yes, specify concisely.
If no or insufficient storage or backup capacities are available, then explain how this will be taken care of.

- Yes

The user quota normally suffices and can be increased when needed. It is not common practice within the group to individually assess the associated costs for the type of research in the projects (limited amount of data). We will contact the administration regarding the budget implications if this rule changes.

How will you ensure that the data are securely stored and not accessed or modified by unauthorized persons?

Password-protected user accounts with two-factor authentication secured through KU Leuven ensure that only the persons on the account can access the working data.

What are the expected costs for data storage and backup during the research project? How will these costs be covered?

The costs are distributed over the different research groups in the department (ESAT). No direct costs will normally be associated with this project specifically.

4. Data preservation after the end of the research project

Which data will be retained for at least five years (or longer, in agreement with other retention policies that are applicable) after the end of the project? In case some data cannot be preserved, clearly state the reasons for this (e.g. legal or contractual restrictions, storage/budget issues, institutional policies...).

1. The Microsoft Sharepoint site will be stored for the min. of 5 years.
2. Simulation files and documentation will be stored on the server of the department for min 5 years, conform the KU Leuven RDM policy.
3. Working data located on individual user accounts is typically removed after the user leaves, so should any of the working data need to be kept, it will also be transferred to the user account of the main PI.

Where will these data be archived (stored and curated for the long-term)?

1. The user account of the primary PI.
2. EnergyVille Sharepoint

What are the expected costs for data preservation during the expected retention period? How will these costs be covered?

No additional costs are expected at this moment.

5. Data sharing and reuse

Will the data (or part of the data) be made available for reuse after/during the project? In the comment section please explain per dataset or data type which data will be made available.

- Yes, in a restricted access repository (after approval, institutional access only, …)

1. Internally (within the research group): models, software code and documentation.
2. Externally: information in publications to reproduce the models and results.

If access is restricted, please specify who will be able to access the data and under what conditions.

To be reused within the research group.
Other researchers from outside our research group can be permitted to use the research data upon asking through email. They can use this data to verify the research results or further development.

Are there any factors that restrict or prevent the sharing of (some of) the data (e.g. as defined in an agreement with a 3rd party, legal restrictions)? Please explain in the comment section per dataset or data type where appropriate.

- No

N/A

Where will the data be made available? If already known, please provide a repository per dataset or data type.

1. Internally: ESAT and research group's SharePoint, as well as the KU Leuven repository.
2. Externally: if models would be made available, it will be through the research group website or Github. To be determined when applicable.

When will the data be made available?

Upon publication of the research results.

Which data usage licenses are you going to provide? If none, please explain why.

CC-BY-4.0

Do you intend to add a PID/DOI/accession number to your dataset(s)? If already available, you have the option to provide it in the comment section.

- Yes

Publicly shared datasets in the KU Leuven RDR are appointed a DOI, for example: doi:10.48804/SXEQCL

What are the expected costs for data sharing? How will these costs be covered?

No additional costs are expected at this moment.

6. Responsibilities

Who will manage data documentation and metadata during the research project?

The researcher is responsible for correctly documenting and providing the metadata

Who will manage data storage and backup during the research project?

The responsible for data storage & back-up is the IT responsible at KU Leuven, Veronica Lucero Ortega.

Who will manage data preservation and sharing?

The researcher is responsible for data preservation and reuse.

Who will update and implement this DMP?

The PI bears the end responsibility of updating & implementing this DMP