Proposition de sujet de thèse CN-Renault, 2019

Sujet : Contrôle d'un chargeur réversible pour véhicule électrique

Contexte :

Dans le cadre du développement de sa gamme de véhicules électriques (VE), Renault s.a.s s'intéresse à la problématique des chargeurs bidirectionnels. Offrant plus de mobilité énergétique, les chargeurs réversibles font du VE un vecteur de stockage et de transport d'énergie.
Renault développe un chargeur triphasé (22KW) / monophasé (7KW) réversible, capable de fonctionner dans les différents modes G2V (charge), V2G et V2H/V2L (décharge).

Objectifs :

Le travail envisagé consiste à rechercher de nouvelles solutions au contrôle du chargeur réversible, d'améliorer l'existant, d'assembler les différentes briques technologiques et de valider sur banc de test les performances du chargeur complet en monophasé (7KW) /Triphasé (22KW).
Pendant la première phase du travail, le candidat devra s'approprier l'existant déjà réalisé du sujet.

- Topologie du chargeur,
- Loi de commande en mode G2V, V2G et V2H/V2L (deux lois de commande dans ce dernier cas seront à évaluer),
- Contrôle par mode Burst du DC/DC,
- Stratégie d'anti-ilotage

La seconde partie du travail sera alors consacrée à l'amélioration et à la recherche de nouvelles solutions de contrôle :

Convertisseur AC/DC :

- Adaptation des lois de commande en mode V2G (source de courant),
- Adaptation des lois de commande en mode V2h/V2L (source de tension),
- Validation des stratégies de contrôle sur banc prototypage rapide (Dspace),
- Etude de robustesse et test sur banc de la stratégie d'anti-ilotage (SMS /SFS) : Evaluer les 2 méthodes SMS et SFS par rapport aux critères : temps de détection/complexité d'implémentation (FPGA)/robustesse aux perturbations réseaux,
- Développement d'une stratégie de génération de consigne de courant pour contrôler un déphasage avec un cos(phi) compris entre 0,9 et 1 en charge et en décharge,
- Validation de la robustesse du contrôle en mode V2H/V2L aux différents appels de courants induits par la connexion/déconnexion de différents profils de charges.

Convertisseur DC/DC :

- Développement d'une stratégie de soft start au démarrage du DC/DC,
- Validation de la régulation du DC/DC sur tout le domaine de faisabilité du contrôle,
- Régulation par mode Burt du convertisseur DC/DC à haute tension batterie/ basse puissance,
- Etude de la faisabilité d'une nouvelle stratégie de contrôle en cas de modification de la topologie du DC/DC (suppression de l'inductance commutée en décharge),
- Développement d'une nouvelle stratégie MLI à la suite de la suppression des diodes en parallèle des mosfest.

Chargeur complet :

- Stratégie de démarrage en mode réversible,
- Essaie et validation du chargeur complet : sur toute la plage de puissance (0 à 22 KW), à différentes tensions batterie (250V à 430V), en mode charge et décharge.

Ce travail sera mené dans le cadre de la chaire entre Renault et Centrale Nantes. Ce sujet s'inscrit également dans les thèmes majeurs retenus dans le cadre de l'action nationale du groupe de travail CSE (Commande des Systèmes Electriques) de l'inter GDR MACS/SEEDS du CNRS http://www2.irccyn.ec-nantes.fr/CSE.

Compétences requises :

- Automatique, Electronique de puissance.
- Convertisseur de puissance.
- MATLAB/Simulink.
- Prototypage rapide (Dspace).

Contacts et financement :

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Tel : 02 40 37 69 13, Email : Malek.Ghanes@ec-nantes.fr
Le financement est disponible par la chaire. Durée : 3 ans. Début : 01/10/2019 ou 01/11/2019.

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CENTRALE NANTES

GROUPE RENAULT

PhD Proposal, CN-Renault, 2019

Subject: Control of a reversible charger for an electric vehicle

Background:

As part of the development of its range of electric vehicles (EV), Renault s.a.s is interested in the issue of two-way chargers. Offering more energy mobility, reversible chargers make EV a vehicle for storing and transporting energy.
Renault is developing a reversible three-phase (22KW) / single-phase (7KW) charger capable of operating in different G2V (charge), V2G and V2H / V2L (discharge) modes.

Objectives:

The work envisaged is to look for new solutions to control the reversible charger, to improve the existing, to assemble the different technological bricks and to validate on the test bench the performance of the full load in single-phase (7KW) / three-phase (22KW)).
During the first phase of the work, the candidate will have to take ownership of the already realized existing subject.

- Charger topology,
- Control law in G2V, V2G and V2H / V2L mode (two control laws in the latter case will be evaluated)
- Burst mode control of the DC / DC,
- Anti-islanding strategy.

The second part of the work will then be devoted to improving and finding new control solutions:

AC/DC converter:

- Adaptation of control laws in V2G mode (current source),
- Adaptation of control laws in V2h / V2L mode (voltage source),
- Validation of control strategies on rapid prototyping bench (Dspace),
- Robustness study and bench test of the anti-islanding strategy (SMS / SFS): Evaluate the 2 SMS and SFS methods against the criteria: detection time / complexity of implementation (FPGA) / robustness to network disturbances ,
- Development of a current command generation strategy to control a phase shift with a cos (phi) between 0.9 and 1 in charge and in discharge,
- Validation of the robustness of the control in V2H / V2L mode to the different currents calls induced by the connection / disconnection of different load profiles.

DC/DC converter:

- Development of a soft start strategy at the start of the DC / DC,
- Validation of DC / DC regulation over the entire field of control feasibility,
- Burt mode control of the DC / DC high voltage battery / low power converter,
- Study of the feasibility of a new control strategy in case of modification of the DC / DC topology (suppression of switched inductance in discharge),
- Development of a new MLI strategy following the deletion of diodes in parallel of mosfest.

Complete charger:

- Startup strategy in reversible mode,
- Test and validation of the complete charger: over the entire power range (0 to 22 KW), at different battery voltages (250V to 430V), in charge and discharge mode.

This work will be carried out within the framework of the Chair between Renault and Centrale Nantes. It is one of the relevant scientific area addresed in the working group of the French CNRS GDR MACS and GDR SEEDS (Control of the Electrical Systems**)** **http://www2.irccyn.ec-nantes.fr/CSE**.

Required Skills:

- Automatic, power electronics.
- Power converter.
- MATLAB / Simulink.
- Rapid prototyping (Dspace).

Contacts and funding:

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Funding is available through the chair. Duration: 3 years. Start: 01/10/2019 or 01/11/2019.

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