« EMR and Inversion-Based Control of an Automatic Subway »

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subways VAL since 1982

automatic driving supplied by a DC rail

SIEMENS

- better energy recovery
- peak power limitation
- safety operation
- cost reduction
- modern product

project NeoVAL

among the innovations: feeding by supercapacitors without supply rail
1. Principle

2. Transfer Part

3. Traction Part

4. Complete System
« PRINCIPLE »
« EMR and IBC of an Automatic Subway »

- Principle of a new hybrid automatic subway -

Classically

Station 1

Station 2

DC supply rails

Network

NO DC supply rails

Subway "Neoval"
« EMR and IBC of an Automatic Subway »

- Structure considered -

Station 1

Network SC1

Station 2

Network SC1

sub-system in station

on-board sub-system

RECHARGE

TRANSFER

TRACTION

tragtion drives
« EMR and IBC of an Automatic Subway »

- EMR of the system -

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Diagram showing the coupling chopper and the connection between the sub-system in station and the on-board sub-system. The diagram includes symbols for various components such as chopper, inductor, and coupling transformers.
4 basic strategies:

- \( i_{SC1} = \text{cst} \)
- \( i_{SC2} = \text{cst} \)
- \( p_{SC1} = \text{cst} \)
- \( p_{SC2} = \text{cst} \)

\[ u_{\text{chop}1 - \text{ref}} \]
\[ i_{\text{sc1} - \text{mes}} \]
\[ u_{\text{sc1} - \text{mes}} \]
\[ i_{\text{sc2} - \text{ref}} \]

\[ u_{\text{chop}2 - \text{ref}} \]
\[ i_{\text{sc1} - \text{ref}} \]
\[ u_{\text{sc1} - \text{mes}} \]
\[ u_{\text{sc2} - \text{mes}} \]

\[ P_{sc2_{-}est} \]
\[ P_{sc1_{-}est} \]

\[ u_{\text{chop},1} \]
\[ u_{\text{chop},2} \]
\[ i_{L1} \]
\[ i_{L2} \]

- \( \text{scps} \)
- \( \text{choppers and DC bus} \)
- \( \text{inductors} \)

\text{dSpace Card}
Some experimental results:

For $i_{SC1} = cst$:
- $u_{SC2-meas} (V)$
- $u_{SC1-meas} (V)$
- $i_{SC1-meas} (A)$
- $i_{SC2-meas} (A)$
- $p_{SC2-est} (W)$

For $i_{SC2} = cst$:
- $u_{SC2-meas} (V)$
- $i_{SC1-meas} (A)$
- $i_{SC2-meas} (A)$
- $p_{SC2-est} (W)$
« Traction Part »
« EMR and IBC of an Automatic Subway »

- Study of the traction part -

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Station 1

SC2

EM

Network SC1

Station 2

Network SC1

sub-system in station

connection

don-board sub-system

traction drives

TRACTION
« EMR and IBC of an Automatic Subway »

- EMR of the studied system -

This part will be emulated
< « EMR and IBC of an Automatic Subway »

- Power HIL Simulation -

EMULATOR PART

This part is emulated

EMULATOR PART

EMULATOR
« EMR and IBC of an Automatic Subway »

- From simulation to experimentation -

Electric machines

dSpace Card

Scps
Choppers
And DC bus
Resistor
Inductors

Resistor
- Some experimental results -
« COMPLETE SYSTEM »
EMR'12, Madrid, June 2012

« EMR and IBC of an Automatic Subway »

- EMR of the complete system -

**sub-system in station**

**connection**

**on-board sub-system**
« EMR and IBC of an Automatic Subway »

- EMR and IBC of the complete system -

sub-system in station

on-board sub-system

strategy in-station

strategy on-board
EMR and IBC of an Automatic Subway

- Simulation of the complete system -

$p_{grid} \text{(pu)}$

$u_{SC1} \text{(pu)} \& u_{SC2} \text{(pu)}$

$i_{L3} \text{(pu)}$

no connection

sub-system in station

on-board sub-system

TRANSFER

BRAKING
« CONCLUSION »
- Conclusion -

- Sizing of SC and Power Electronics
- Management of the energy transfer thanks to EMR
- Simulation of the complete system
- Development of a testbed
- Validation in real time
« BIOGRAPHIES AND REFERENCES »
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