

**EMR'23, Lille (France)**

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# «EMR-based control of AC/DC microgrids»

**Dr. Javier SOLANO**

ElFER Europäisches Institut für Energieforschung EDF-KIT EWIV

Karlsruhe, Germany



European Institute  
for Energy Research  
by EDF and KIT

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**Power Distribution between Two VSC  
in Droop-PQ Control Mode**

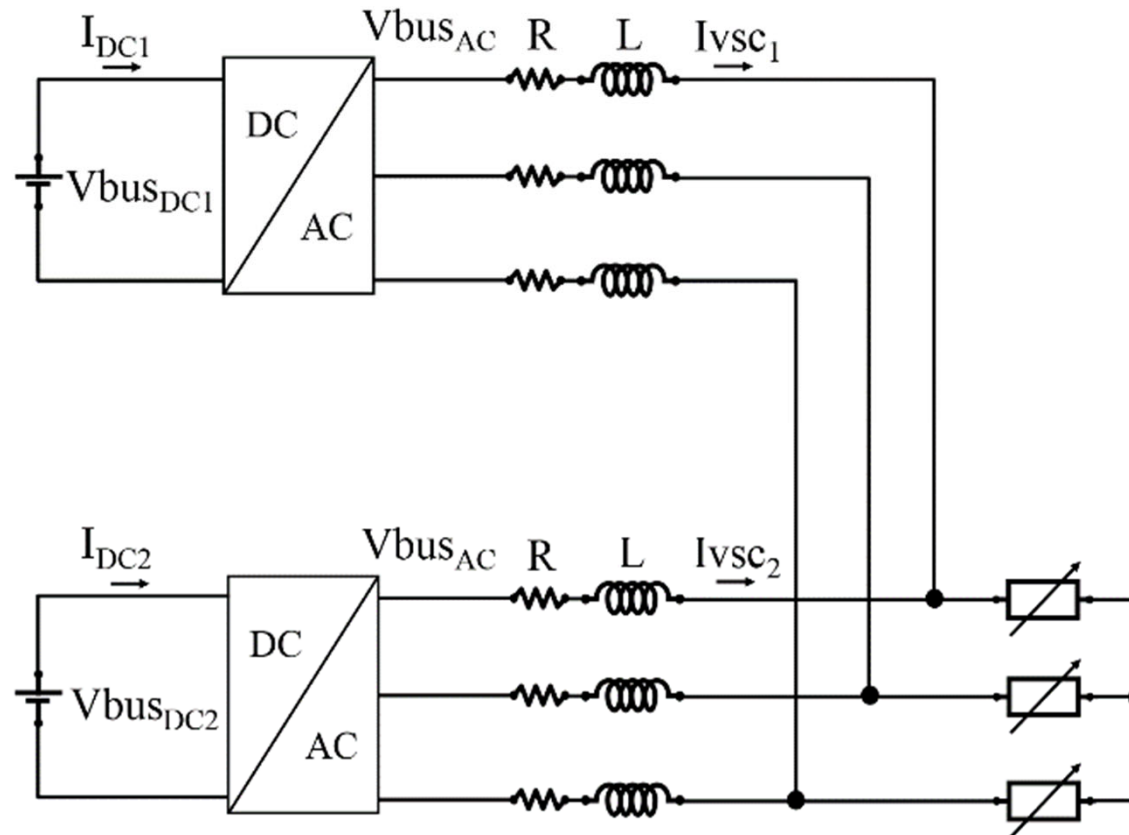
2

**Power Distribution among a  
Synchronous Generator and Two VSC**

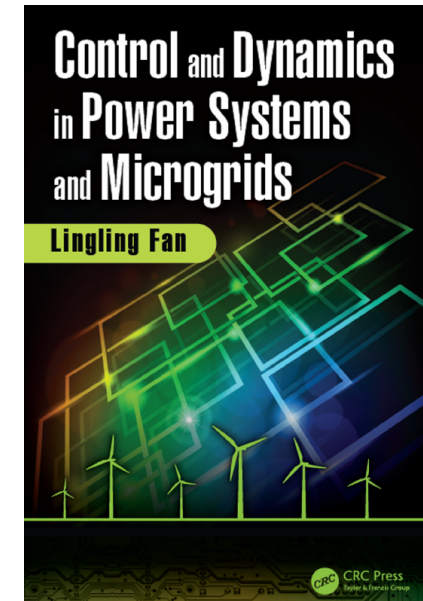


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# **«PART 1. Power Distribution between Two VSC in Droop-PQ Control Mode»**



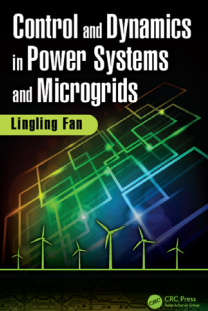
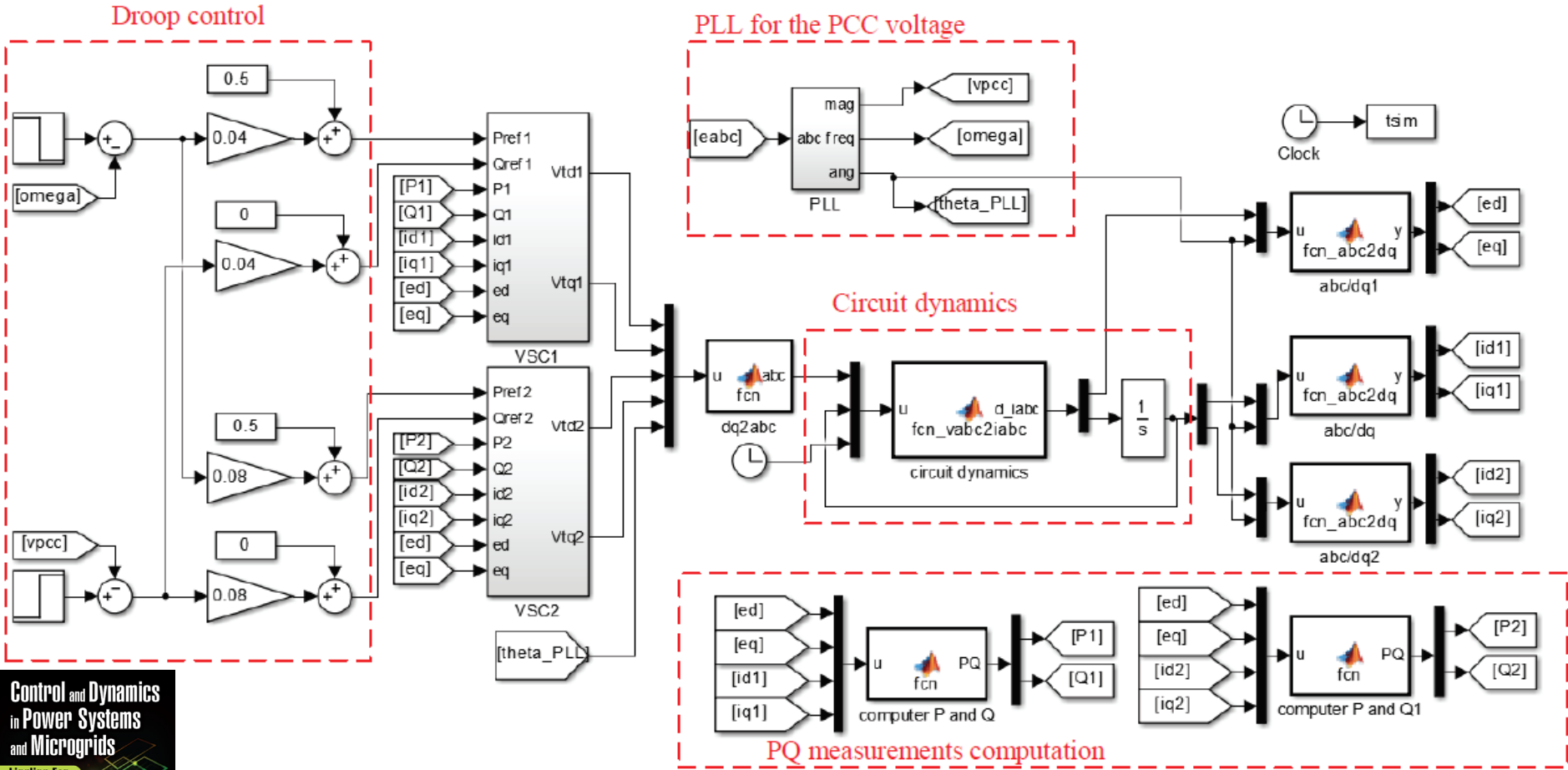
### Power Distribution between Two VSC in Droop-PQ Control Mode



# EMR-based control of AC/DC microgrids

## - Two VSC in Droop-PQ Control Mode Implementation -

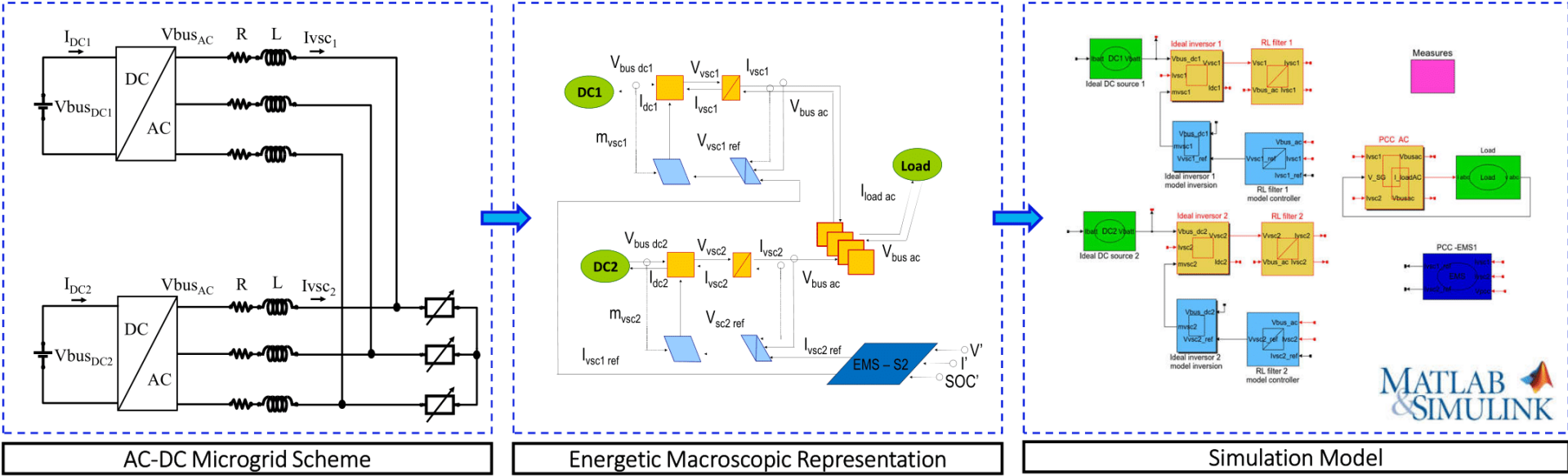
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# EMR-based control of AC/DC microgrids

- Using EMR to organize the model in a different way -

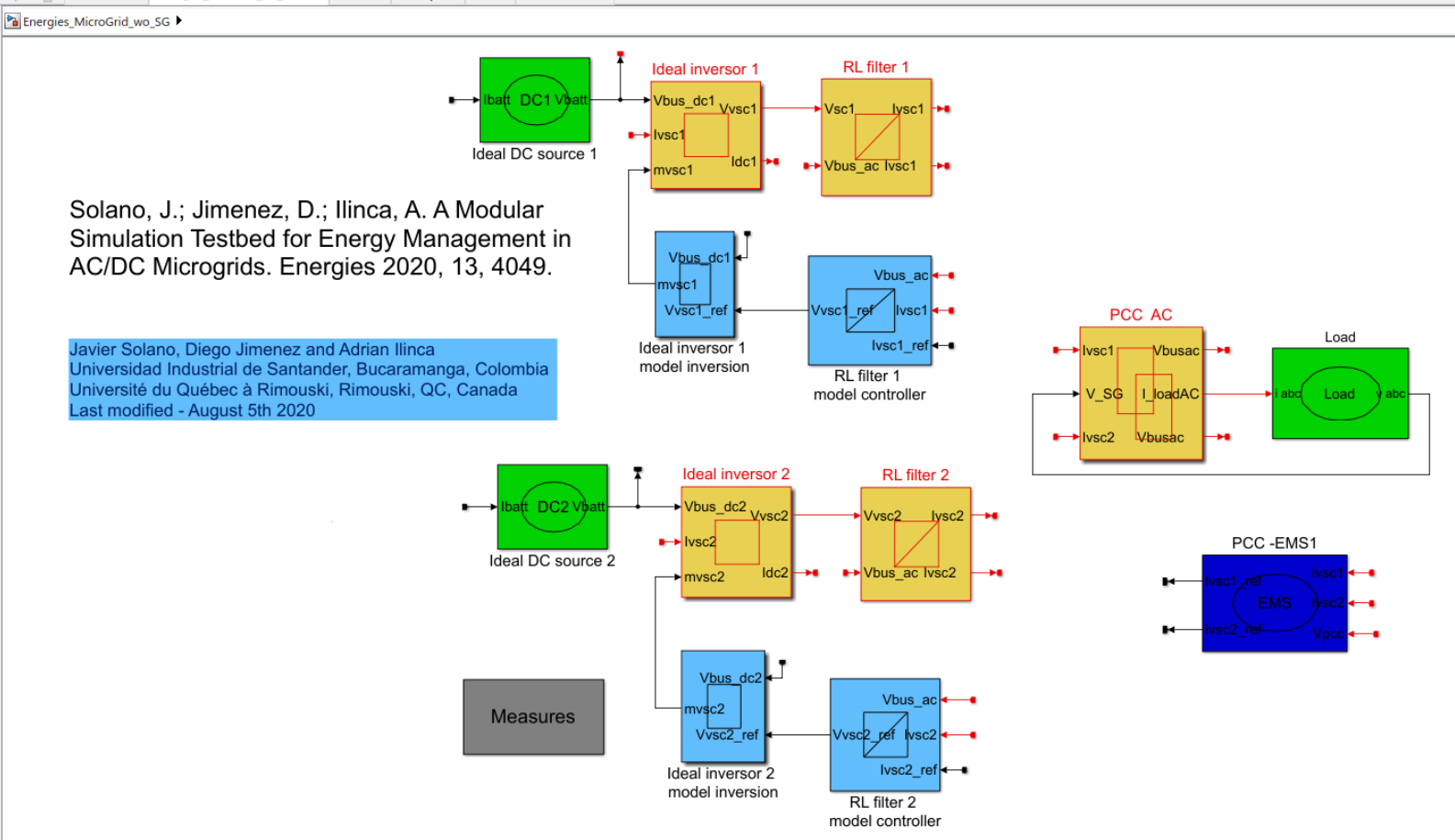
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# EMR-based control of AC/DC microgrids

## - AC-DC Microgrid EMR and MCS – Matlab screenshot-

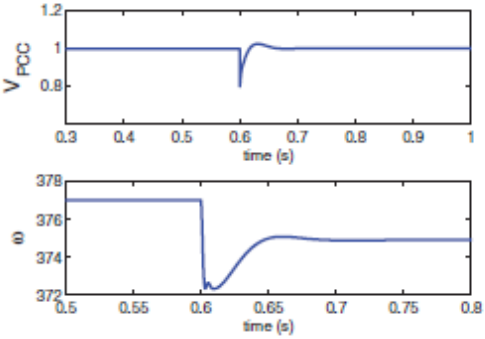
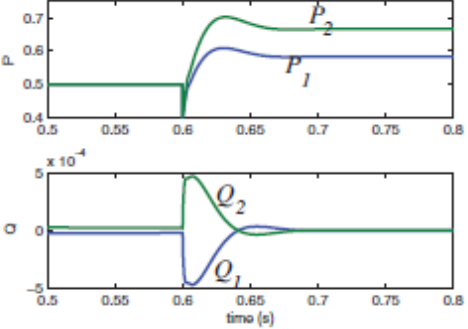
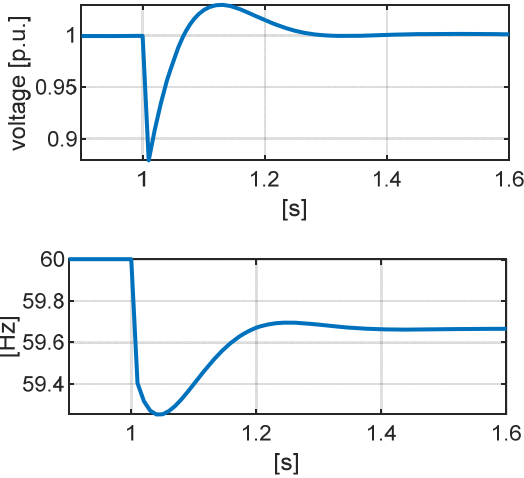
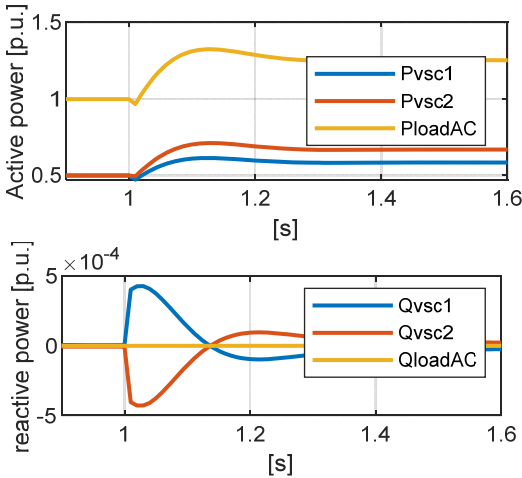
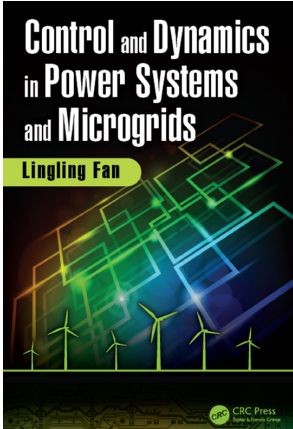
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# EMR-based control of AC/DC microgrids

## - Simulation results -

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### Article A Modular Simulation Testbed for Energy Management in AC/DC Microgrids

Javier Solano <sup>1</sup>, Diego Jimenez <sup>1</sup> and Adrian Ilinca <sup>2,\*</sup>  
<sup>1</sup> Escuela de Ingenierías Eléctrica, Electrónica y de Telecomunicaciones, Universidad Industrial de Santander, Bucaramanga 580002, Colombia; jsolano@uis.edu.co (J.S.); diego.jimenez@uis.edu.co (D.J.)  
<sup>2</sup> Département de Mathématiques, Université du Québec à Rimouski, Rimouski, QC G5L 3A1, Canada  
 \* Correspondence: adrian\_ilinca@uqar.ca; Tel: +57-7-634-4000 (ext. 2367)

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**Abstract:** This paper introduces a modular testbed to simulate AC/DC microgrids. The testbed is implemented in Matlab Simulink and is based on the energetic macroscopic representation (EMR) formalism. It is designed to be a tool to evaluate energy management strategies in AC/DC microgrids. The microgrid simulation model includes a photovoltaic generator, a fuel cell system, ultracapacitors, and batteries on the DC side. It includes voltage source converters (VSC) to couple the DC side with the AC side of the microgrid, which includes a variable AC load and a synchronous generator. Two case studies illustrate the use of the testbed. The model is implemented in Matlab Simulink and made openly available for the scientific community. Using this model, researchers can develop and evaluate energy management strategies in AC/DC microgrids.





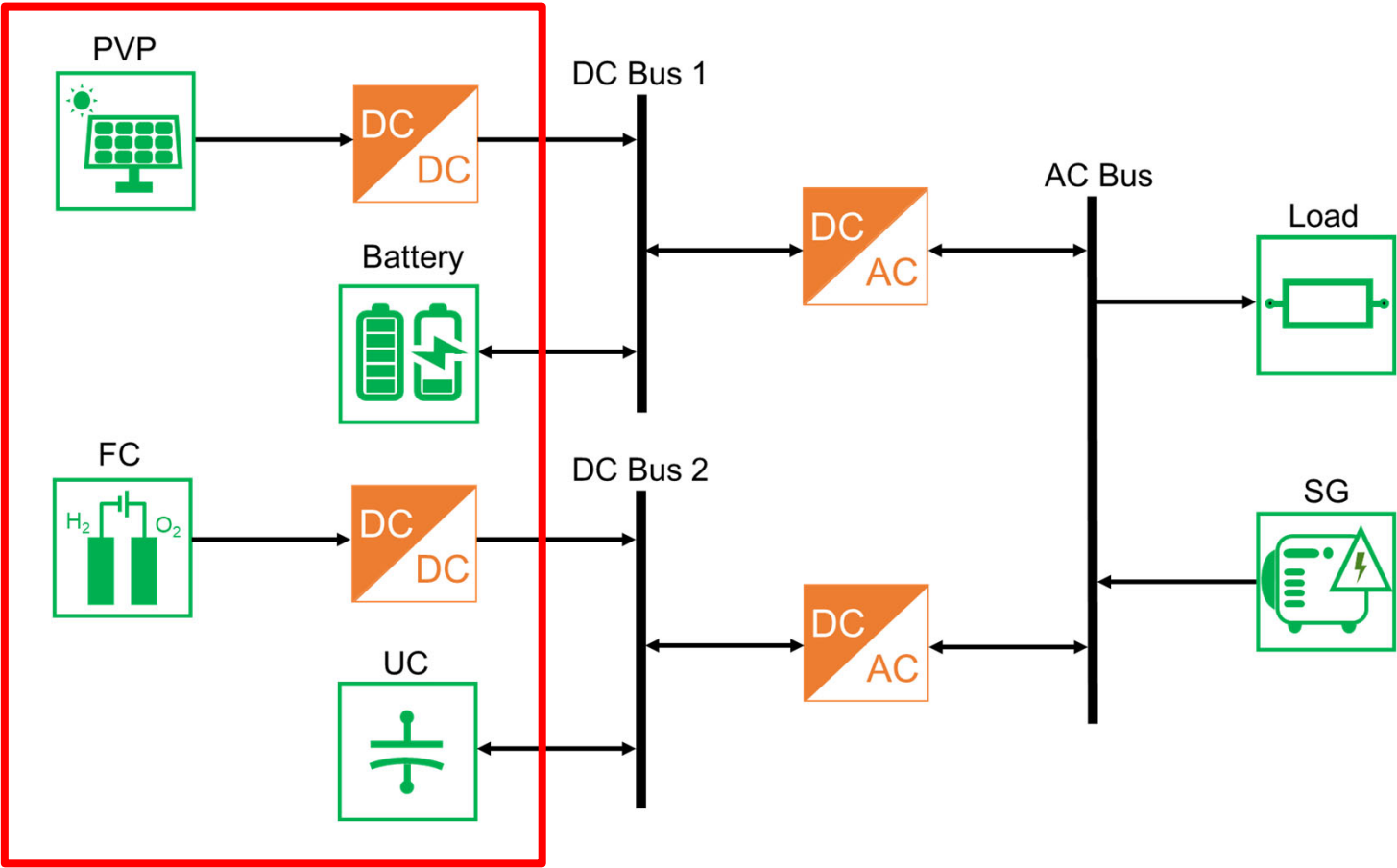
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# **«PART 2. Power Distribution among a Synchronous Generator and Two VSC»**

# EMR-based control of AC/DC microgrids

## - AC/DC microgrid schematic -

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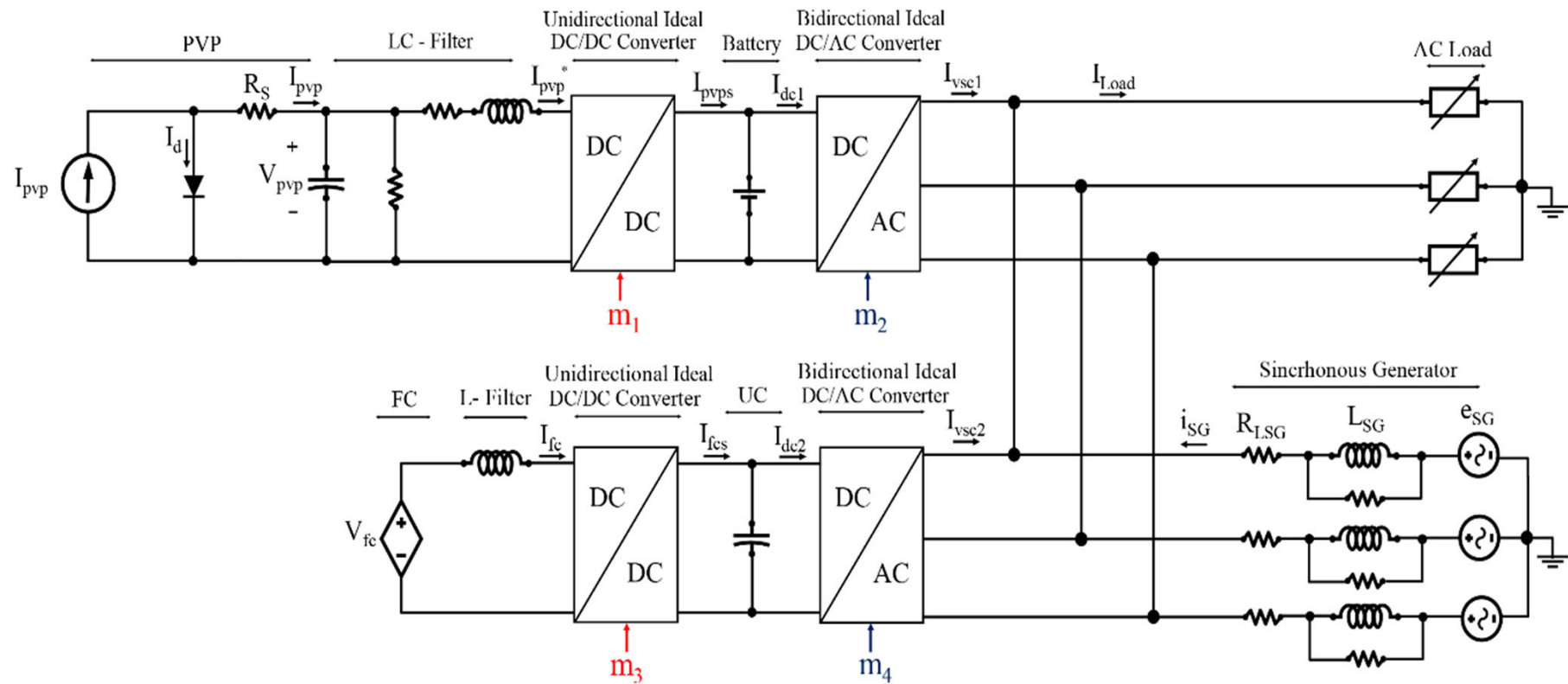


# EMR-based control of AC/DC microgrids

## - VSC1 +VSC2 (FC+SC) schematic -

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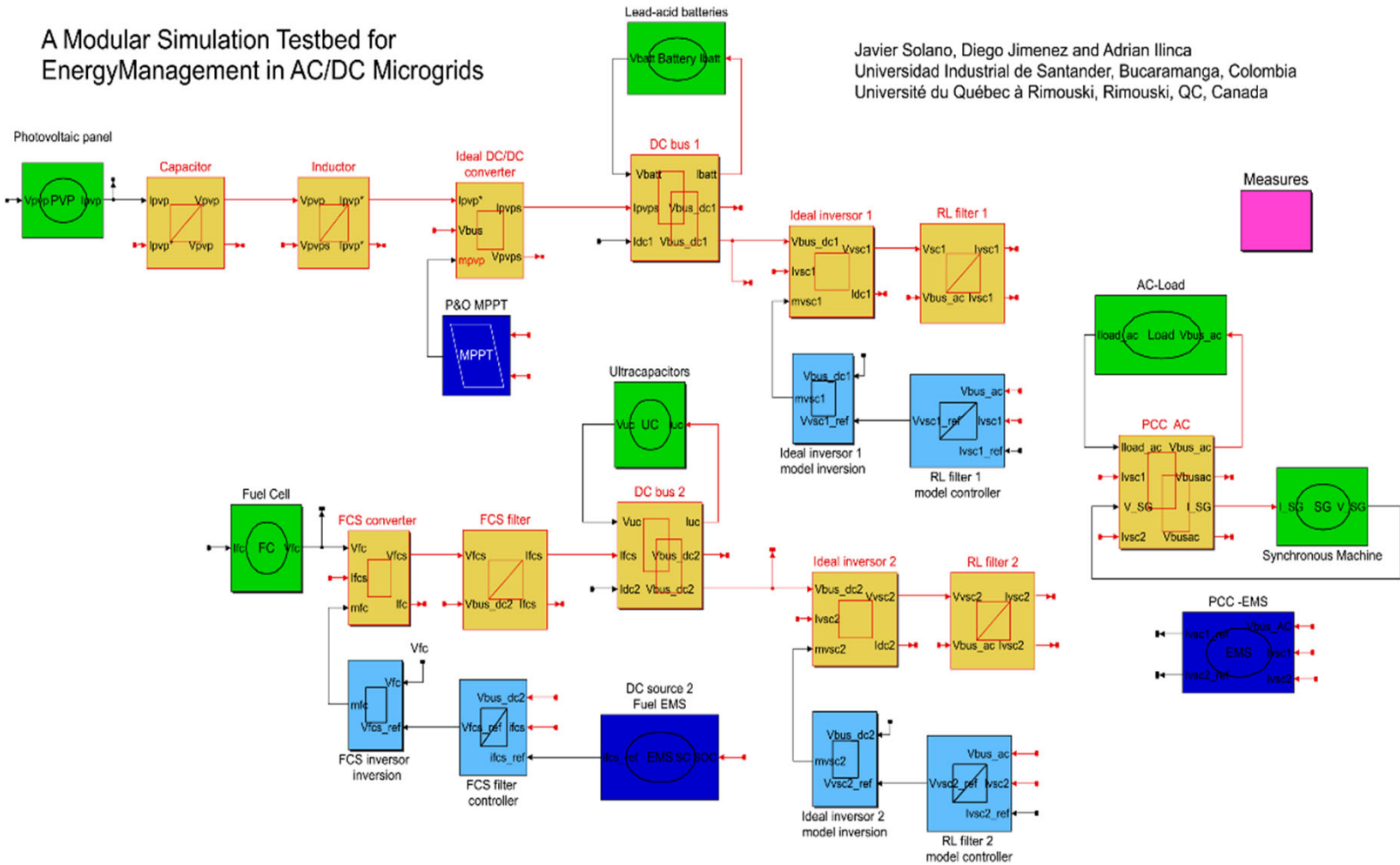
# EMR-based control of AC/DC microgrids

- VSC1+VSC2 + SM + AC load EMR implemented in Matlab -

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A Modular Simulation Testbed for Energy Management in AC/DC Microgrids

Javier Solano, Diego Jimenez and Adrian Ilinca  
 Universidad Industrial de Santander, Bucaramanga, Colombia  
 Université du Québec à Rimouski, Rimouski, QC, Canada

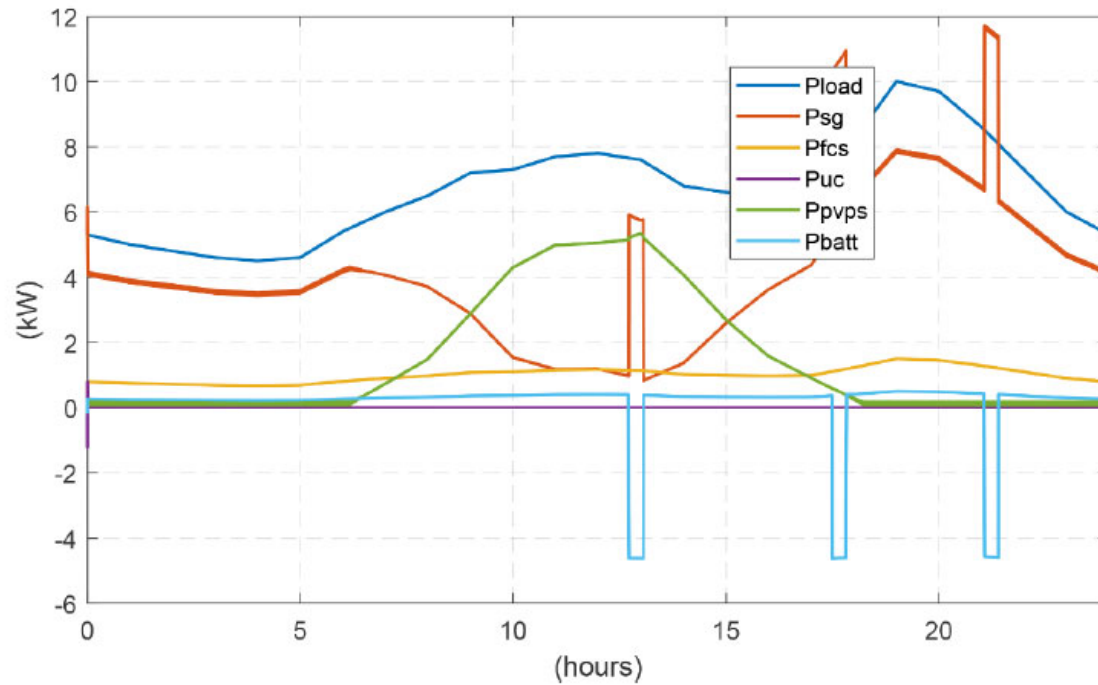


# EMR-based control of AC/DC microgrids

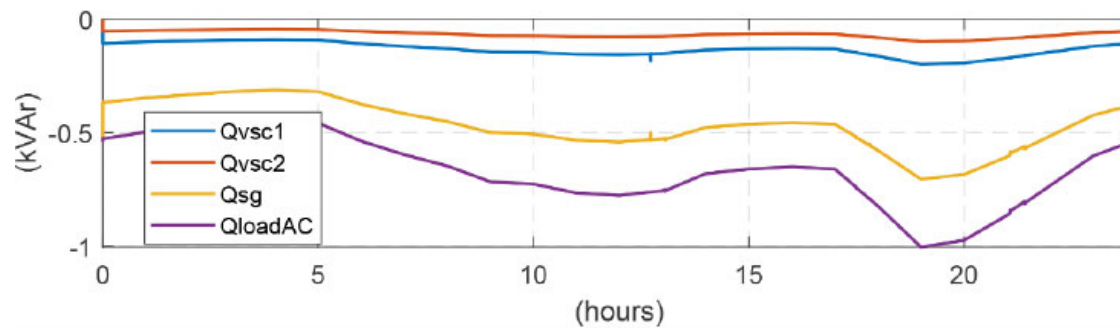
## - Simulation results -

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(a) Active AC SG.



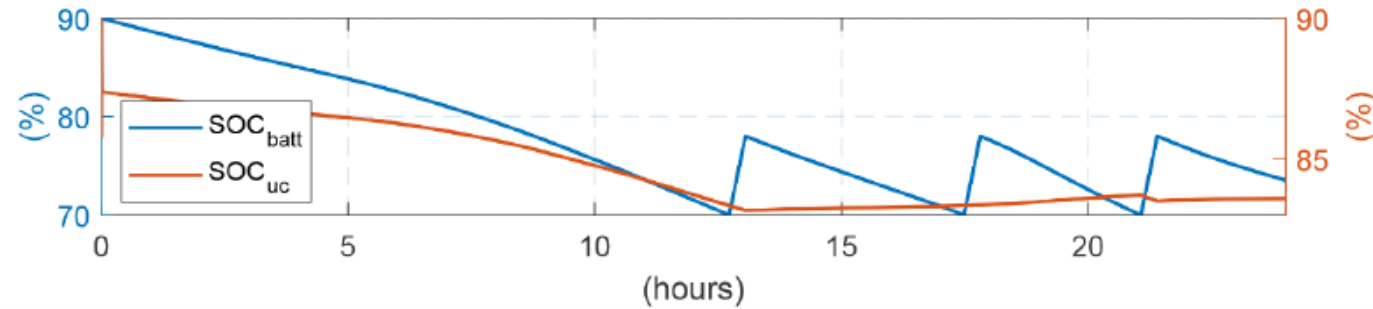
(b) Reactive AC SG.

# EMR-based control of AC/DC microgrids

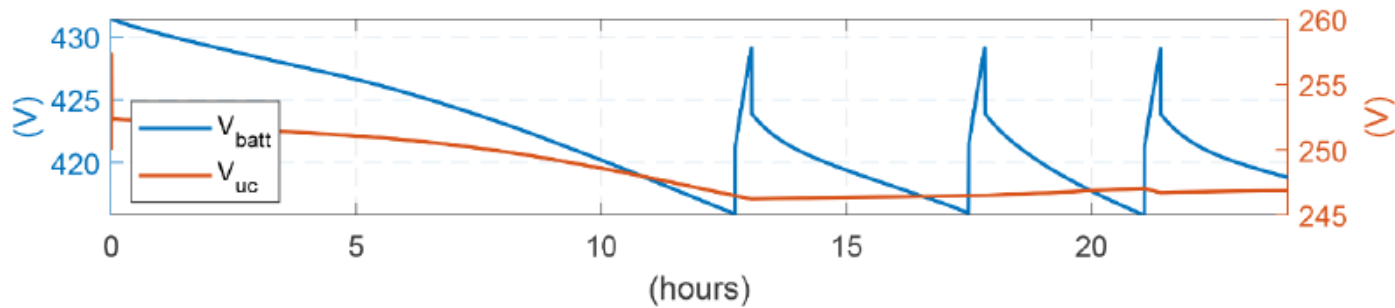
## - Simulation results -

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(c) Batteries' and ultracapacitors' SOC.



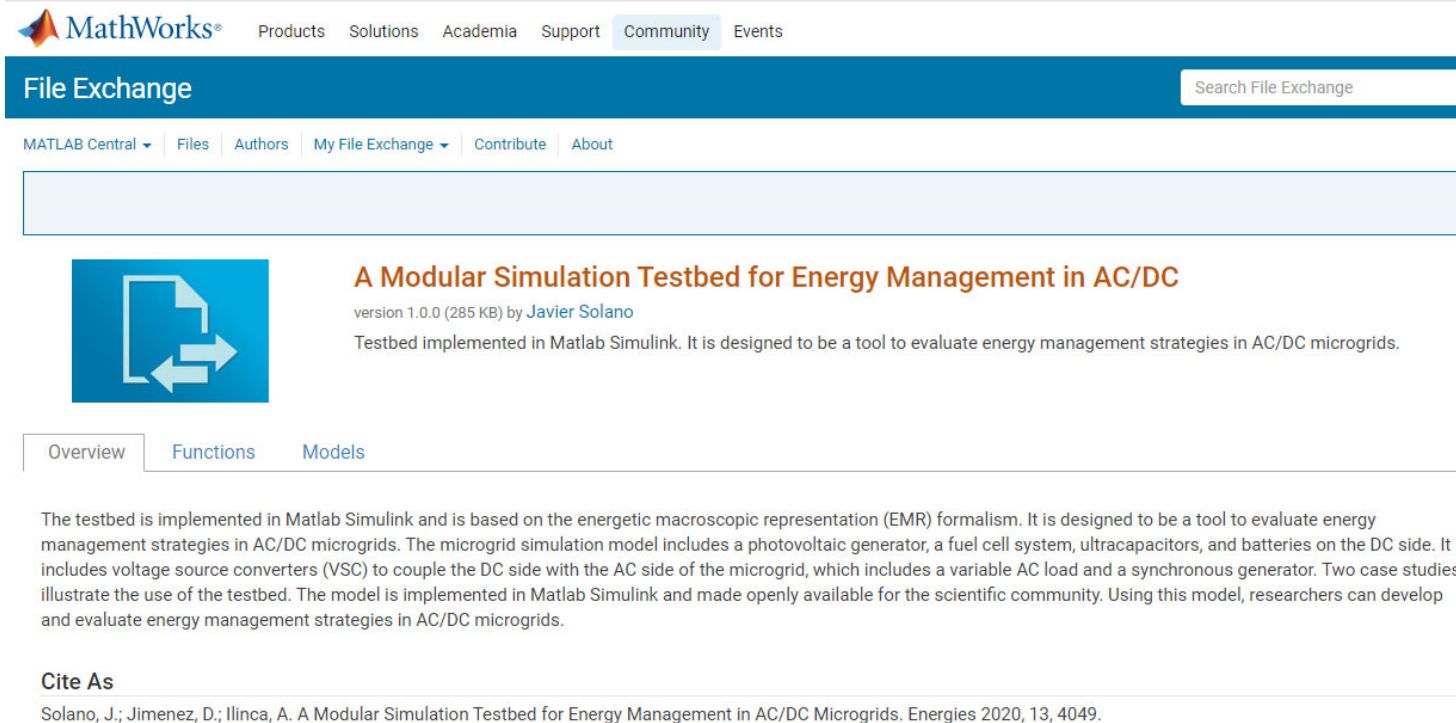
(d) DC bus voltages.

# EMR-based control of AC/DC microgrids

## - A modular simulation testbed for EM in AC-DC MG -

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The screenshot shows the MathWorks File Exchange interface. At the top, there is a navigation bar with links for Products, Solutions, Academia, Support, Community, and Events. Below this is a blue header for 'File Exchange' with a search bar. A secondary navigation bar includes 'MATLAB Central', 'Files', 'Authors', 'My File Exchange', 'Contribute', and 'About'. The main content area features a blue icon of a document with arrows, followed by the title 'A Modular Simulation Testbed for Energy Management in AC/DC', version 1.0.0 (285 KB) by Javier Solano, and a brief description: 'Testbed implemented in Matlab Simulink. It is designed to be a tool to evaluate energy management strategies in AC/DC microgrids.' Below the description are tabs for 'Overview', 'Functions', and 'Models'. The 'Overview' tab is active, displaying a paragraph about the testbed's implementation in Matlab Simulink, its basis on the EMR formalism, and its components like photovoltaic generators, fuel cell systems, ultracapacitors, batteries, VSCs, AC loads, and synchronous generators. A 'Cite As' section follows, providing the citation: Solano, J.; Jimenez, D.; Ilincă, A. A Modular Simulation Testbed for Energy Management in AC/DC Microgrids. Energies 2020, 13, 4049.

<https://www.mdpi.com/1996-1073/13/16/4049/s1>

[https://www.mathworks.com/matlabcentral/fileexchange/78919-a-modular-simulation-testbed-for-energy-management-in-ac-dc?s\\_tid=FX\\_rc1\\_behav](https://www.mathworks.com/matlabcentral/fileexchange/78919-a-modular-simulation-testbed-for-energy-management-in-ac-dc?s_tid=FX_rc1_behav)



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# « BIOGRAPHIES AND REFERENCES »





[Javier.Solano@eifer.org](mailto:Javier.Solano@eifer.org)

**Dr. J. Solano**

ElfER Europäisches Institut für Energieforschung EDF-KIT EWIV  
PhD in Electrical Engineering at University of Franche-Comté (2012)  
Research topics: Low carbon hydrogen systems



European Institute  
for Energy Research  
by EDF and KIT

<http://www.eifer.org>

[Fan 2017] Fan, L. Control and Dynamics in Power Systems and Microgrids; CRC Press: Cleveland, OH, USA, 2017.

[Solano 2020] Solano, J.; Jimenez, D.; Ilinca, A. A Modular Simulation Testbed for Energy Management in AC/DC Microgrids. *Energies* 2020, 13, 4049. [doi.org/10.3390/en13164049](https://doi.org/10.3390/en13164049).