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A vector-based flexible-complexity tool for simulation and small-signal analysis of hybrid AC/DC power systems

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Abstract-

This paper presents VFlexP, an open-source, vector-based tool for the time domain simulation, static analysis, and small-signal analysis of hybrid AC/DC power systems, built upon MATLAB-Simulink. Unlike existing tools such as PowerFactory, Simplus Grid Tool, and PSCAD, VFlexP allows for a flexible-complexity representation of all devices without taking any traditional simplifications for granted, and the seamless inclusion of new models without extensive modifications. VFlexP has a module to analyse the relevance of the state variables of the model in a given input–output relationship. This information can then be used to simplify the model in subsequent studies. VFlexP has been designed to obtain an accurate initial point for simulation from a conventional power-flow analysis in order to achieve fast initialisation without troublesome and time-consuming initial transients. The tool’s graphical user interface groups all power system elements of the same type in a single block, even if they have different parameters, providing a clean representation even for large systems. These characteristics make VFlexP a valuable tool for the detailed analysis and non-linear time simulation of hybrid power systems in a fast-changing scenario, even though, for the time being, the analysis and simulation carried out are limited to a d-q representation of a balanced power system.

Index Terms- Flexible complexity; Model reduction; Small signal analysis; Vector-based

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