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Novel simulation methods for investigations on distributed power generation

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This work presents a compendious overview over Power Hardware-in-the-Loop (PHIL) simulations that are used for designing, analysing and testing of electrical power system and its components. PHIL simulations are an advanced application of real time simulations that represent novel methods which conjoins soft- and hardware simulation / testing. It briefly outlines necessary requirements for the implementation of PHIL simulations, which are defined by the nature of the digital real time simulator (DRTS), the power amplifier (PA) and the Power Interface (PI). Fundamental characteristics such as the input/output (IO) systems, interface algorithm (IA) and system stability considerations are discussed for PHIL systems in order to illustrate both flexibility and complexity of this compound simulation method. Superior to ordinary offline simulation methods (numeric solvers) or classic laboratory testing the PHIL simulation method is able to extend the application range of investigations on electric system such as distributed power generations. Benefits and disadvantageous issues of PHIL simulations are heavily depending on the system topology and the relevant use case(s) set variously in its origin. Important issues that are part of ongoing discussions can be simulated, modelled and run in this novel simulation method PHIL. The focus is set to experimental results, its verification and useable statements or solutions valuable for both industry and network operator can be achieved exemplarily for the following areas such as (a) Islanding detection scenarios (unintentional islanding), (b) Grid fault scenarios (LVRT, realistic vs. normative grid faults), (c) Integration of communication techniques (Co-simulation, communication protocols), (d) Advanced controls features of the latest generation (P/Q controls, etc.) or (e) System stability behaviour of multiple generation units connected (interactions).

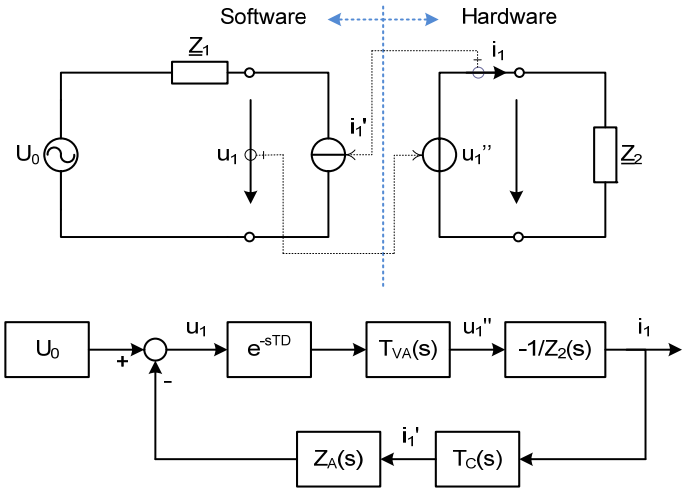

Fig. 1. Sketch of components and interfacing of real software/hardware power interface (voltage type) of a PHIL simulation

Keywords: Simulation methods, Distributed power generation, Hardware-in-the-loop method, Integration of renewables.

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