Resum de Tesi Doctoral

UNIVERSITAT POLITÈCNICA DE CATALUNYA
BARCELONATECH
Escola de Doctorat

DNI/NIE/Passaport	45883158K
Nom i cognoms	Andrés Tarrasó Martínez
Títol de la tesi	Virtually Synchronous Power Plant Control
Unitat estructural	Departament d'Enginyeria Elèctrica
Programa	Sistemas de Energía Eléctrica
Codis UNESCO	332202 · 332203 · 332204 · 332205

(Mínim 1 i màxim 4, podeu veure els codis a http://doctorat.upc.edu/gestio-academica/impresos/tesi-matricula-i-diposit/codis-unesco)

Resum de la tesi de 4000 caràcters màxim (si supera els 4000 es tallarà automàticament)

During the last century, the electrical energy infrastructures have been governed by synchronous generators, producing electrical energy to the vast majority of the population worldwide. However, power systems are no longer what they used to be. During the last two decades of this new millennium the classical, centralized and hierarchical networks have experienced an intense integration of renewable energy sources, mainly wind and solar, thanks also to the evolution and development of power conversion and power electronics industry. Although the current electrical system was designed to have a core of generation power plants, responsible of producing the necessary energy to supply end users and a clear power flow, divided mainly into transmission and distribution networks, as well as scalable consumers connected at different levels, this scenario has dramatically changed with the addition of renewable generation units. The massive installation of wind and solar farms, connected at medium voltage networks, as well as the proliferation of small distributed generators interfaced by power converters in low voltage systems is changing the paradigm of energy generation, distribution and consumption.
Despite the feasibility of this integration in the existing electrical network, the addition of these distributed generators made grid operators face new challenges, especially considering the stochastic profile of such energy producers. Furthermore, the replacement of traditional generation units for renewable energy sources has harmed the stability and the reliable response during grid contingencies. In order to cope with the difficult task of operating the electrical network, transmission system operators have increased the requirements and modified the grid codes for the newly integrated devices.
In an effort to enable a more natural behavior of the renewable systems into the electrical grid, advanced control strategies were presented in the literature to emulate the behavior of traditional synchronous generators. These approaches focused mainly on the power converter relying on their local measurement points to resemble the operation of a traditional generating unit. However, the integration of those units into bigger systems, such as power plants, is still not clear as the effect of accumulating hundreds or thousands of units has not been properly addressed. In this regard, the work of this thesis deals with the study of the so-called virtual synchronous machine (VSM) in three control layers. Furthermore, an in-depth analysis of the general structure used for the different virtual synchronous machine approaches is presented, which constitutes the base implementation tree for all existent strategies of virtual synchronous generation. In a first stage, the most inner control loop is studied and analyzed regarding the current control on the power converter. This internal regulator is in charge of the current injection and the tracking of all external power reference. Afterward, the synchronous control is oriented to the device, where the generating unit relies on its local measurements to emulate a synchronous machine in the power converter. In this regard, a sensorless approach to the virtual synchronous machine is introduced, increasing the stability of the power converter and reducing the voltage measurements used. Finally, the model of the synchronous control is extrapolated into a power plant control layer to be able to regulate multiple units in a coordinated manner, thus emulating the behavior of a unique synchronous machine. In this regard, the local measurements are not used for the emulation of the virtual machine, but they are switched to PCC measurements, allowing to set the desired dynamic response at the power plant level.

Lloc	Terrassa, Barcelona	Data	31-01-2022

Signatura

A Tarrasó M