Resum de Tesi Doctoral

UNIVERSITAT POLITÈCNICA DE CATALUNYA
BARCELONATECH
Escola de Doctorat

DNI/NIE/Passaport	Y0317475C
Nom i cognoms	FABIO ANDRADE RENGIFO
Títol de la tesi	STUDY OF STABILITY AND NON-LINEAR CONTROL APPLIED TO MICROGRID
Unitat estructural	DEPARTAMENTO DE INGENIERÍA ELECTRÓNICA
Programa	DOCTORADO EN INGENIERÍA ELECTRÓNICA
Codis UNESCO	330600 | 332201 | |

(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)

The "inertialess" and intermittent production of renewable generators has increased significantly in recent years. Based on electronic converter interfaces, intermittent generators such as photovoltaic devices or windmills are connected, stored and managed by a smart control system for supplying energy to local consumers. Such a system is known as a Microgrid.

The modern power generators connected in Microgrid are highly efficient, reliable, modular, environmentally friendly, noiseless, and controlled with high precision. Because of this, they will be a significant competitor in future power markets.

In the state of the art for the study of the Microgrid stability several models for power generators are suggested. They show a clear predominance of inverters in parallel connection controlled by voltage and current loops, using the droop curves of the relationships between active power vs. frequency and reactive power vs. voltage.

These models have been generally linearized at an operating point and they could operate under small perturbations. Authors have studied and identified the roots of the system in the complex plane. Furthermore, how the roots are moving depending on small variations of system parameters, parameters such as slopes of the droop curves, line impedances, etc. have ben also studied.

However, these models are only valid while the system does not undergo large variations around this operating point.

Therefore, these models do not reflect a reality in Microgrids when they suffer major changes, for example the connection or disconnection of the public grid in unexpected ways, or intermittent generation sources. As they are based on renewable energy, they can pass to deliver maximum power to not deliver power at very short times due to an unexpected change in the environment.

This thesis applies the current theory of nonlinear systems analysis, such as Lyapunov methods, procedures Popov and phase planes, to determine the stability of the Microgrid against sudden changes in input energies and to propose a control loop to improve its stability.

For supporting the new models, the concept of electrostatic machine is developed. This allows generators based on power electronic converters be modeled as rotating electrostatic machines with variable input voltage (i.e., energy). Also, this useful mathematical model enables the analysis of renewable power sources for any operational point and energy delivered, even with discontinuous energy supply (non-constant DC Bus).

Besides, this thesis presents analytical tools by means of the Lyapunov functions that could be used for the large signal stability analysis in Microgrid. In addition, this methodology allows finding the boundaries of the stability region.

The proposed model and methodology for stability studies allows analyzing different kind of Microgrid with n-generators connected in different ways in presence of large variations of the energy supplied by the power source.

Finally, simulations and experimental result have been presented in order to validate the proposed methodology, stability analysis and control approaches.

Lloc Terrassa Data 18/09/2013

Signatura