PERUN *assists* EPFL-DESL *in the experimental verification of a novel Smart grid control concept*

"LARA-200 Smart Grid Line proved to be a cost-effective and flexible solution that assisted us in testing advanced controls for modern and future active distribution networks."

Prof. Mario Paolone, Head of EPFL-DESL

Introduction

The conventional approach for the control of distribution networks in the presence of active generation, controllable loads and energy storage systems faces numerous challenges. *EPFL-DESL* addressed this problem by a method (called *COMMELEC*) that directly control the targeted grid by defining explicit and real-time set-points for active and reactive power absorptions or injections. This requires solving an optimization problem that quickly becomes intractable when systems are large or diverse. *Commelec* addresses this problem by: (i) a common abstract model and protocol. Resources advertise their state to a grid agent, using a device independent description. A grid agent controls its resource using a single algorithm, common to all grid agents. The goal of this algorithm is to maintain the system in safe state of operation while trying to satisfy the resources' willingness to produce or absorb power. (ii) An aggregation method, i.e. subsystems can be aggregated into virtual devices that hide their internal complexity. Thus the proposed method can easily cope with systems of any size or complexity.

To support demonstration and validation of this framework with respect to photovoltaic power converters, *PERUN Technologies* provided the *DESL* with the solution ***LARA-200 Smart Grid Line*** which enables the user to design a supervisory and low-level control by providing open access and high level of configurability of PV power electronic interfaces.

The Challenge

EPFL-DESL has recently proposed a composable method for the real-time control of active distribution networks with explicit power set-points. This approach quantifies and exploits the available flexibilities of resources connected to power distribution systems in real-time to:

1. track a (P,Q) power reference (for active and reactive power respectively)
2. implement the power set-point in less than 100ms.

In PV converters, these two requirements are subject to the variable power-availability associated to the fluctuations of irradiance/temperature conditions to which PV panels are exposed. This poses non-trivial challenges to the power-converters control design. Even more, no standard market available PV power-converter could cope with the challenge of setting arbitrary references for P and Q at the level of 100 ms since they usually operate in MPPT mode without possibility to adjust active or reactive power arbitrarily. However, this ability to adjust arbitrarily P and Q at small time pace is a crucial pre-requisite for the implementation of the COMMELEC control framework .

The Solution.

"The fact that we can easily exploit the flexibility of a PV plant, made possible by LARA-200, is one of key elements for the verification of our results and ideas."

Dr. Lorenzo Reyes Chamorro, EPFL-DESL

The specified requirements demanded a great deal of configurability and open access for efficient, comprehensive and safe research in the laboratory. *PERUN Technologies* provided a flexible solution based on the configurable and open platform *LARA-100*. Two *LARA-100*s have been configured into the customized solution named *LARA-200 Smart Grid Line* dedicated for an advanced and open power management in the domain of grid-connected converter applications such as PVs.

PERUN TECHNOLOGIES

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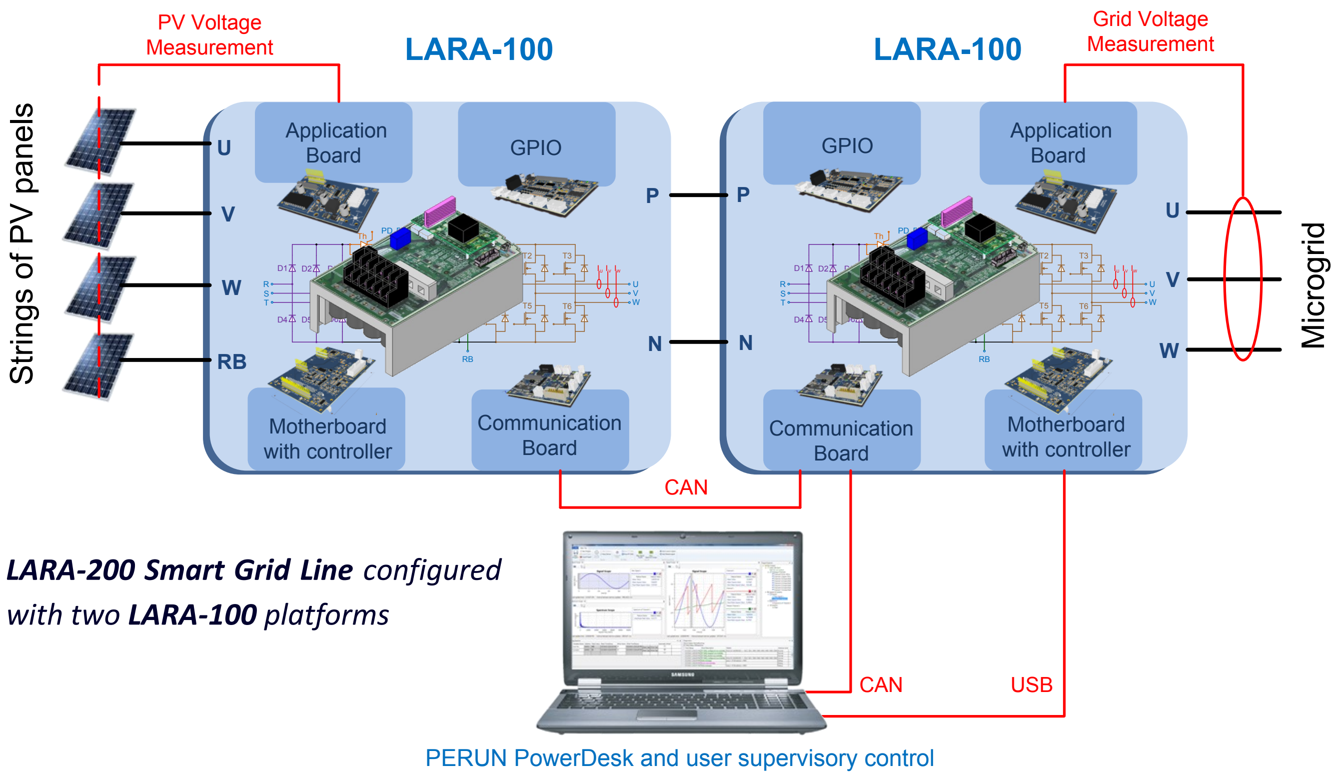

***LARA-200 Smart Grid Line** configured with two **LARA-100** platforms*

The user can design supervisory (higher-level) control using *PERUN*'s software called *PERUN PowerDesk*. Low-level control (currents, voltages, PLL) is implemented on Texas Instruments DSP docked in *LARA-100*. The user can also modify this DSP low-level control code. *LARA-200 Smart Grid Line* therefore enables flexible management of renewable sources to implement a novel approach in distribution grids operation.

"The sharing of different technical competences between people from PERUN *and us ensures that we have what we need to support our research."*

Enrica Scolari, PhD Student, EPFL-DESL

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