



UNIVERSITY OF ZAGREB
Faculty of Electrical Engineering and Computing
Unska 3, Zagreb, CROATIA



Research on Cooperative Renewable Energy Systems on UNIZG-FER

Asst. Prof. Mario Vašak

Workshop for Preparation of Croatian Technology Platform for Cooperative
Renewable Energy Systems and Smart Grids

Zagreb, July 2, 2013



Centre of Research Excellence
for Advanced Cooperative Systems



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- Department of Control and Computer Engineering:
 - Laboratory for Renewable Energy Systems (LARES)
 - Optimal Control Group (OCG)
- Department of Power Systems
 - Computer Aided Design of Distribution Networks group (CADDIN)
 - Electric Power System Dynamics, Automatization and Control group (EPSDAC)
- Department of Electroacoustics
 - Environmental Noise Control (ENC)

- Inter-sectoral R&D in the area of smart grids
 - LARES
 - models, constraints and objectives (mc&o) in operation of renewable energy sources and microgrids
 - EPSDAC&CADDIN
 - mc&o in microgrids integration in the smart grid
 - ENC
 - mc&o in renewable energy sources operation within the environment
 - OCG
 - microgrids and smart grids multi-objective control under constraints



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Laboratory for Renewable Energy Systems (LARES) Optimal Control Group (OCG)

Presentation of activities



LARES

Laboratory
for Renewable
Energy Systems

wind sun hydrogen



Advanced Control Team

- Goal:
 - Perform experiments-supported research of renewable energy systems
- Objectives:
 - To improve energy conversion efficiency and lifetime of renewable energy sources through advanced control methods
 - To establish control design procedures for microgrids and smart grids

<http://www.lares.fer.hr>

<http://act.rasip.fer.hr>



LARES Laboratory
for Renewable
Energy Systems
wind sun hydrogen



Advanced Control Team

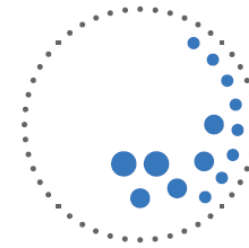
- Laboratory-scale wind turbine designed to emulate a megawatt-scale wind turbine
- Wind chamber with a blower



LARES
wind



- Electrolyser
- Metal-hydrid tanks
- Fuel cells stack



LARES
hydrogen



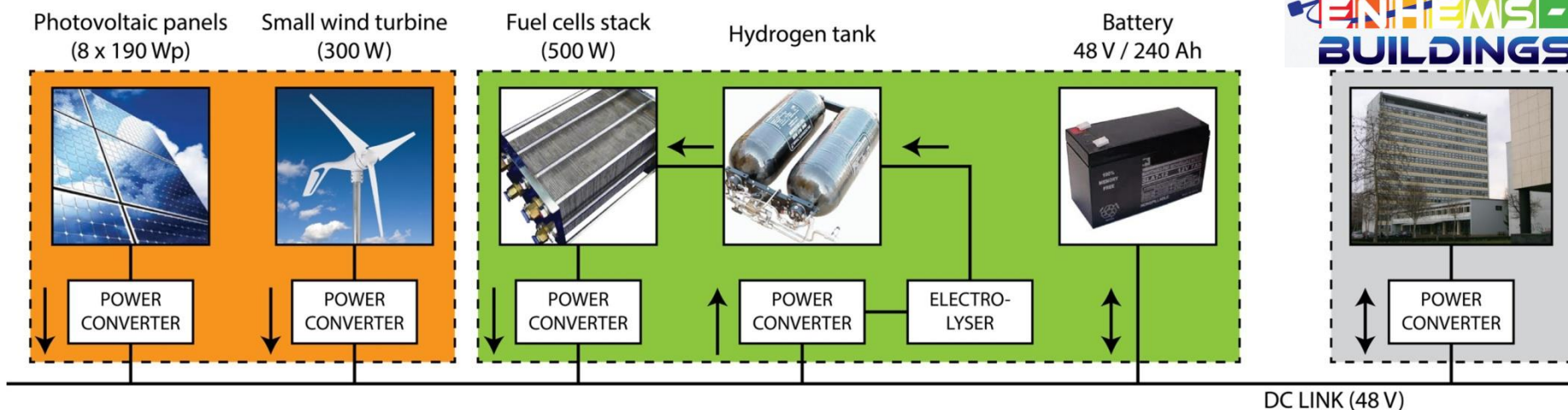
- Photovoltaic equipment
 - 3 x 3,5 kWp on two-axis trackers
 - 3 x 3,5 kWp fixed
 - Each 3 kWp group with its own power converter
 - High-precision measurement of solar irradiance



LARES
sun



- PV panels, batteries, fuel cells stack and electrolyser, grid connection, wind turbine, controllable load
 - Interoperation with a smart buildings concept



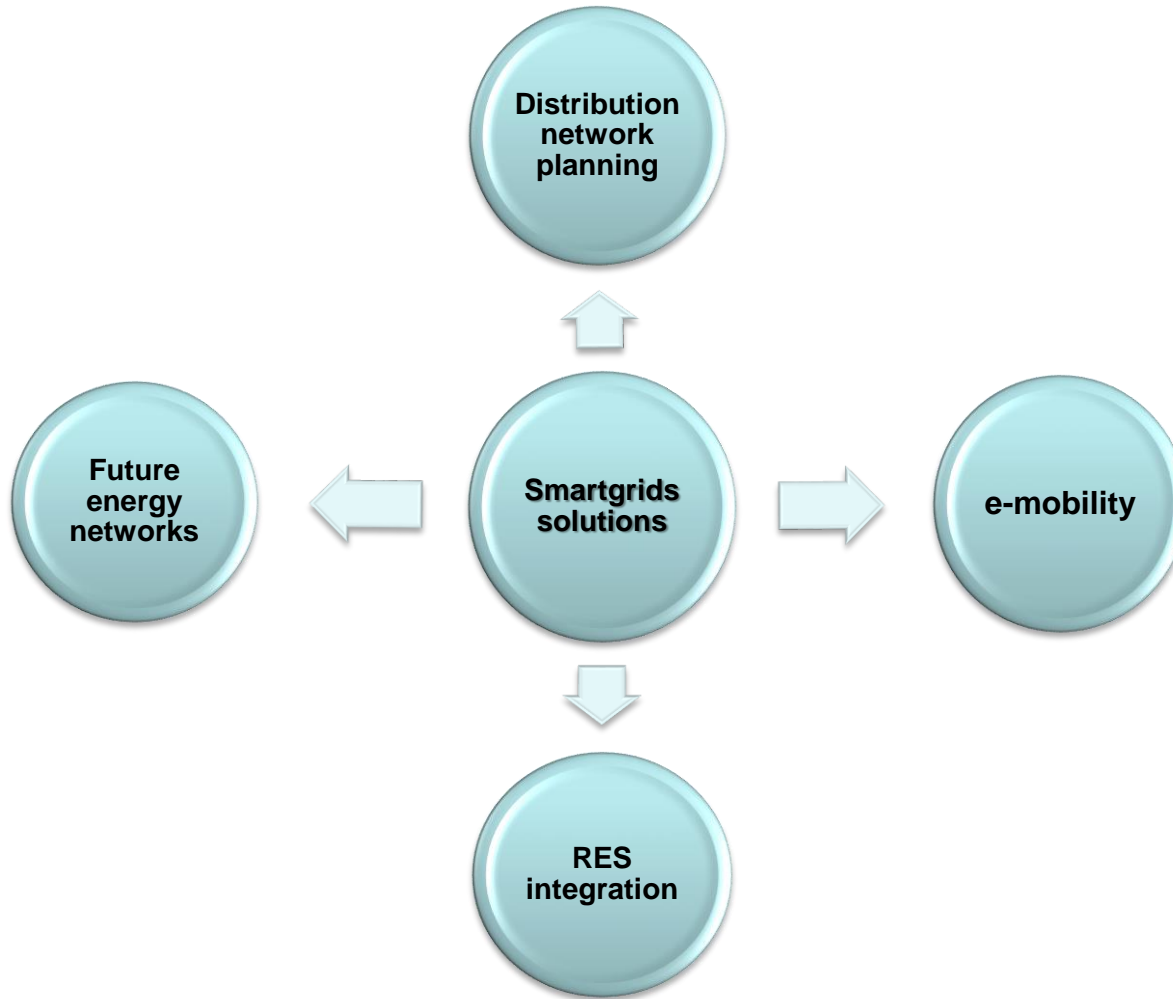


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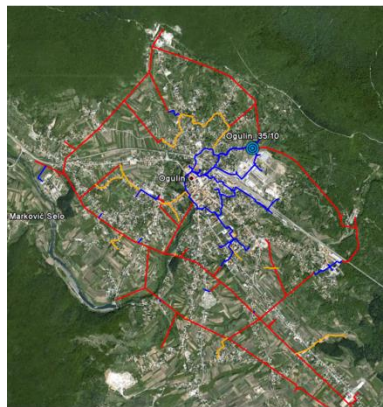


Computer Aided Design of Distribution Networks group (CADDIN)

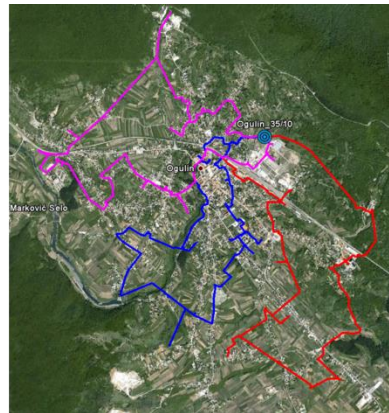
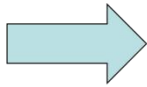
Electric Power System Dynamics, Automatization and Control group (EPSDAC)



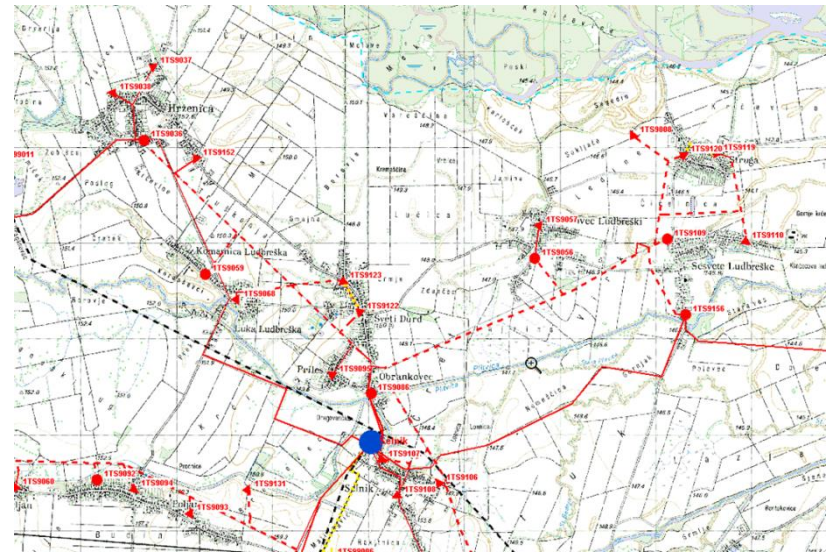
- Grid layout and operational cost minimization
 - Evolutionary algorithm
- Integration with geoinformation systems



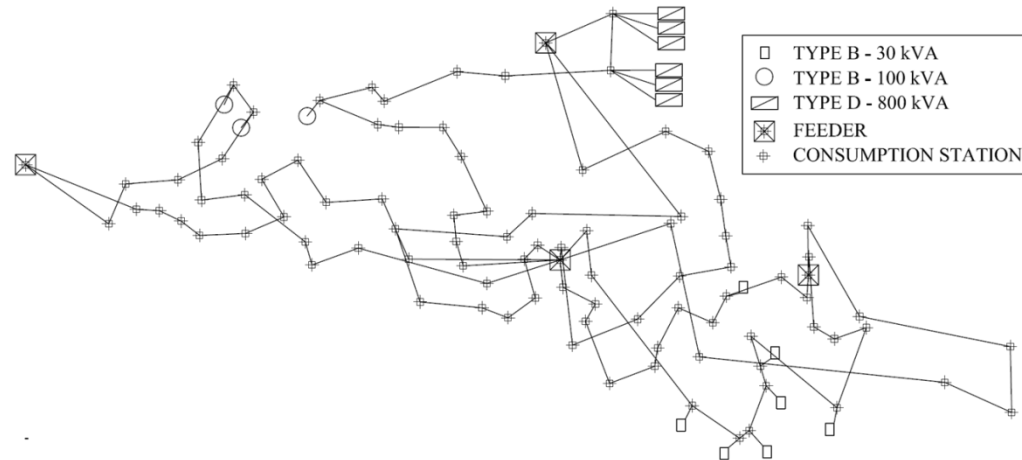
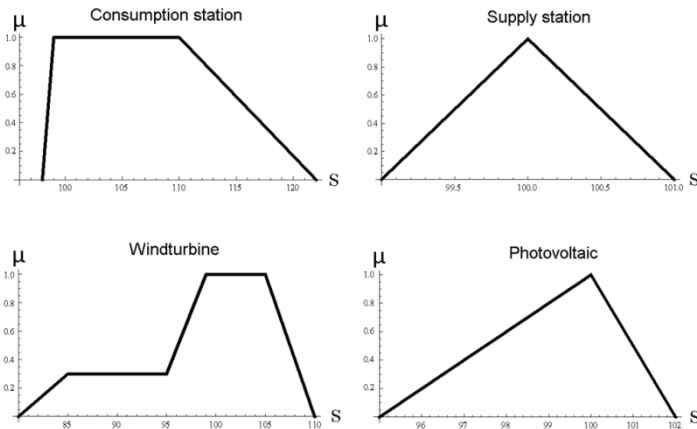
before



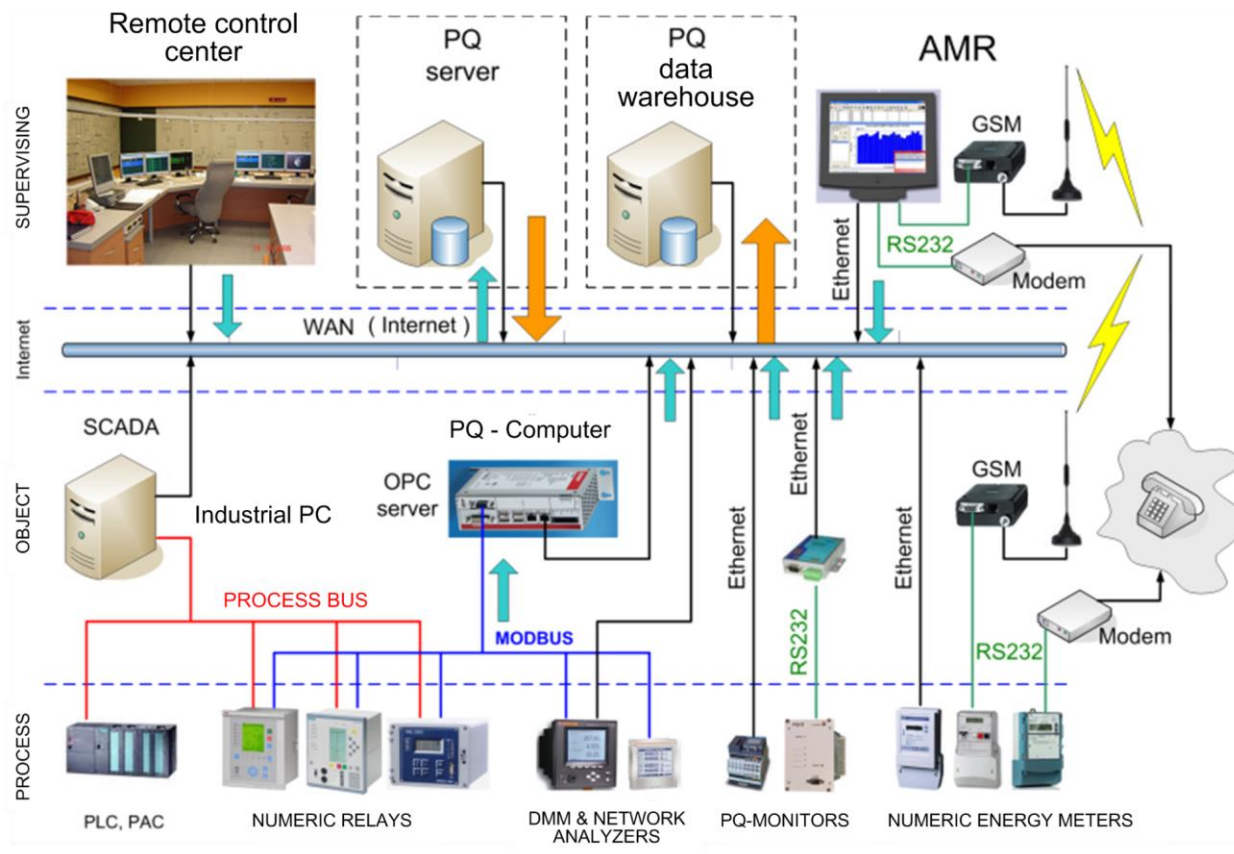
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- Significant impact on planning and operation of distribution network



- Continuous Power Quality monitoring
- Source of information for network analysis and on-line control



- Electrical vehicles and infrastructure network
- GIS map of charging stations



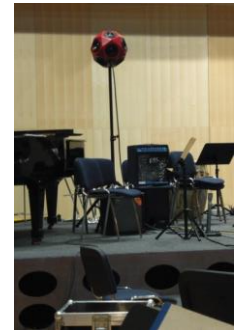
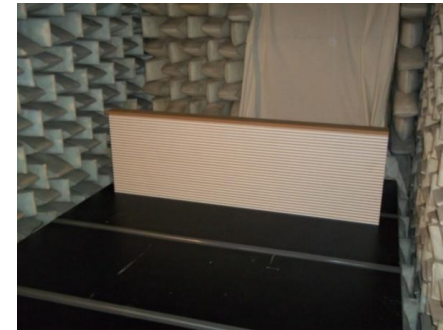
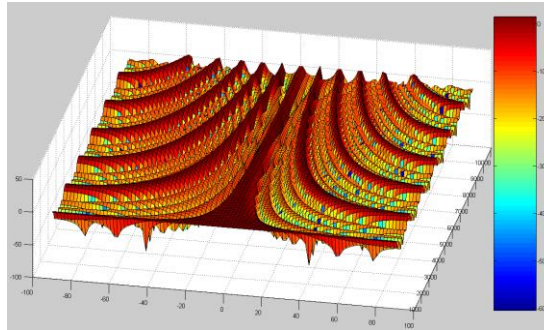
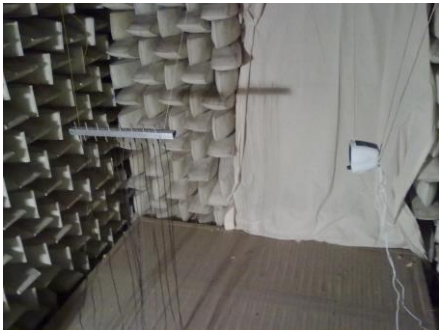


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Environmental Noise Control group (ENC)

- ENC research focus:
 - noise source identification
 - acoustical measurements of noise parameters
 - prediction of noise levels and spectra
 - design of noise abatement devices
 - quality of noise; soundscape approach to noise perception



- Complementary expertises of the ACROSS groups in SRD3
 - Renewable energy sources operation
 - Electricity grid analysis and design
 - Noise propagation analysis and control
- Binding expertises through control and optimization techniques of ACROSS SRD4
- Open for both national and regional cooperation



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www.smartgrids.hr