NEURAL NETWORKS FOR MICROGRID OPTIMIZATION

AND

NON-CONVENTIONAL ENERGY SOURCES
AUTOMATIC CONTROL

EDGAR N. SANCHEZ
CINVESTAV, UNIDAD GUADALAJARA, MEXICO
OUTLINE

• Neural Networks for Prediction

• Neural Networks for Optimization

• DFIG Neural Control

• Wastewater Treatment Neuro Fuzzy Control

• Solid Waste Disposal Neuro-Fuzzy Control
Power Production Forecasting for Photovoltaic Generation Systems via Neural Networks with Particle Swarm Optimization Kalman Learning
The Yucatan region is considered in third place in terms of wind and solar potential in Mexico. The wind power is estimated around 1000 MW and the solar irradiance is around 6 kW-hr/m² daily.
Recurrent Neural Network

The input vector to the neural network can include, in addition to external inputs to the network, past outputs taken from it, composing the regressor vector.
PV Power Generation Recurrent NN trained with EKF+PSO

The mean square error (MSE) reached in training is $5 \times 10^{-4}$ in 200 iterations.
Neural Network for Optimization
CONNECTION

• **DC voltage bus** which connects a battery bank, a photovoltaic cells bank and a output load test bench.

• **Wind power generator** is connected directly to the utility grid.
Sliding Mode Control with Real-Time Neural Networks for a Doubly Fed Induction Generator
Real–Time Results
• Discrete-time sliding modes for RSC are used to track a reference trajectory for the electric torque and to keep the electric power factor constant.

• For the GSC, discrete-time sliding modes are used to keep the dc voltage constant and to keep the electric power factor constant in the step-up transformer.

• For the real-time implementation, the electric torque and the reactive power tracking is achieved for a time-varying electric torque reference.
Hybrid Intelligent Inverse Optimal Control for an Anaerobic Digestion Process
The AD process considered is developed in a scale CSTR from Cinvestav, Unidad Saltillo with biomass filter, which is used to improve the substrate treatment. Commonly, this operation mode allows a continuous treatment of wastewater, which implies a continuous biogas production.
Integrated Hybrid Intelligent Control Scheme

- Input substrate \( S_{2in} \)
- TS supervisor for reference trajectories
- TS supervisor gain scheduling
- TS supervisor controller
- Reference trajectories
- Inverse optimal control
- Open loop
- Process
- RHONO

- \( D_{in} \) action
- \( b_{inc} \) action

- Estimated Biomass \( \hat{X}_2 \)
NEURAL CONTROL FOR A SOLID WASTE INCINERATION PROCESS
Incineration is a process that involves the complete combustion of organic substances contained in waste materials. Incineration of waste materials converts the waste into ash, flue gas, and heat.
CONTROL STRUCTURE