Ricardo Cardona Rivera

Tutor: Mario di Bernardo

XXXIV Cycle - Ist year presentation

Analysis and Control of Electrical Power Networks

Università degli Studi di Napoli Federico II

Background

Undergraduate Degree: 5-year Electronic Engineering degree

M. Sc. Degree: Automation Engineering (September 2017) at Universidad Nacional de Colombia, Manizales

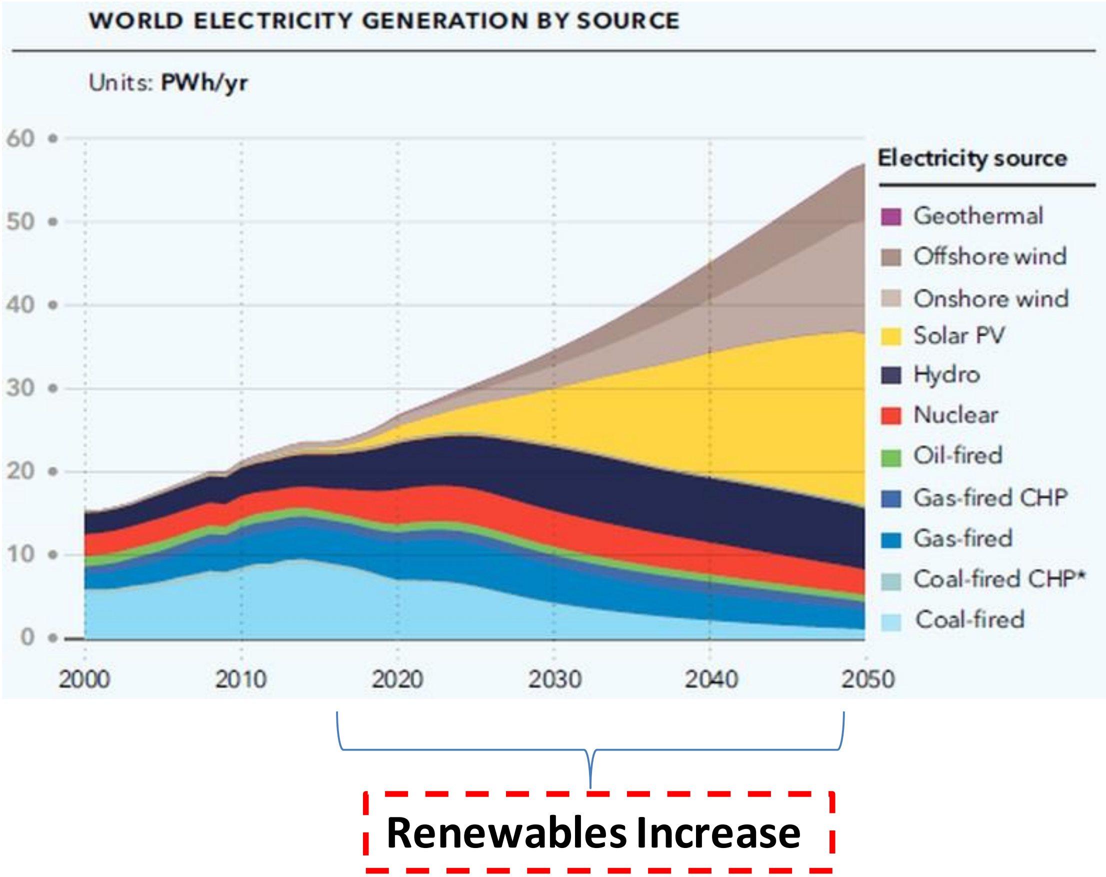
Research Group: Sincronizzazione Controllo di Reti, Processi e Sistemi nonlineari (SINCRO)

Scholarship: Borsa di Ateneo riservata a studenti stranieri

Motivation and Aims

- Why the power network:
  - Key components of critical infrastructures.
  - New control challenges due to the introduction of renewables.
  - Distributed generation requires new control strategies. Transition from centralized to the decentralized and distributed paradigm.

Taken from DNV GL's Energy Transition Outlook 2018



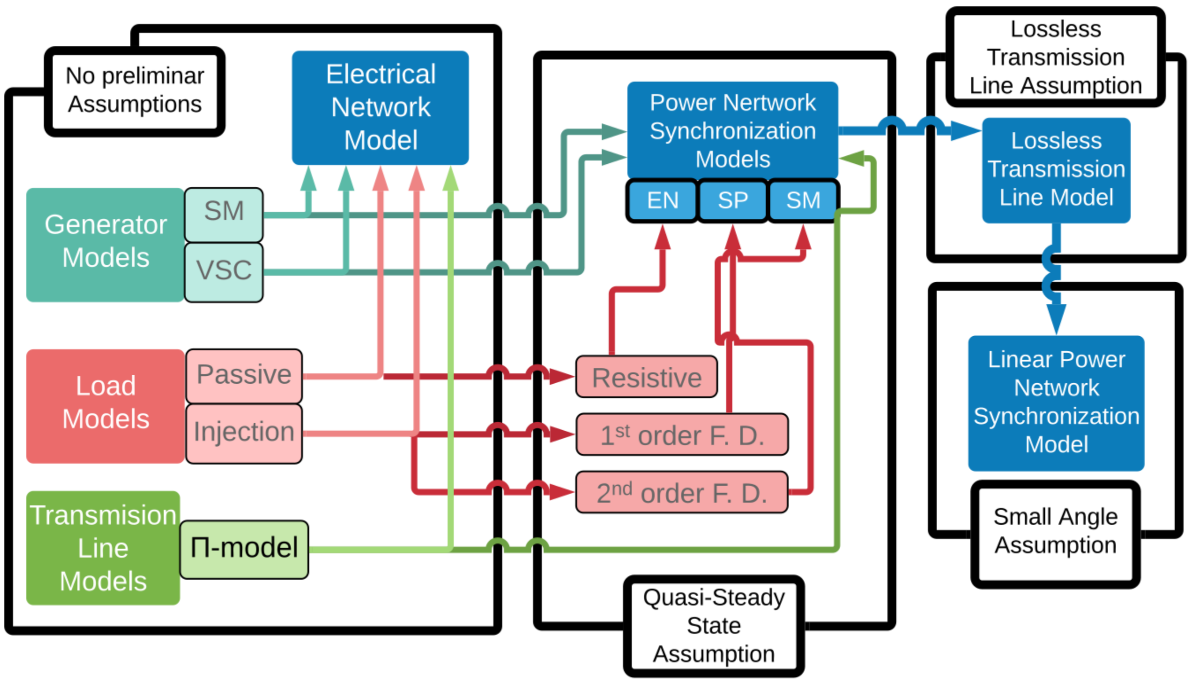
Motivation and Aims

- Limitations of current control and management strategies:
  - Robustness decreases because of renewable energy sources (Low inertia phenomenon)
  - Frequency restoration controllers are designed under strong transmission line assumptions.
  - Network topology is not used for control purposes.

- Key Research Questions:
  - How to design decentralized control strategies for power networks, that overcome previous limitations?
  - Which power network models can be used for decentralized control strategies design?

Research activity so far

- I carried out an extensive literature review on modelling and control of power networks



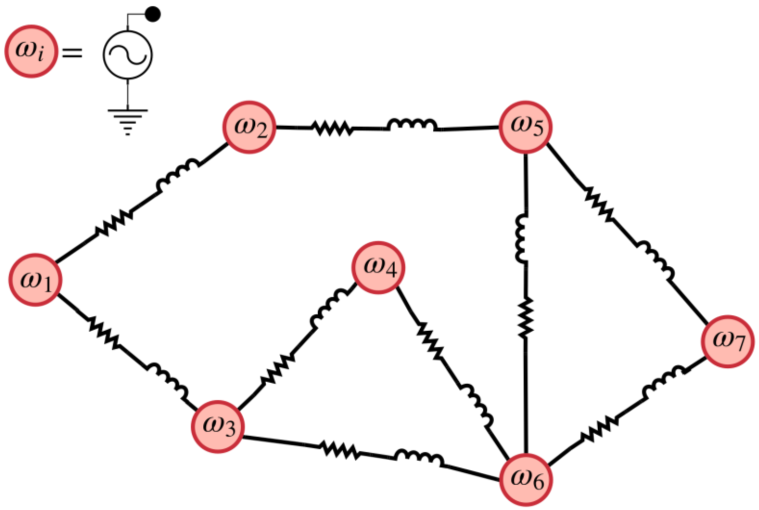
- Power network models can be classified depending on the use of three main assumptions

Power Network Models

- The Power Network model synchronization model is then defined as:

$$\frac{2H_i}{\omega_{ref}}\ddot{\delta}_i + \frac{D_i}{\omega_{ref}}\dot{\delta}_i = P_i^* - \sum_{j=1}^{n} \left|\hat{V}_i \hat{V}_j Y_{0ij}\right| \sin\left(\delta_i - \delta_j - \gamma_{0ij}\right) + u_i$$

- Where $\dot{\delta}_i = \omega_i - \omega_{ref}$ is the frequency deviation from the nominal value



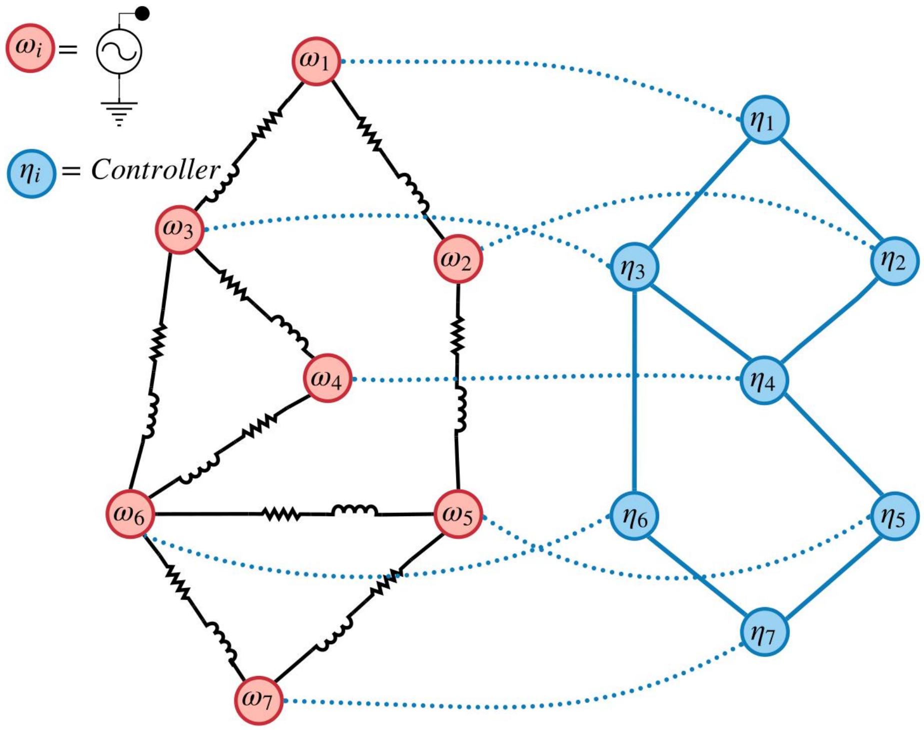
Products

Publications (in preparation):

- *We are currently writing a review paper on modelling and control of the power grid.*

Next research steps

- Possible Solutions:
  - Design and validate Multiplex network control methods (PI Multiplex control) for power grids.
  - Exploit Network topology for optimal power dispatch.
  - Validate numerically and experimentally (in collaboration with Pisa University) the control strategies and design



Next years

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	Credits year 1								Credits year 2					
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Thank you for your attention.