Communication for Control in Smart Grid
(in a nutshell)

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Objective: Transmission of signal(s) $x(n)$ from source point(s) to destination(s) via a communication channel.

Result: Receiving a distorted version of the signal $\hat{x}(n)$

Main Issue: Resource usage vs. distortion trade-off
- Resources: Power, time, frequency, etc.
- Distortion: $E[d(x(n), \hat{x}(n))]$

Known Fact: “Allowing for long delays makes it possible to transmit at maximum rate...”

$$\min E[d(x(n), \hat{x}(n))]$$
Objective: Stabilize a dynamical system with control actions through a controller device

known Fact: “Distortions, delay, etc in observing $y(t)$ in general degrades the controller performance”
$x(n) = F(x(n-1), u(n-1), w(n-1))$

$y(n) = G(x(n), u(n), v(n))$

$z(n)$

$r(n)$

$\hat{x}(n)$

- Practical Schemes
- Analyzing Trade-offs
- Performance Limits
Distributed generators as plants
Wireless communication channels
Particular signal models
Tight delay requirements
Real-time compression scheme for grid signals

- Sum-of-harmonics source model
- Use of cyclostationary signal characteristics
- Use of adaptive predictors and differential coders
- Controllability achievable with very small bitrates (40 kbps)
- Application in a future communication control standard for smart grid

More work...

- Wireless channel resistance improvement
- Implementation of the communication system on hardware
- Implementation within the smart grid setting in smart grid lab at NTNU/IME
Thank you for your attention!

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