Controller Design for Systems with Clock Offsets

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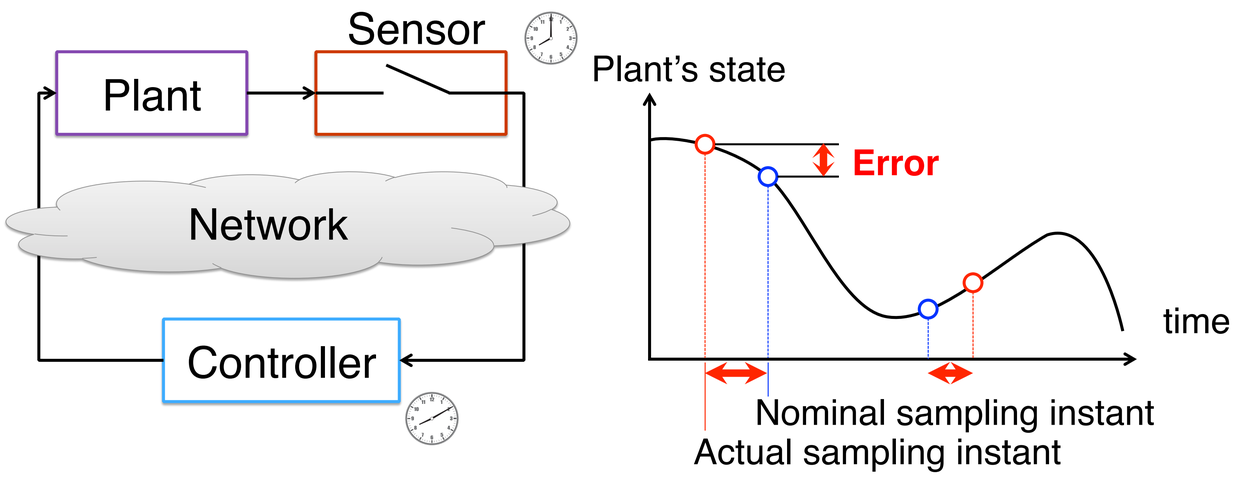
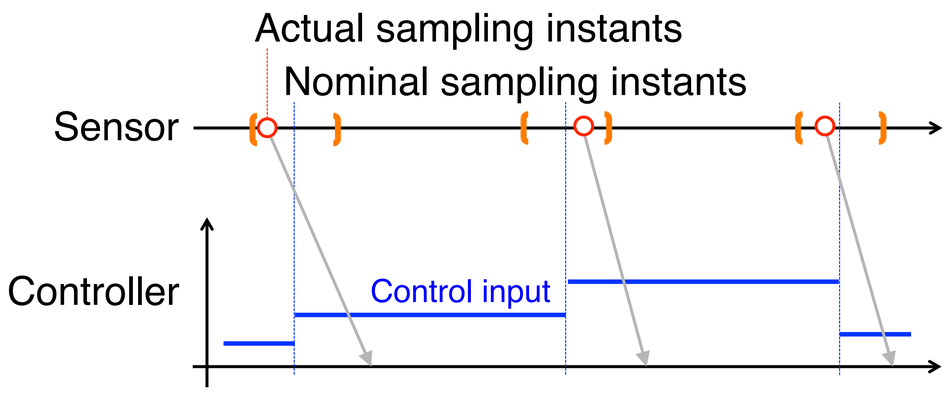
Background



- Sensor and controller act on **local** clocks.
- Because of clock offsets between the local clocks, actual sampling instants are different from nominal ones.
- Timing errors introduce signal distortion.



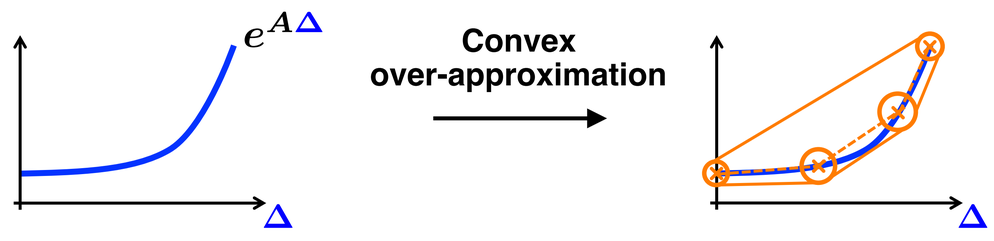
How to design controllers for systems with **clock offsets**?

Approach

Variable clock offset Δ appears in the **nonlinear** form $e^{A\Delta}$.
(A : system matrix)

Convex over-approximation overcomes this nonlinearity:

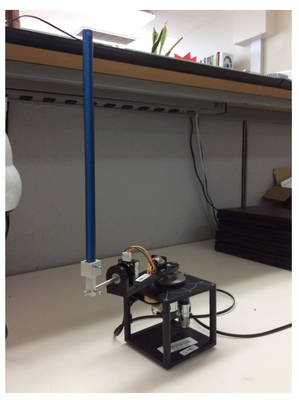
$e^{A\Delta}$ = **(linear approximation term)** + **(uncertainty term)**

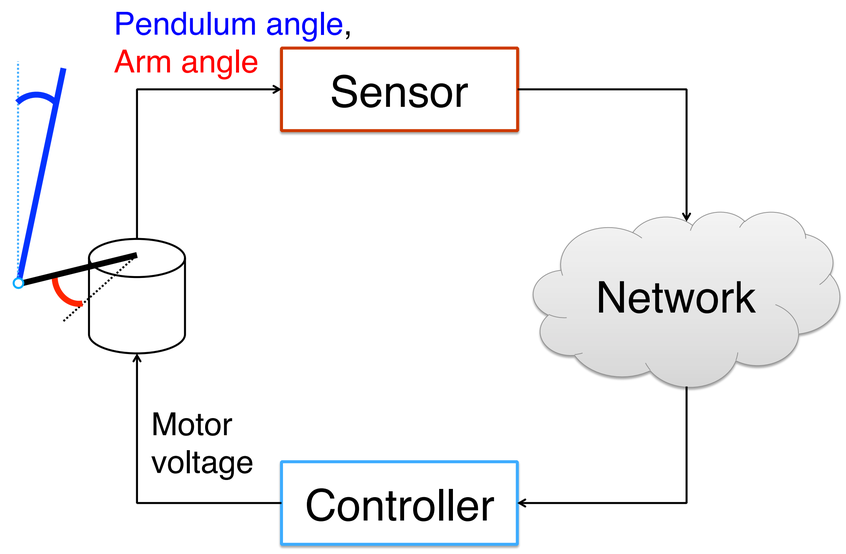


➡ Controller design via bilinear matrix inequalities

Efficiently solved with semi-definite programming solver

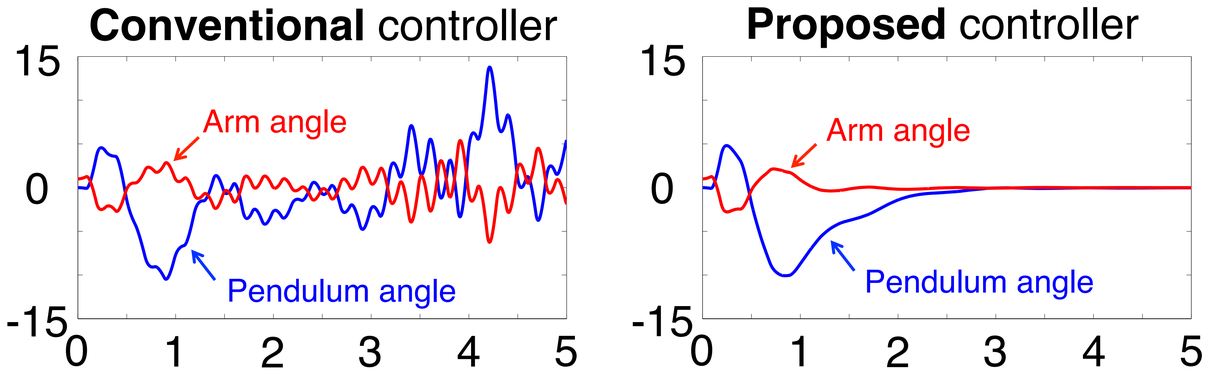
Example: Inverted pendulum





Real world examples
Segway, Rocket, etc.

Simulation results



Proposed controller is robust against clock offsets

Conclusion

- Sensors & controllers are not synchronized in networks
- Proposed method gives offset-tolerant controllers

Related works

- How much do offsets affect control performances?
- How large offsets are allowed for stabilization?