הפקולטה למדעי הטבע
תכנית להנדסת תכנה

אוניברסיטת בן-גוריון בנגב
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Computational resource management of multi channel controller

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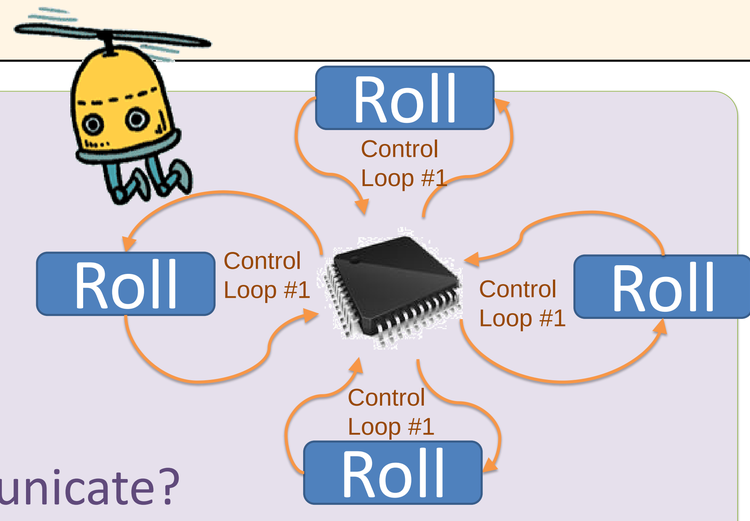
Today's computer power allows for consolidation of controllers where a computer can regulate many control loops, each with its varying needs of computation resources



Problems:

- How to schedule all the control tasks?
- How should the control Eng. (task) and the software Eng. (scheduler) communicate?

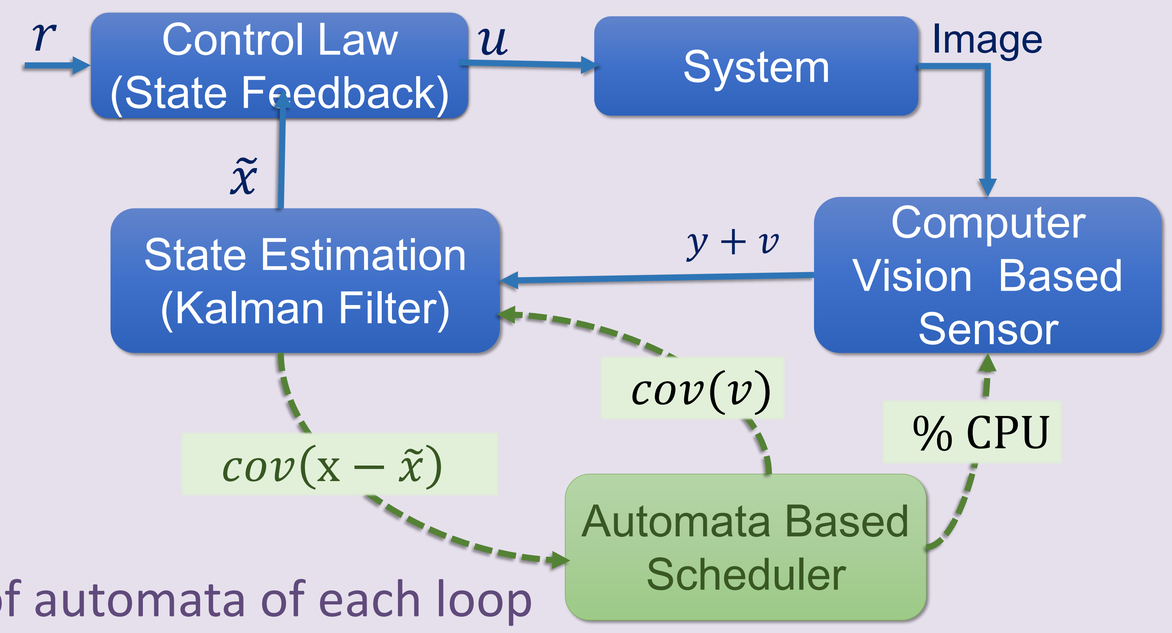
Dynamic scheduling approach (desktop OS)

Real-Time scheduling approach

Goal: Efficiency of dynamic scheduling + predictability of real-time scheduling

Our Proposal:

- Schedule the sensors:
  More CPU → less noisy observation
- State estimation also computes the covariance
- Controllers can deals with measurements with varying noise
- Automata based scheduler:
  for fast decision making and for allowing composition of automata of each loop



Research plan:

- Use UAV (quadcopter) controlled by APM (ArduPilot Mega) based controller
- Develop optic-flow based speedometers and prove that noise is a function of (controllable) CPU usage
- Use Kallman Filter or particle filter to estimate the state and to get the covariance of this estimation as a function of the covariance of the measurement errors
- Enhance APM with a mechanism for (guarded) automata based scheduling
- Develop analysis and composition methods for guarded automata
- Develop algorithms for generation of guarded automata that guarantee, e.g., stability

Related work:

- **Co-design of Anytime Computation and Robust Control**
  - define interface between controller and vision based, anytime, estimator to achieve optimal controller
- Shlomo Zilberstein and Stuart Russell, **Optimal composition of real-time systems (AI)**
  - how to allocate computation time optimally among the components
- Merav Bukra and Gera Weiss, **GameComposer: A Framework for Dynamic Scheduling in Control Systems**
  - define strong interface between the control loops and the scheduler (guarded automata)
  - Game-based algorithms for solving liveness scheduling requirements (of the composed automata)
  - Automatic generation of automata-based specifications from a switched-system (optional improvement to use in our work)