Optimal Sensor and Actuator Selection in Large-Scale Dynamic Networks

Neil K. Dhingra, Mihailo R. Jovanović, and Zhi-Quan Luo

Department of Electrical and Computer Engineering

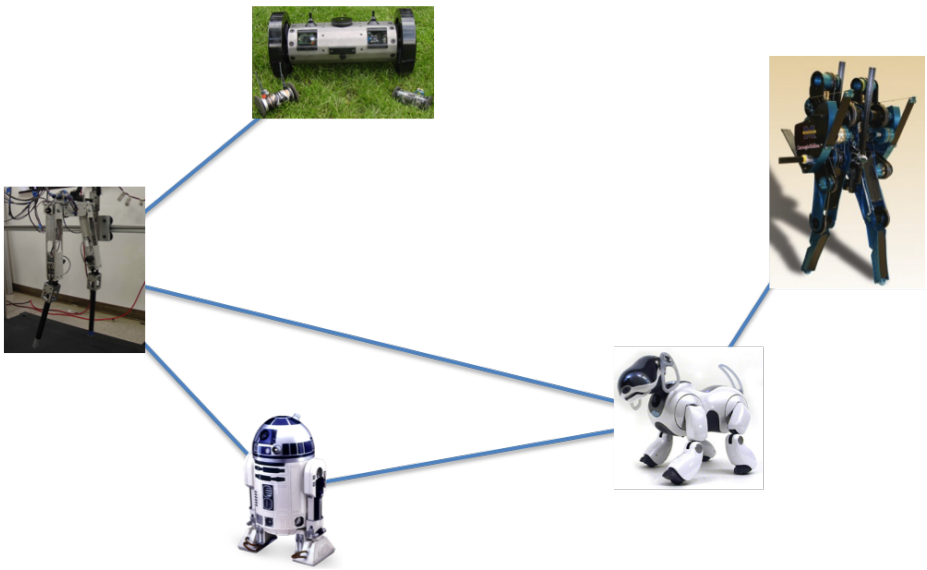
UNIVERSITY OF MINNESOTA

MnDRIVE Kickoff Event; April 17, 2014

Motivation

Challenging in large-scale systems

- Heterogenous robotic networks
- Phasor Measurement Units in power networks



Problem Formulation

Linear dynamical system with **many potential actuators**

$$\dot{x} \;=\; A\,x \;+\; B_1\,d \;+\; B_2\,u$$

Problem Formulation

Linear dynamical system with **many potential actuators**

$$\dot{x} \;=\; A\,x \;+\; B_1\,d \;+\; B_2\,u$$

Objective: identify **row-sparse** state-feedback controller

$$\text{minimize} \qquad J(K) \qquad + \qquad \gamma \sum_i \|e_i^T K\|_2$$

$J(K)$ ↓ **performance index**

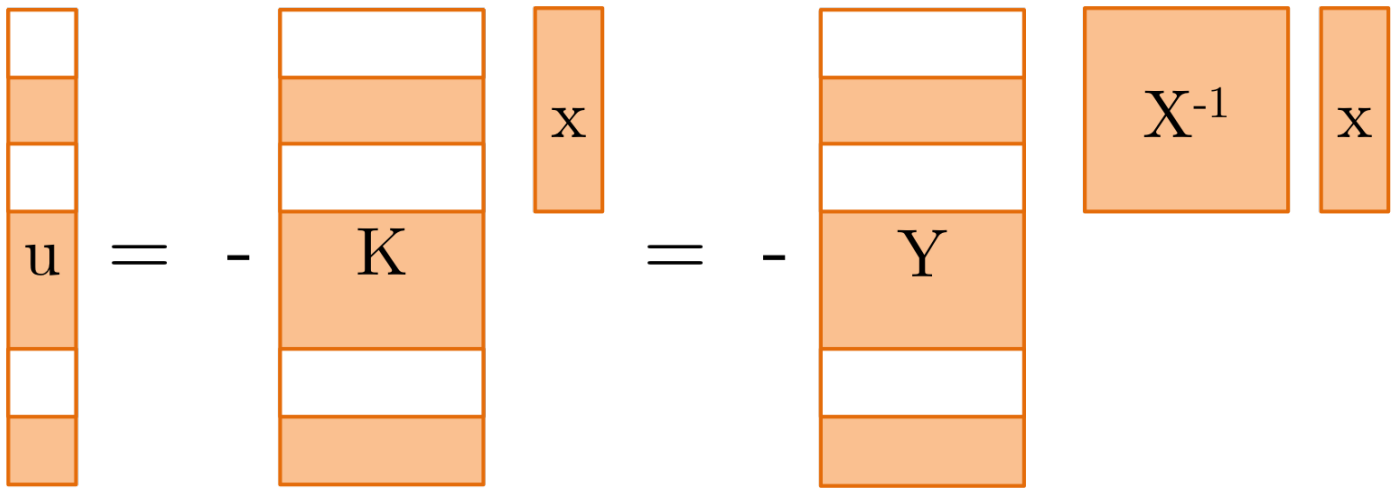
$\gamma \sum_i \|e_i^T K\|_2$ ↓ **row-sparsity-promoting penalty function**

Challenge: $J(K)$ – **non-convex** function of K

Solution

Change of variables $Y := K\,X$

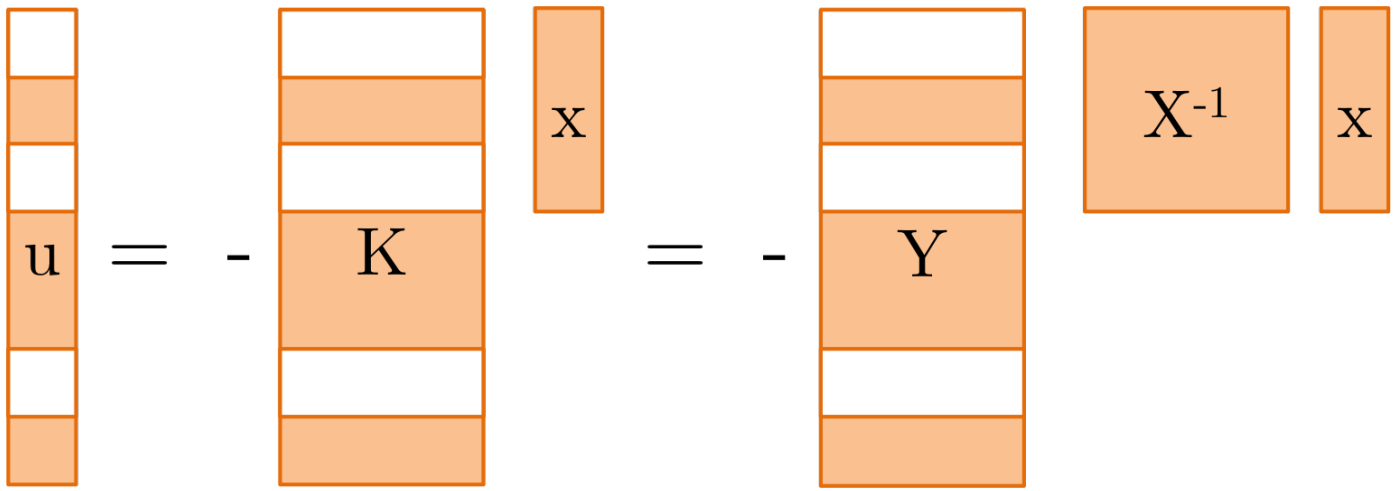
- **Convex dependence** of $J(K)$ on X and Y
- Row-sparse **structure preserved**



Solution

Change of variables $Y := K\,X$

- **Convex dependence** of $J(K)$ on X and Y
- Row-sparse **structure preserved**



Optimization problem

- **Semidefinite program**

Key contribution

- **An efficient algorithm for large-scale networks**