

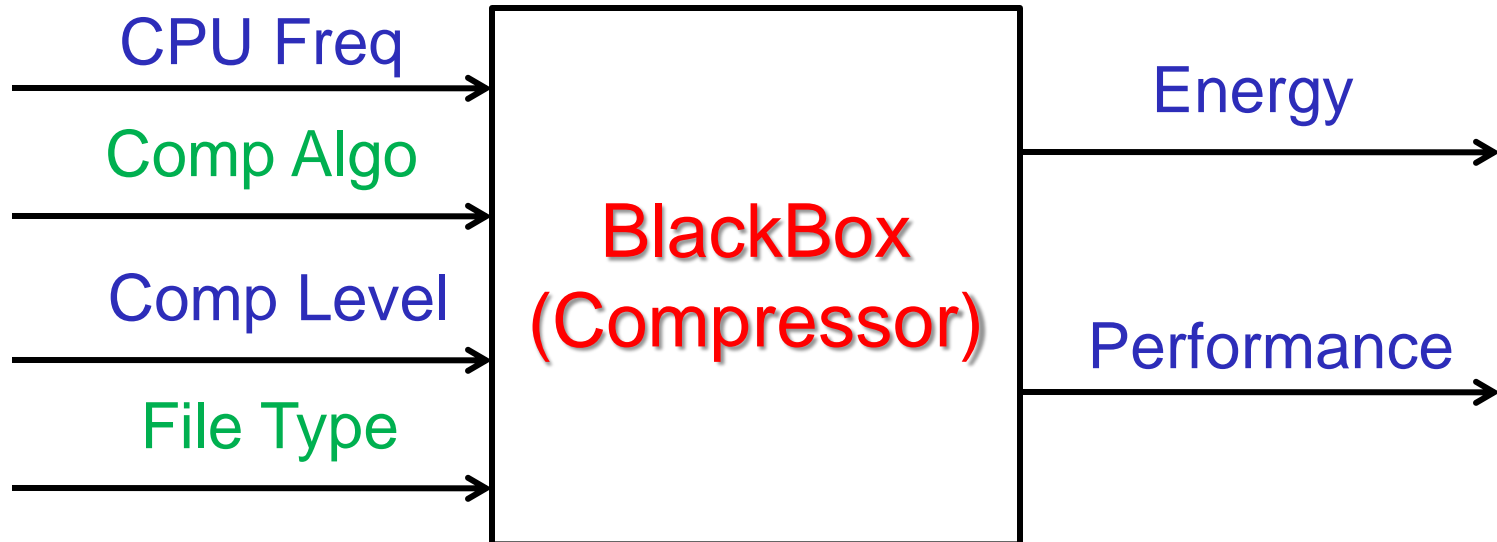
Power and Performance in Compression Systems: A Control Theoretical Approach with Evaluation

Zhichao Li, R. Grosu, S. A. Smolka,
S. D. Stoller, and E. Zadok

<http://www.cs.stonybrook.edu>

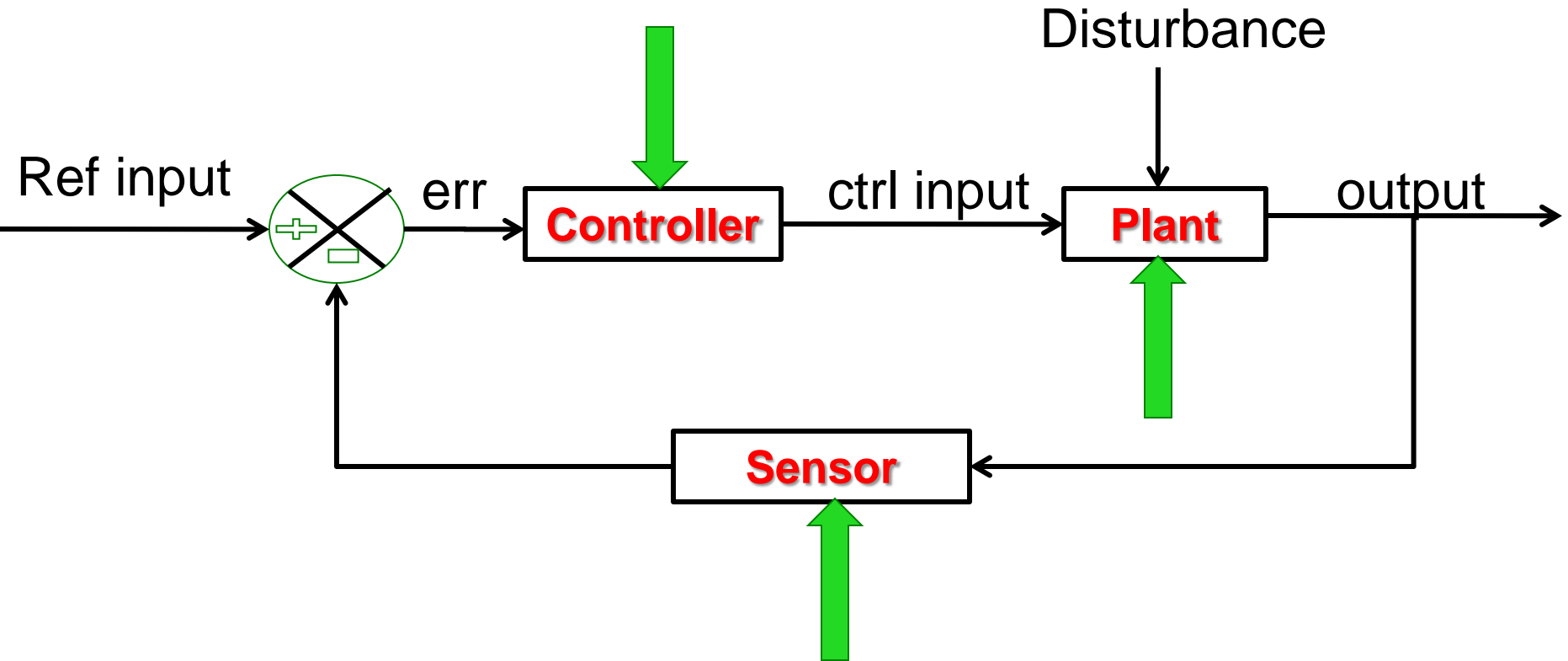
BlackBox

- E.g., centralized backup system
 - ◆ Receiving multiple streams from network



Control Theoretical Approach

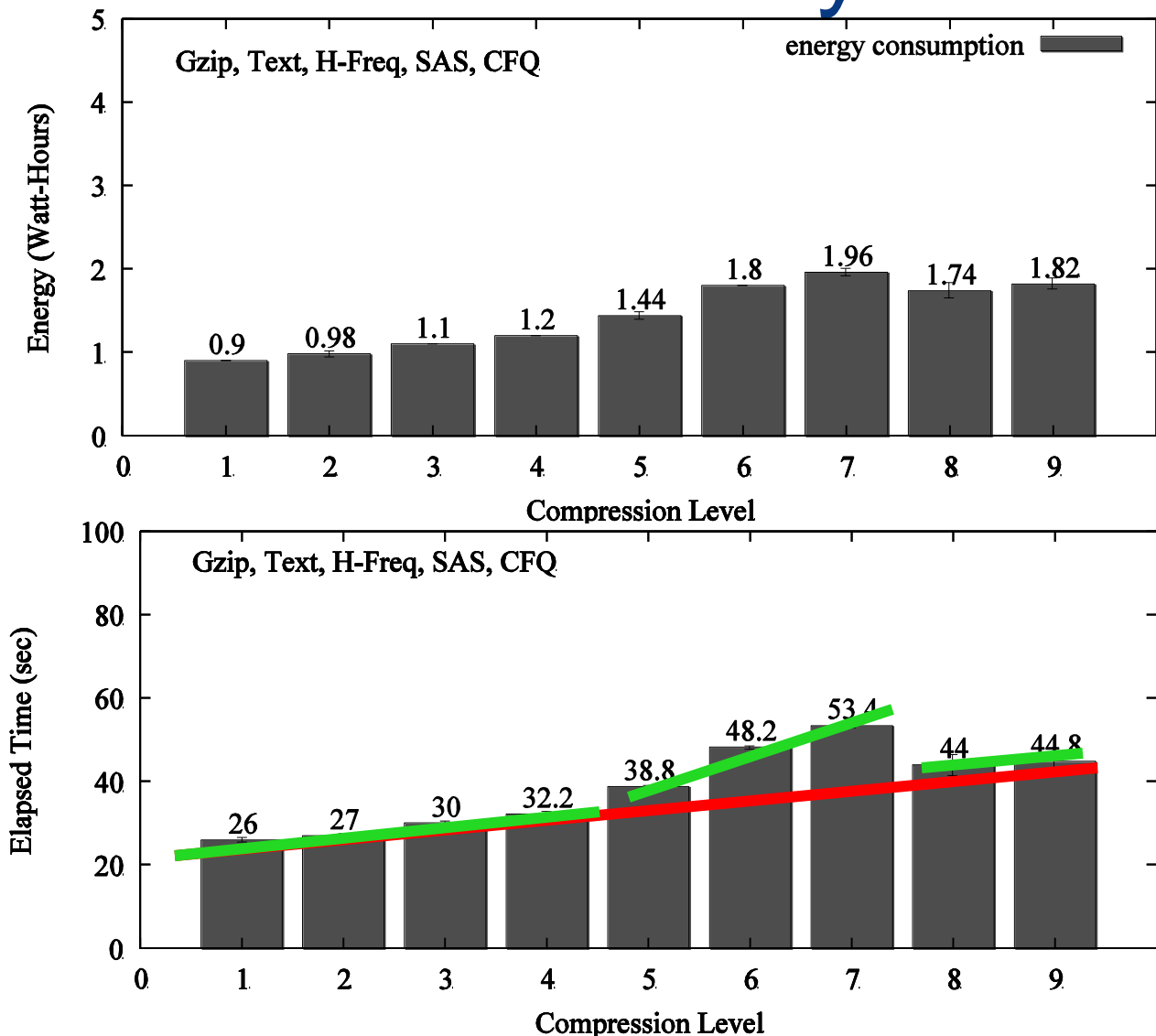
Plant with feedback controller



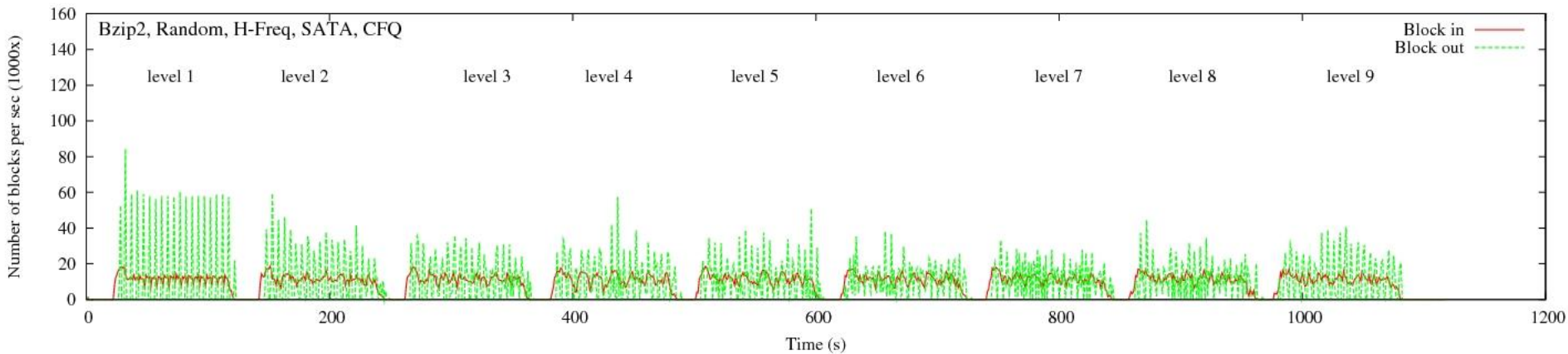
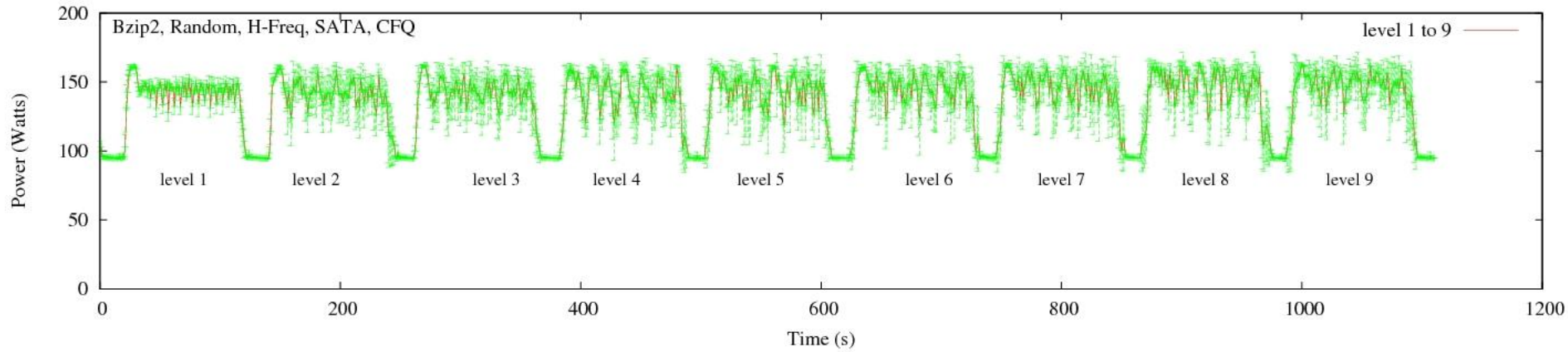
Motivation

- Optimize energy *and* performance
- Compression study [SYSTOR'09]
 - ◆ File type, hardware, compression algs.
 - ◆ 10x better, to 200x worse
- Server workload study [FAST/TOS'10]
 - ◆ Web/DB/Email/file server workloads
 - ◆ F/S mount/format params., hardware
 - ◆ 0.5x to 9x variation in perf./energy

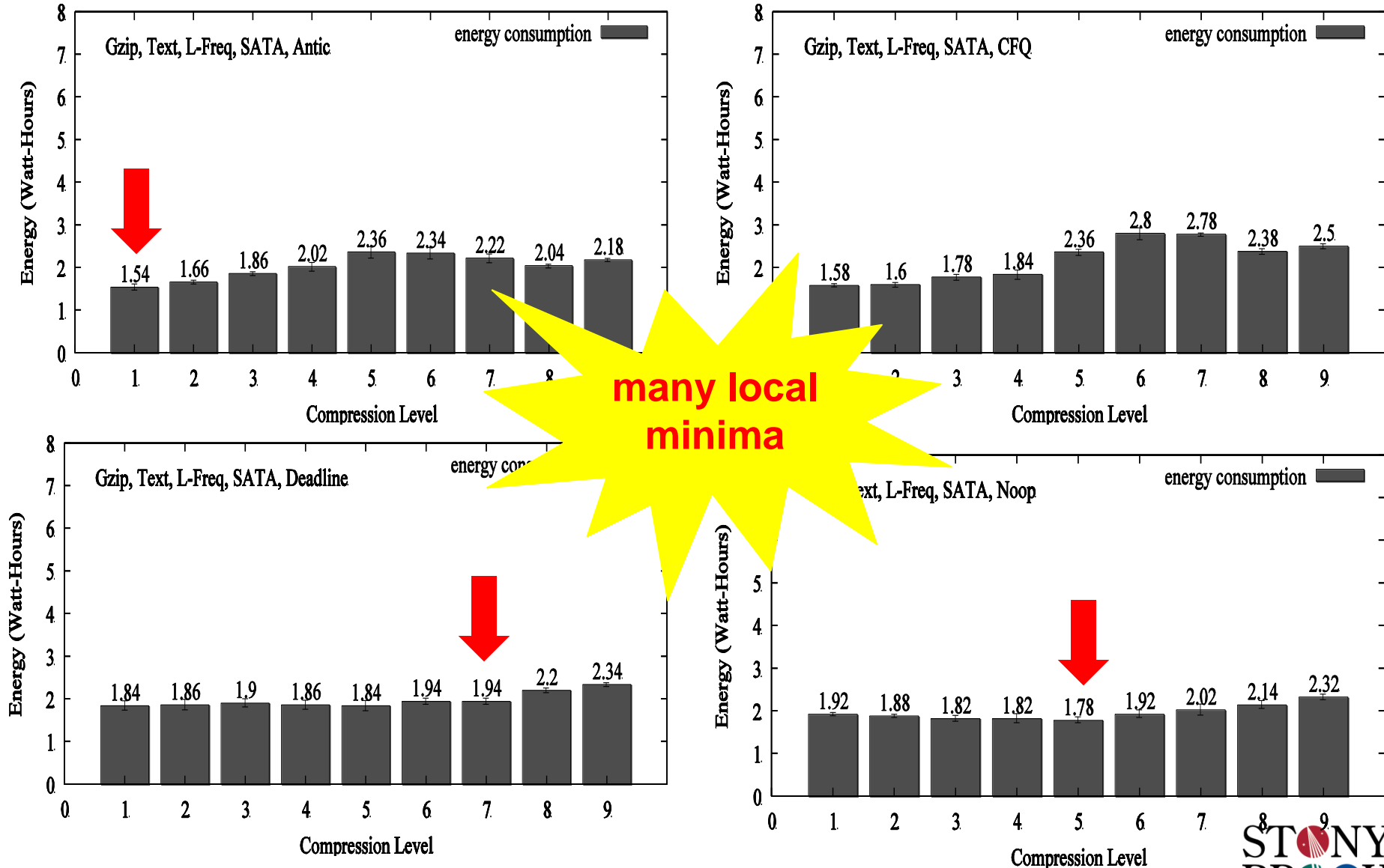
Nonlinearity



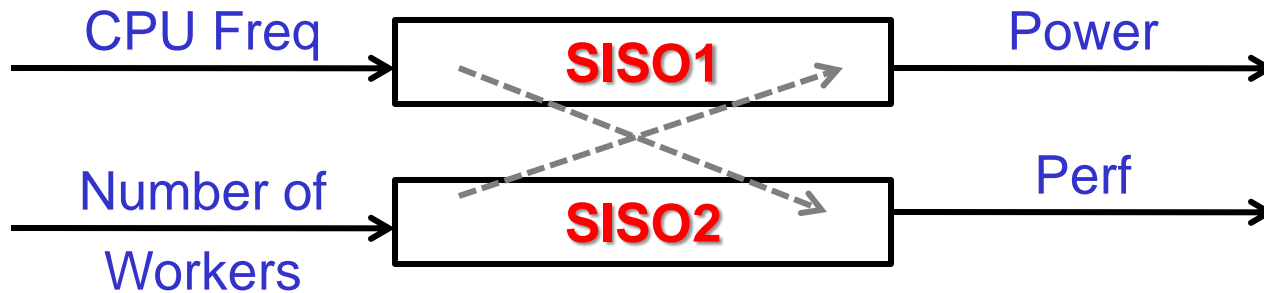
Instability (cont.)



Multi-dimensionality

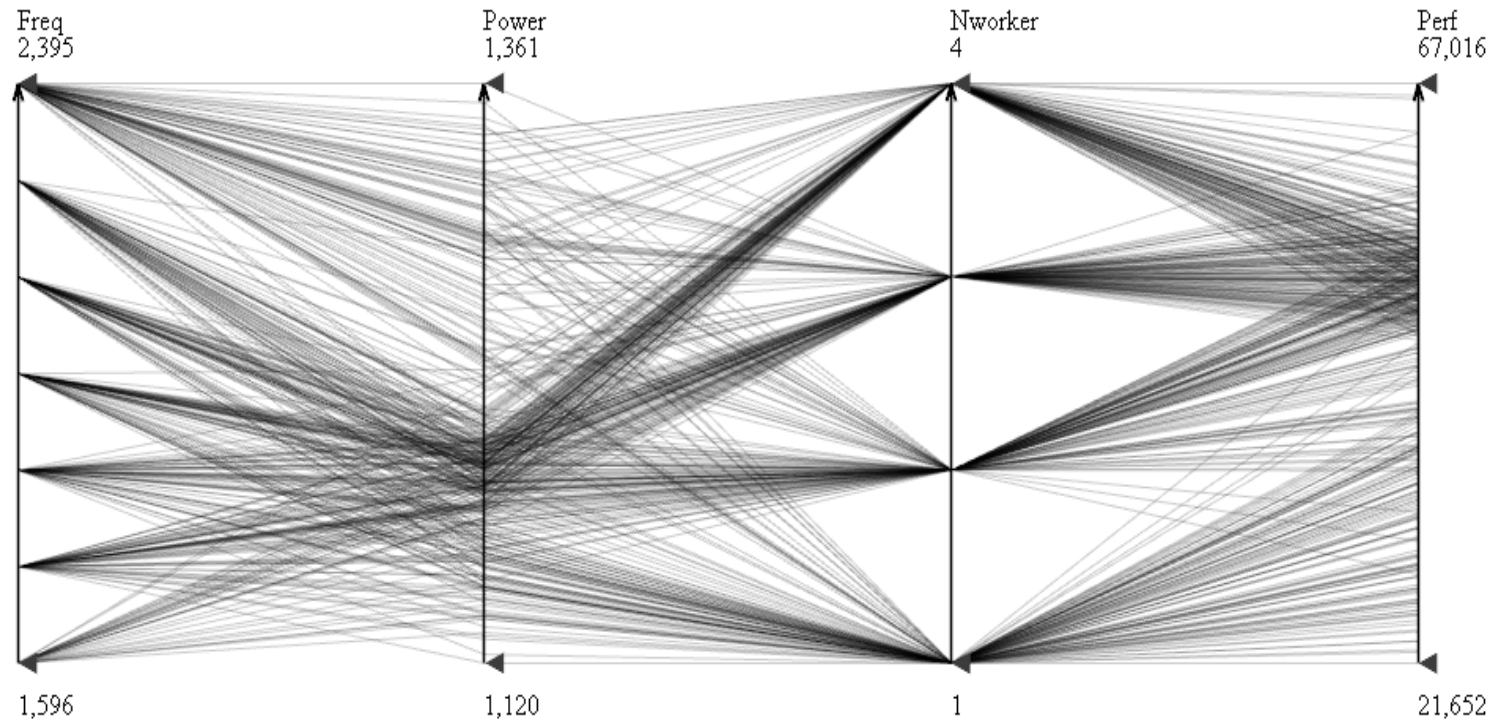


Current Model and Types



MIMO model and two SISO models

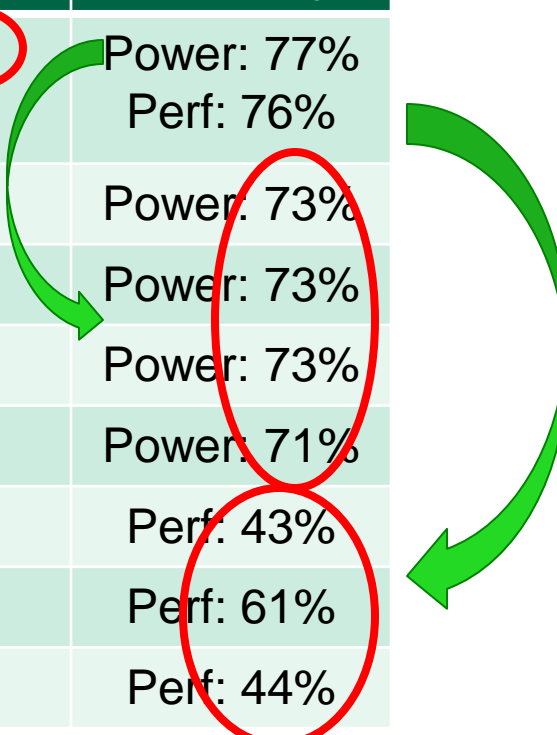
Parallel Coordinates Visualization



Freq and Power, Nworker and Perf have strong positive correlation;
Power and Nworker have relative strong positive correlation

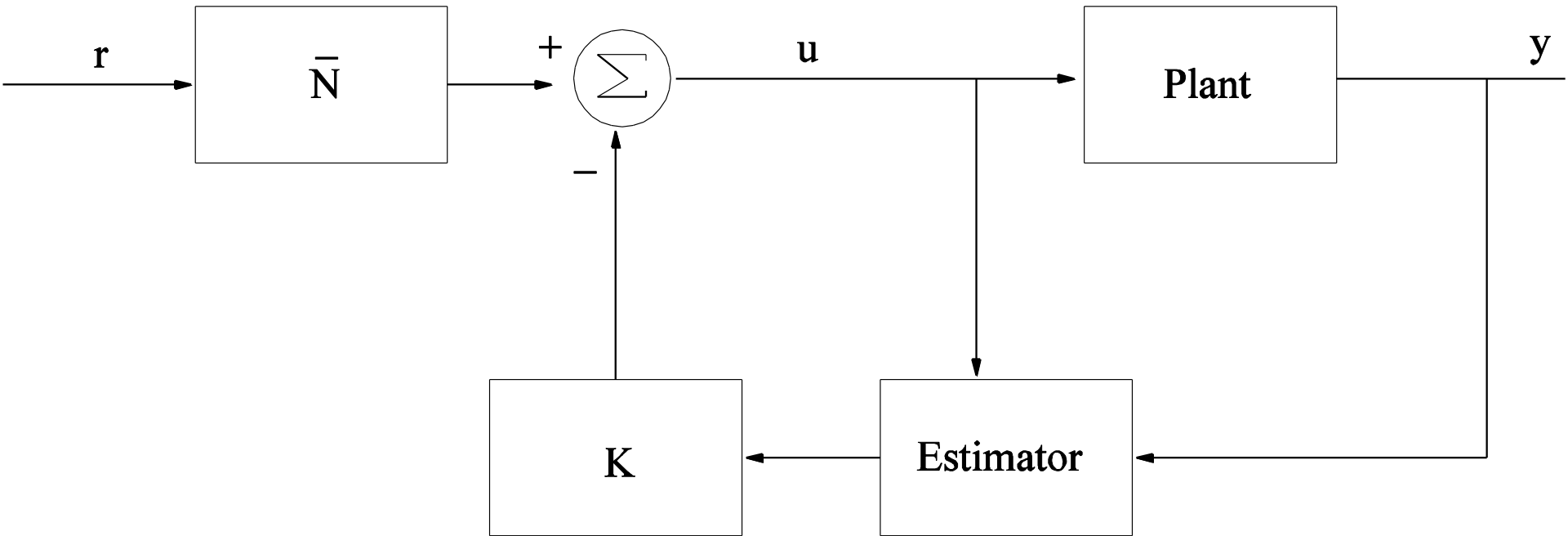
SISO vs. MIMO Results

Model	Fixed Input	Order	Accuracy
MIMO	N/A	3	Power: 77% Perf: 76%
SISO1	1 worker	1	Power: 73%
SISO1	2 workers	1	Power: 73%
SISO1	3 workers	1	Power: 73%
SISO1	4 workers	1	Power: 71%
SISO2	2395MHz Freq	1	Perf: 43%
SISO2	1995MHz Freq	2	Perf: 61%
SISO2	1596MHz Freq	1	Perf: 44%



Evaluation of MIMO and SISO models with MIMO data

Controller Design



Feed forward Controller

Simulation

