Control System Research Activities

@

Chulalongkorn University

จุฬาลงกรณ์มหาวิทยาลัย

Pillar of the Kingdom

Outline

- Profiles
- Facilities
- Research Activities

Control System Research Lab (CSRL)

Established since 1985

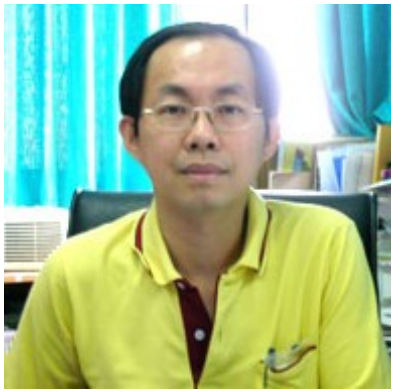
Objective

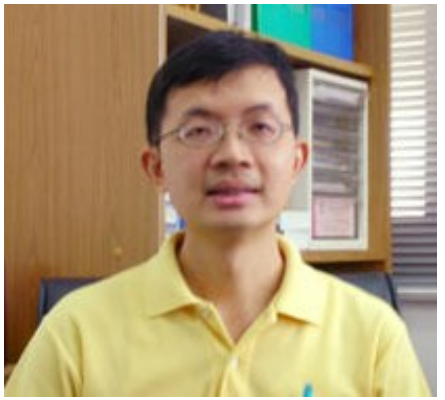
To conduct research and development in areas of control systems, analysis, design and applications

Strategic Research Area

Advanced control & optimization, embedded systems & robotics

Faculty Members




Watcharapong Khovidhungij

Manop Wongsaisuwan

Suchin Arunsawatwong

David Banjerdpongchai

Jitkomut Songsiri

Students

As of Oct 2013

2 PhD
4 Master
9 undergrad

Offerred courses

Linear Control Systems I & II

Computational Techniques for Engineers

Digital Control Systems

Introduction to Mathematical Analysis

Control System Theory

Convex Optimization

Multivariable Control

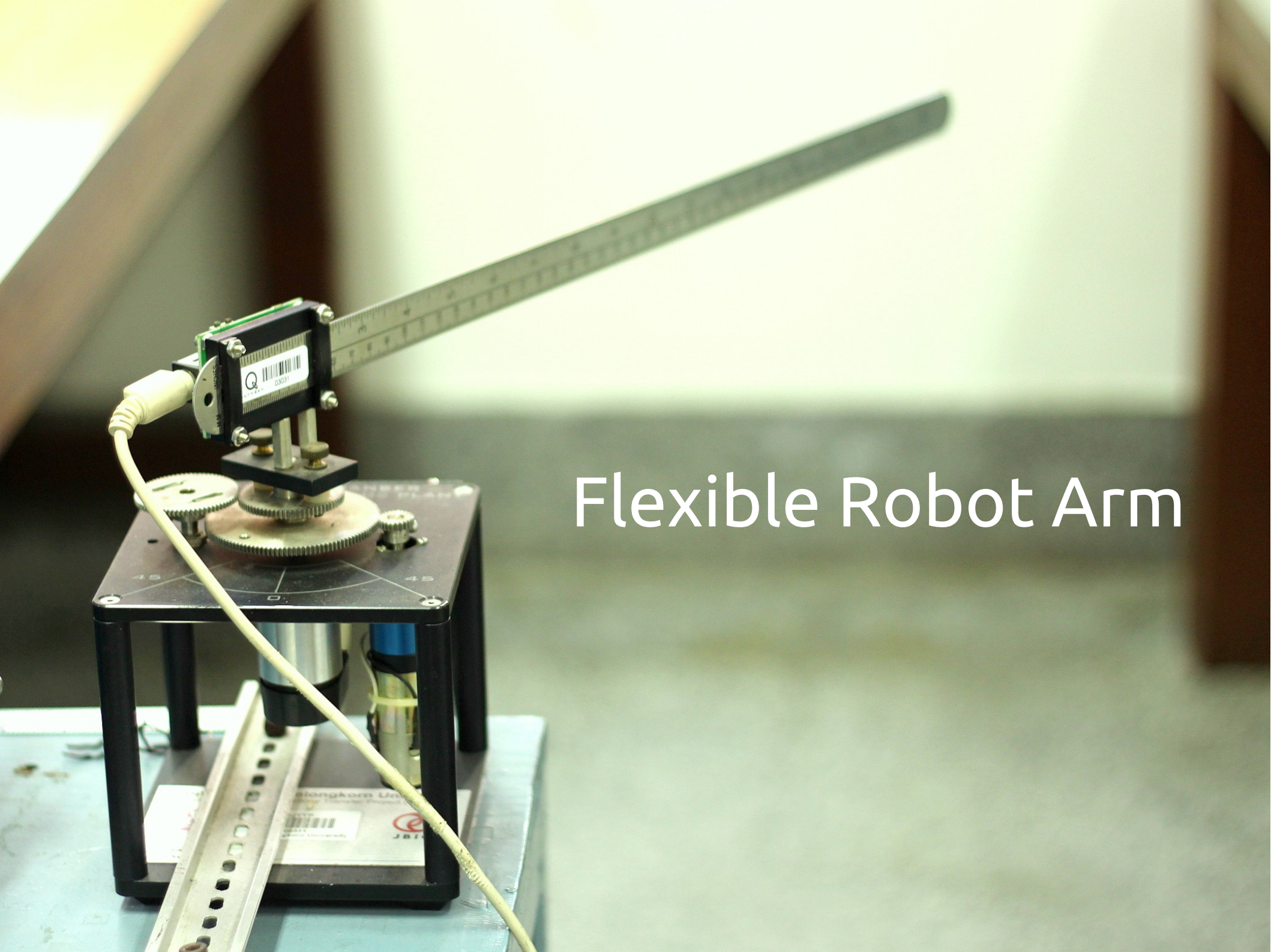
Nonlinear Control Systems

Introduction to Optimization Techniques

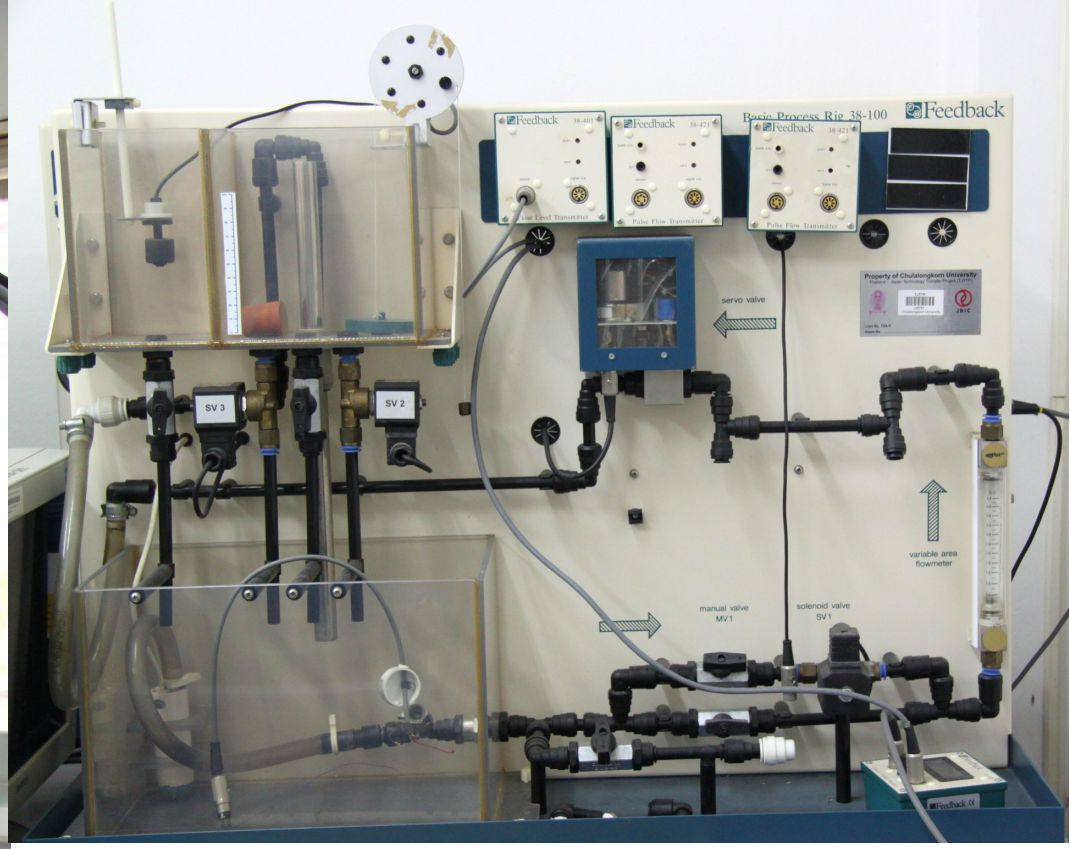
System Identification

Industrial Control and Instrumentation


YOKOGAWA
Research & Lab equipment

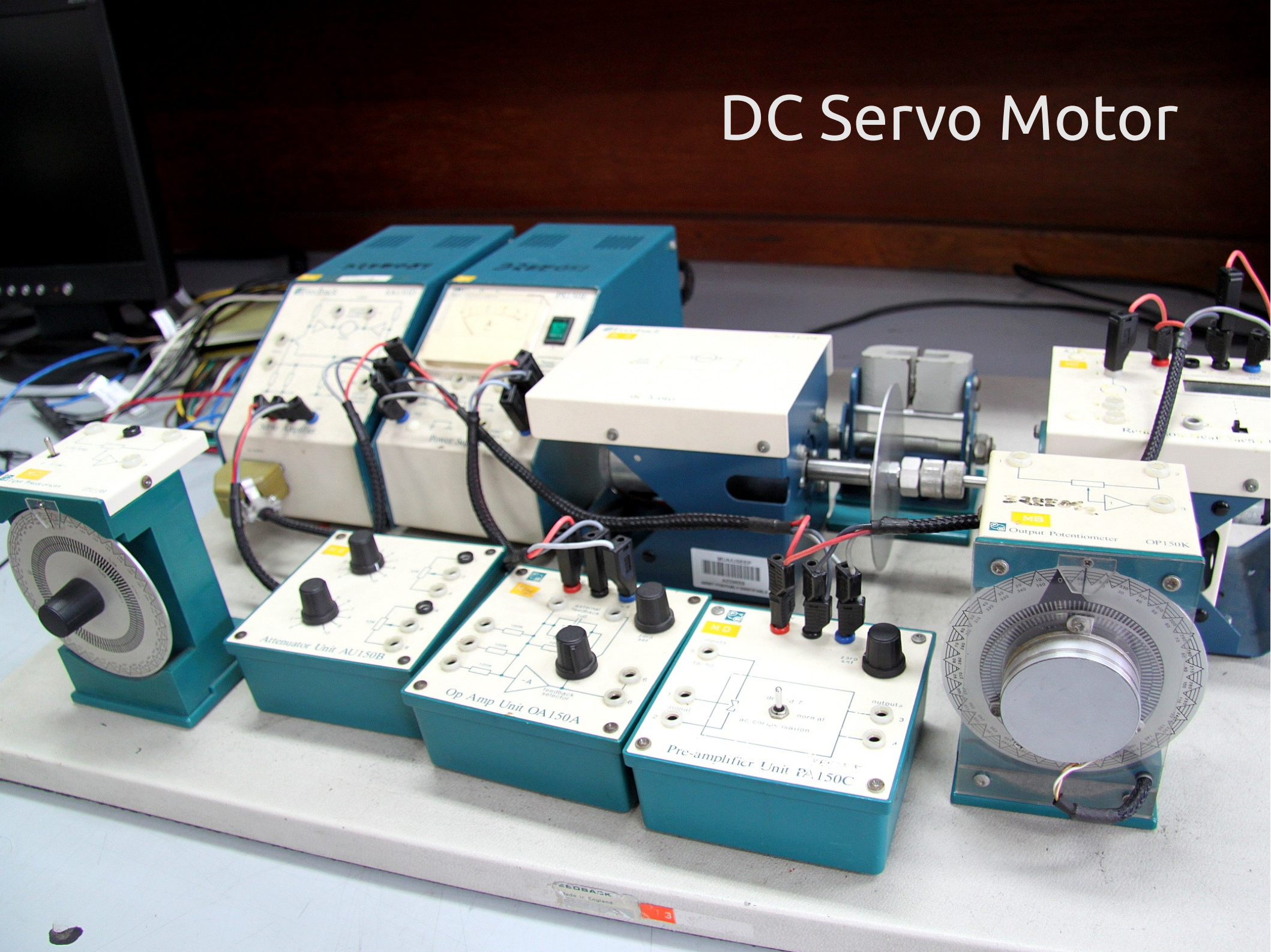

Flexible Robot Arm

Multi-DOF Torsion

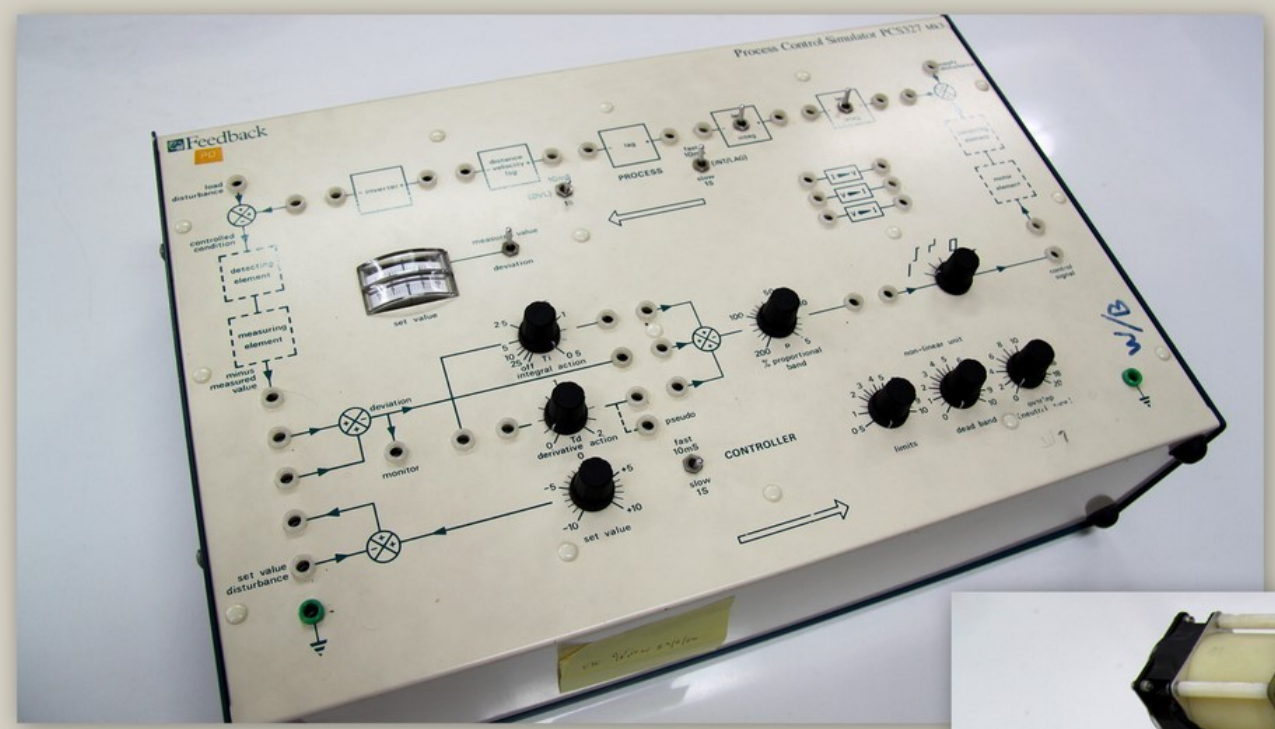


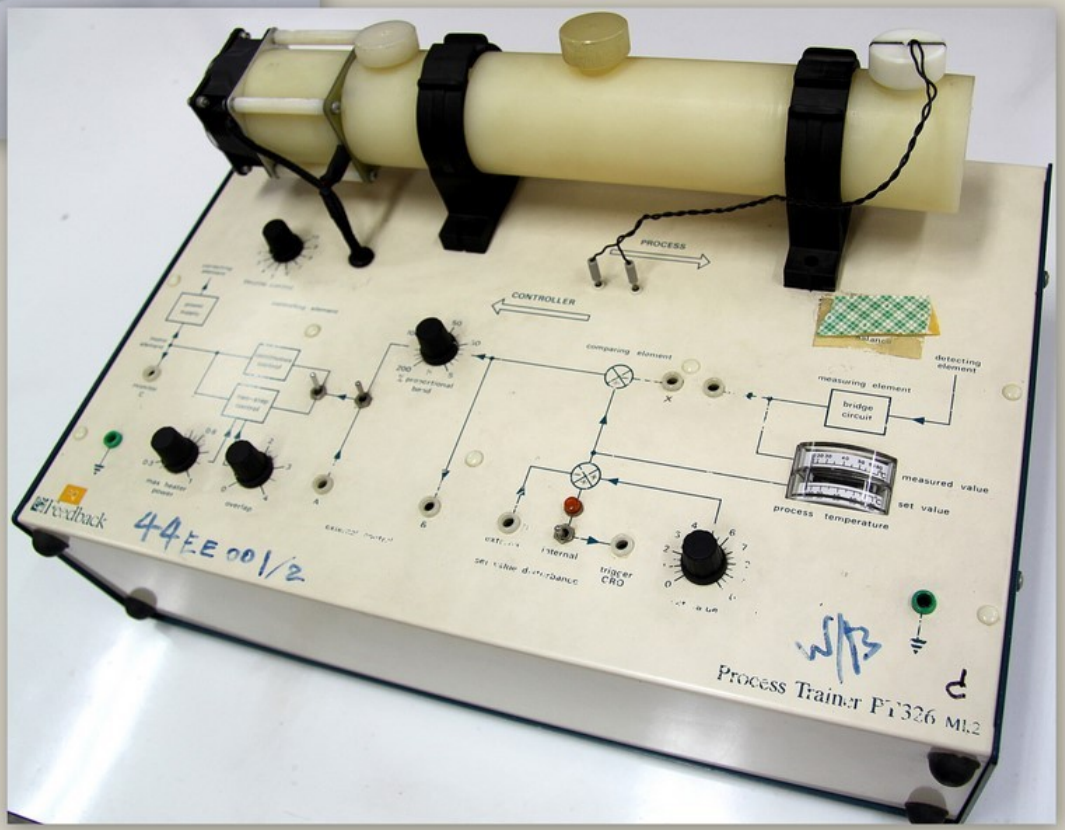
Process control

DC Servo Motor

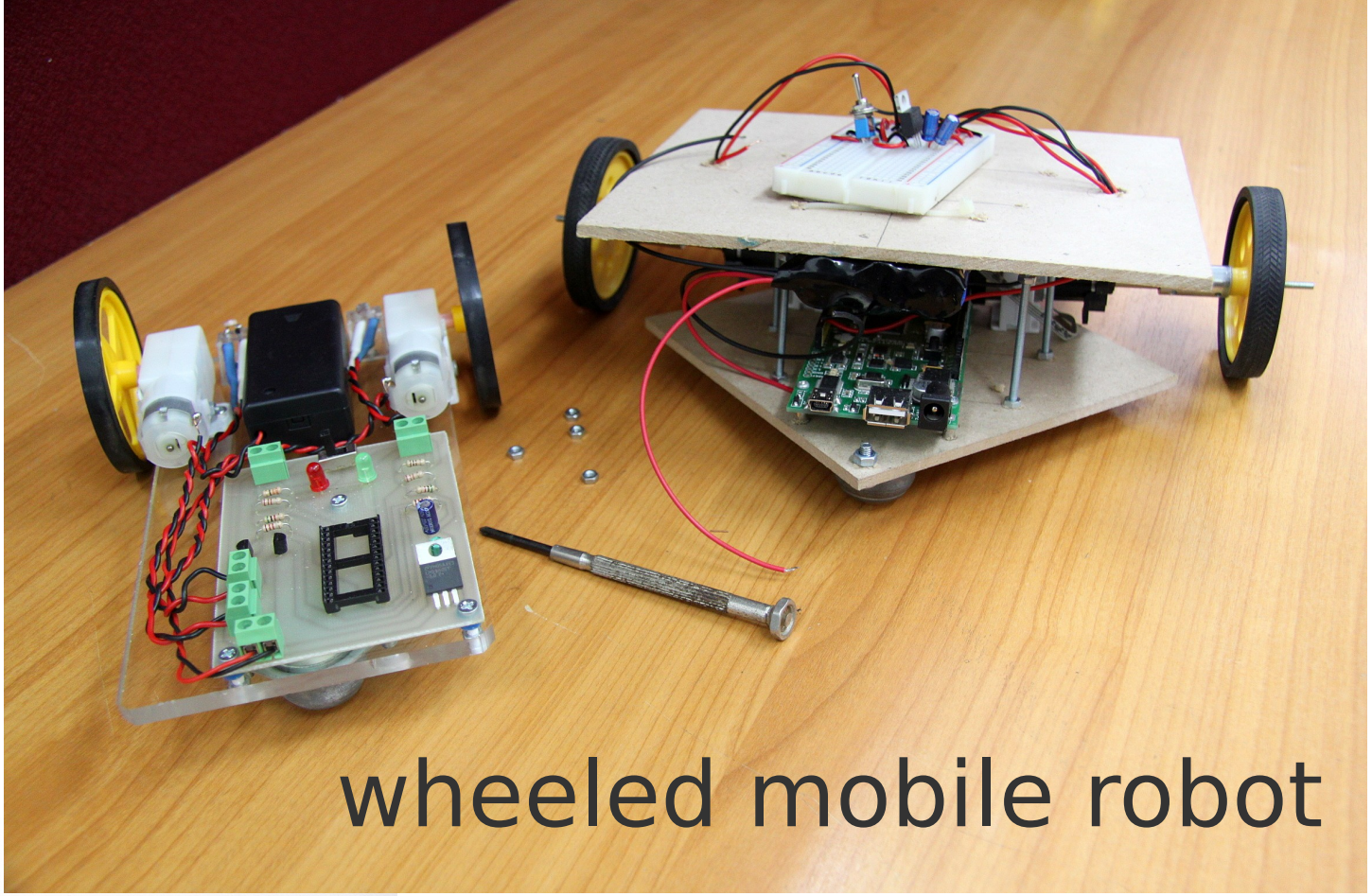


Process Simulator





Heat Exchanger



wheeled mobile robot

CNC machine

Work environment

Research Activities

Control design and optimization in power systems

Stability analysis for nonlinear systems

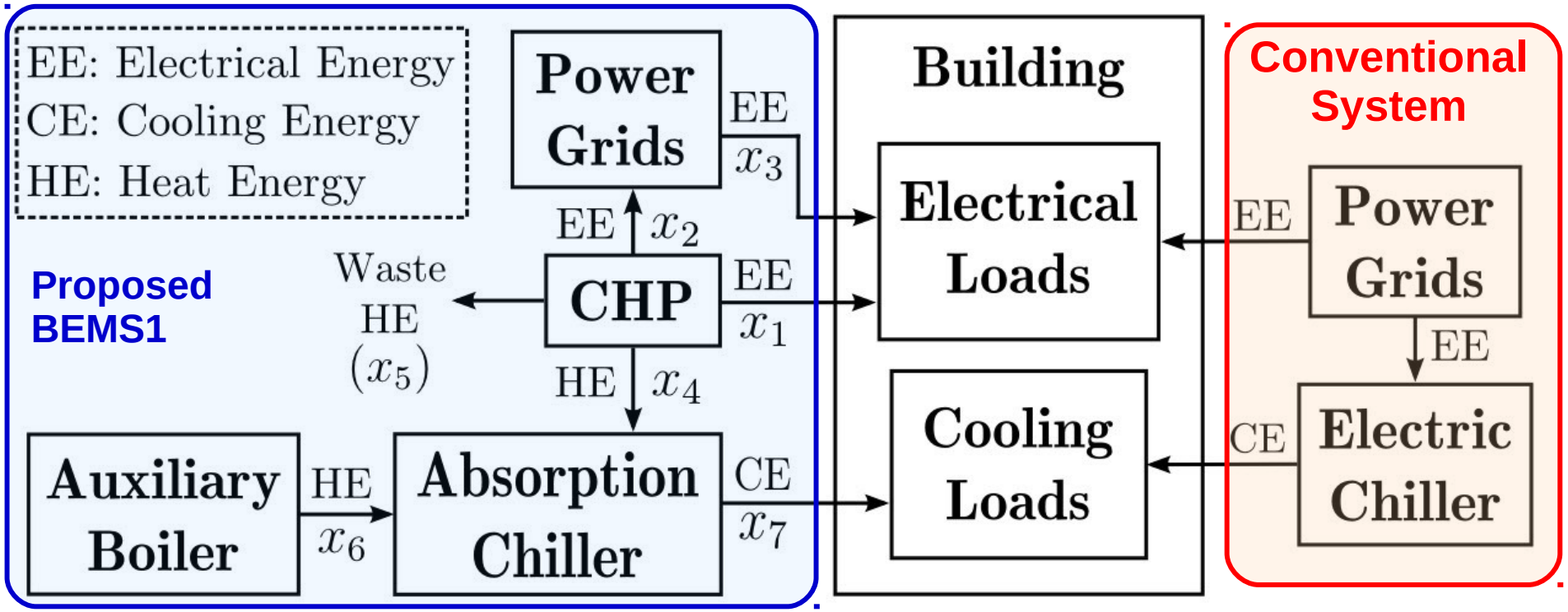
Control design for non-rational MIMO plants

Simultaneous Localization and Mapping (SLAM)

Sparse optimization in system identification

Operation of Combined Cooling and Heating and Power Generation System for Building Load

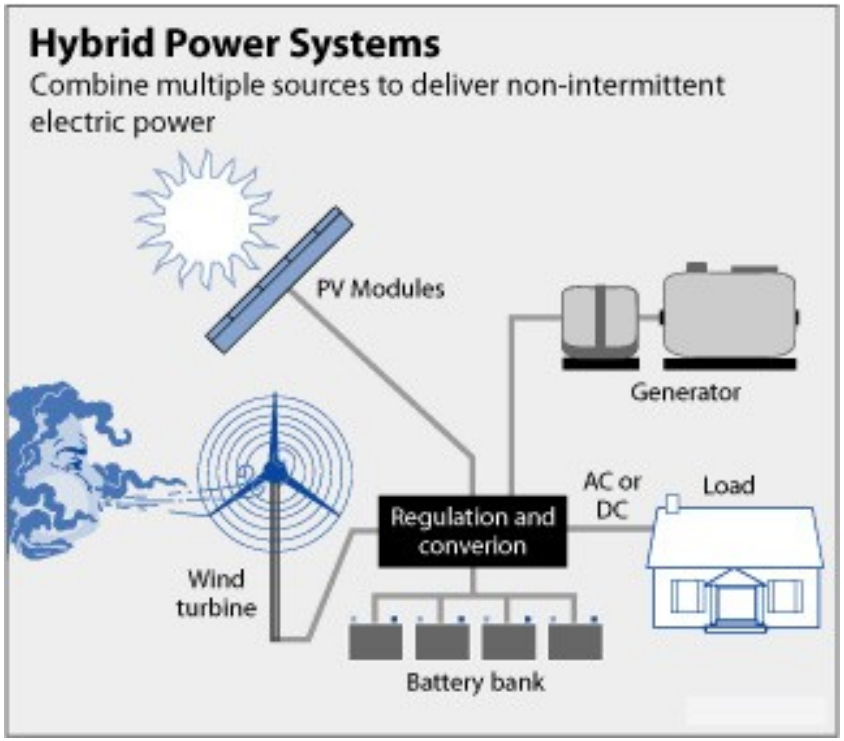
Thanakorn Petkajee and David Bangjerdpongchai



design economic and environmental optimal operations of building energy management system (BEMS) using CHP (combined heat and power)

Design of Power System Stabilizer Operating Under Load Voltage Fluctuation

Patipan Kalvibool and Suchin Arunsawatwong

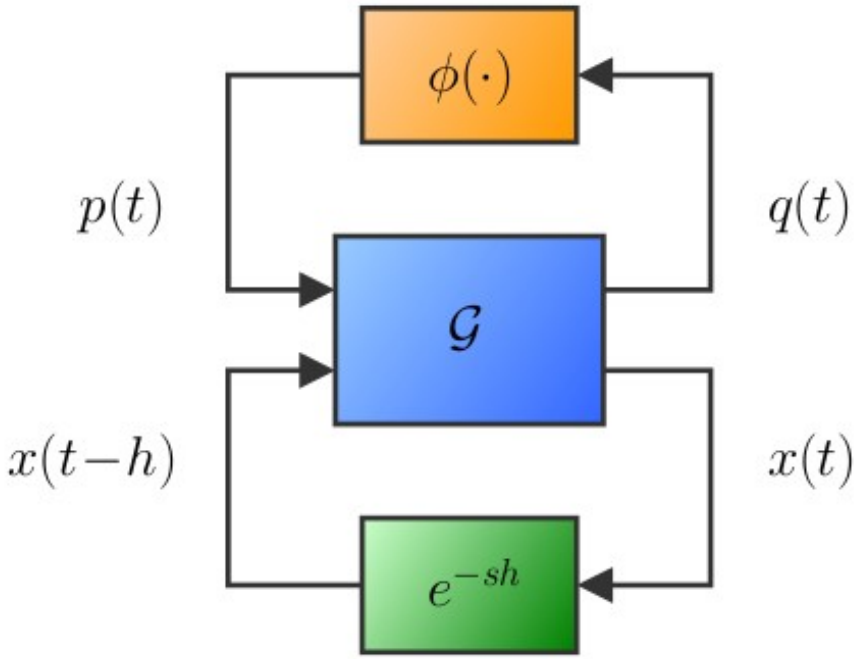


Using renewable energy (solar/wind) which may have high uncertain characteristic might reduce the power system reliability

By using the principle of matching and Zakian's framework, we design the power system stabilizer (PSS) so that the power system is stable under the presence of load voltage deviation that satisfies bounding conditions on their magnitude and slope

Absolute Stability Criteria for Lur'e Systems with Time Delays

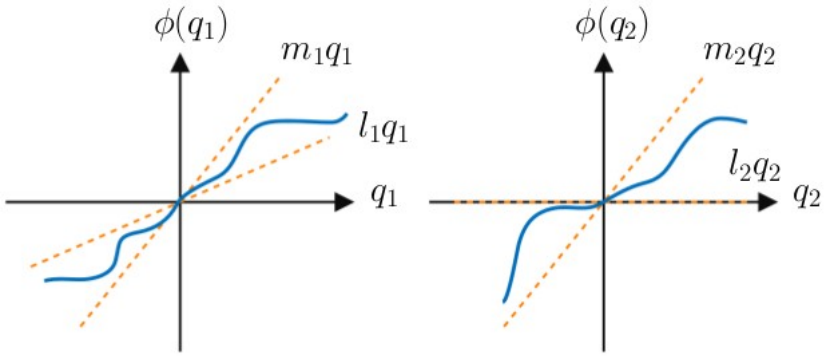
Thapana Nampradit and David Banjerdpongchai



$$\dot{x}(t) = Ax(t) + A_1x(t-h) + B_pp(t),$$
$$q(t) = C_qx(t),$$
$$p(t) = \phi(q(t)), \quad \phi \in \Phi(l,m),$$

with an initial condition

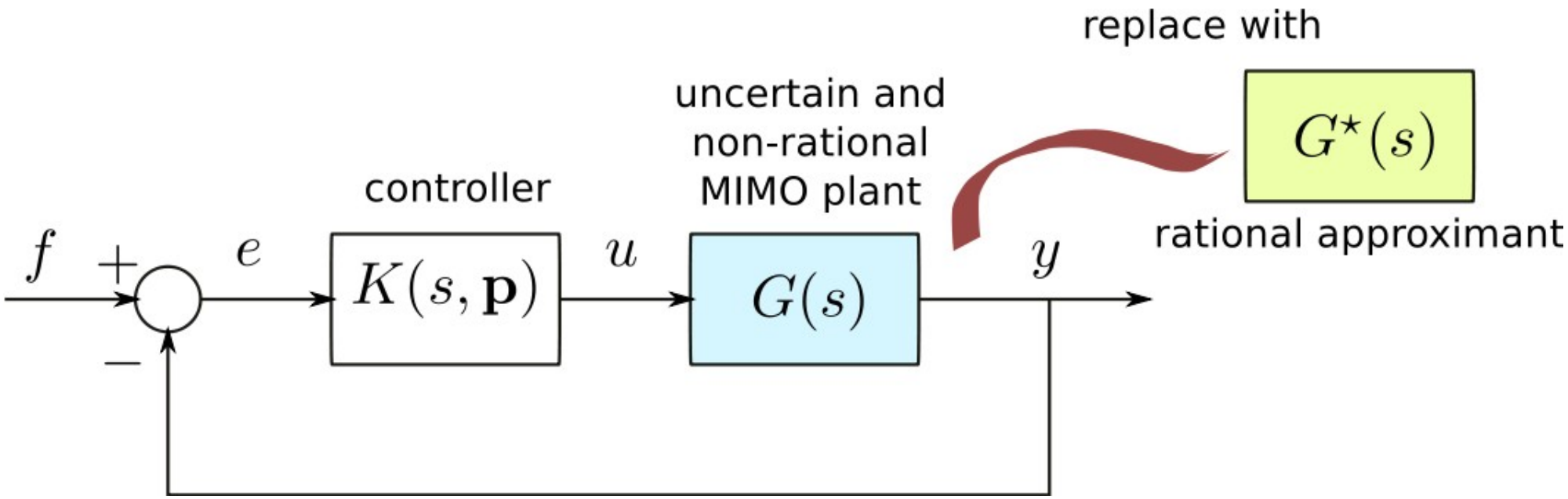
$$x(\theta) = \varphi(\theta), \quad \forall\theta \in [-h, 0].$$



determine the maximum allowable time delay to guarantee the absolute stability

Extension of Theory of Majorants to Two-input Two-output Feedback Systems

Tadchanon Chuman and Suchin Arunsawatwong



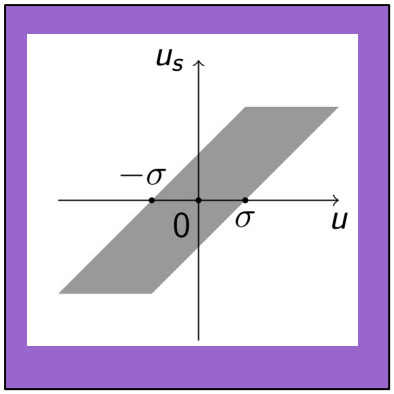
Derive a criterion of approximation to ensure satisfactory results for the orginal system

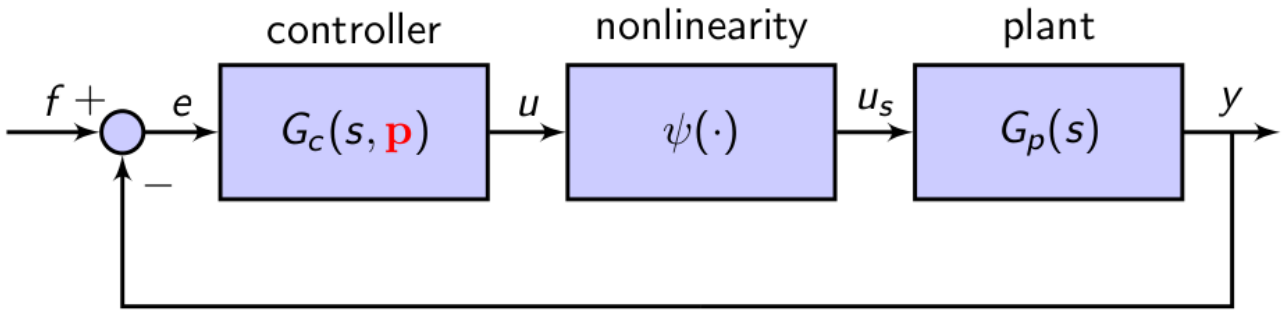
Design Goal

ensure bounds for the peak error and control signal for any input in a possible set

Design of Feedback Systems with Backlash for Inputs Restricted in Magnitude and Slope

Hai Hoang Nguyen and Suchin Arunsawatwong



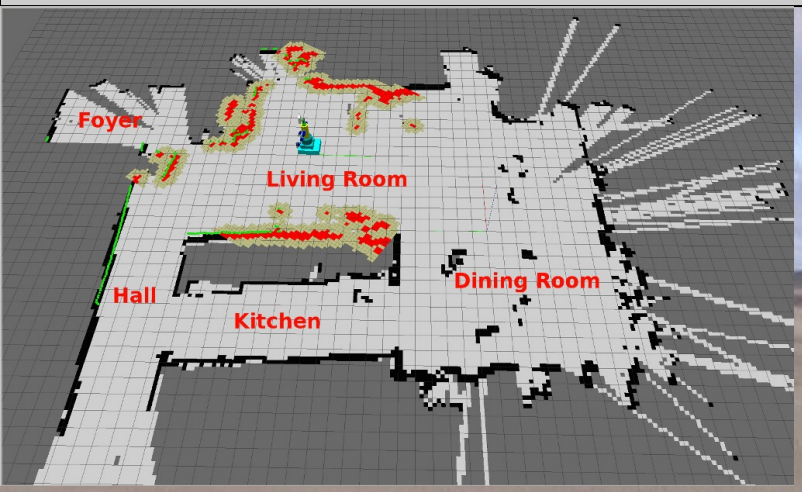


Design the controller parameters so that the peak error and the peak control signal are bounded by specified values for any input in a possible set.

The design formulation is based on the principle of matching. The original design inequalities are replaced with the surrogate design criteria that are in keeping with the method of inequalities

Simultaneous Localization and Mapping (SLAM)

Hong Khac Nguyen and Manop Wongsaisuwan



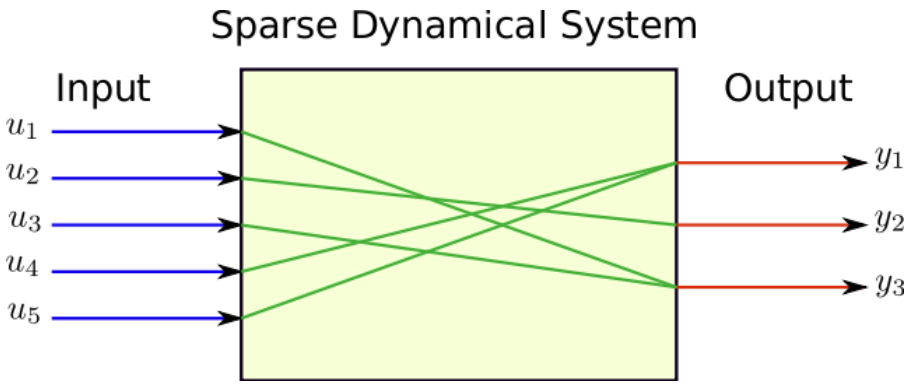
SLAM is the problem of a mobile robot moving in a previously unknown place in order to incrementally build a map of that environment while at the same time specifying its position in the map

We aim to investigate a technique to the problem of finding a motion control signal that optimizes the moving time between the starting point and the prescribed destination in the SLAM scenario. We want the robot to reach the destination within minimal time while maintaining the error in the estimations of robot's pose and landmarks' positions.

This work focuses on UKF-SLAM (Unscented Kalman Filter) which is a derivative-free filter and produces equal or better results than Extended Kalman filter

Sparse Optimization in System Identification

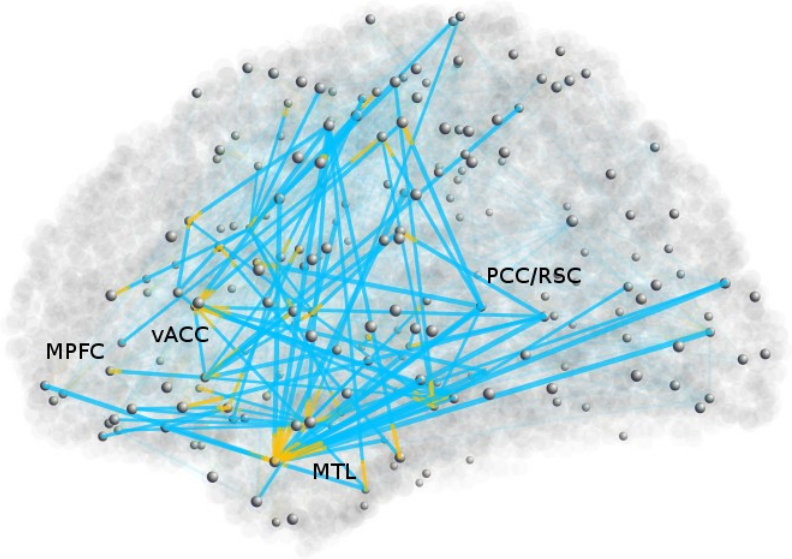
Jitkomut Songsiri



Benefits of having sparse representation or parsimonious models

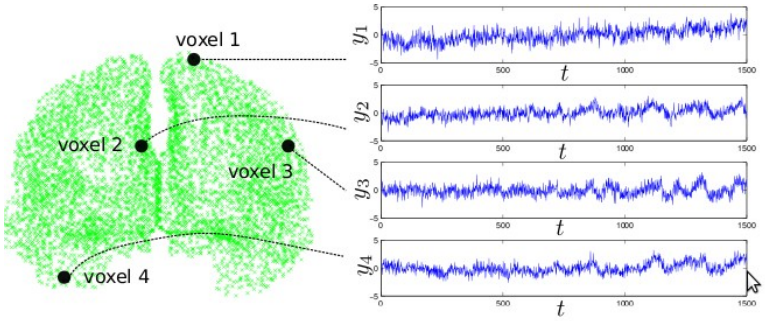
avoid over fitting in estimation

provide a meaningful relationship between variables in the system



Sparse structure in brain signals

(fMRI time series)



$$\dot{x} = Ax + Bu$$ sparse dynamic matrix

$$y(t) = \int_0^t h(t-\tau)u(\tau)d\tau$$ sparse impulse matrix

$$S(\omega) = \sum_{k=-\infty}^{\infty} R_k e^{-j\omega k}$$ sparse spectrum

sparse inverse spectrum

Collaborative Network

Chulalongkorn University

จุฬาลงกรณ์มหาวิทยาลัย

Pillar of the Kingdom

AUN/SEED-Net