

## Jaepil Ban

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## Education

Mar'12- Ph.D., Electrical Engineering,  
Feb'20 **Pohang University of Science and Technology**, South Korea  
Advisor: Sangwoo Kim

Mar'04- B.S., Electronic and Electrical Engineering  
Feb'12 **Ajou University**, South Korea

## Research Interests

My research area includes: control and stability analysis of linear/nonlinear dynamical systems such as hybrid systems, reset control systems, switched/impulsive systems, networked control systems, and industrial control systems. I am currently interested in the stability and energy scheduling of modern power systems including microgrids with distributed energy sources.

## Research Experiences

- Mar'18- **Development of Dynamic temperature estimation model and predictive control algorithm based on a model predictive control (MPC)**  
*Collaborated with POSCO* *Supervisor: Prof. Sang Woo Kim*
  - Developed a dynamic model of an indirect-fired annealing furnace by using its geometry and radiation heat transfer between components.
  - Identified the unknown parameters of the annealing furnace by using the operation data.
  - Developed an observer-based model predictive control algorithm.

- Mar'18-      **Design of Alpha Grid platform and research on components technology**  
*Collaborated with **Korea Electric Power Cooperation**      Supervisor: Prof. Sang Woo Kim*
- Investigated the influence of the electrical fault of generators for a fuel-cost curve.
  - Investigated the correlation between the fault indicator and the degraded output power of generators.
  - Developed an optimal energy scheduling algorithm with faulty distributed energy resources.
- Aug'17-      **Development of the artificial-intelligence-based control algorithm for automation of**  
Feb'18      **POSCO EMLPVD process**  
*Collaborated with **PIBEX (R&D Company of POSCO)**      Supervisor: Prof. Sang Woo Kim*
- Developed a physical vapor decomposition process model by using an artificial neural network.
  - Proposed an online-model-learning algorithm to enhance the accuracy of the neural network model for an insufficient-data environment.
- Jun'17-      **Development of simulator for Sendzimir mill and improvement on control algorithm**  
Mar'18      *Collaborated with **POSCO**      Supervisor: Prof. Sang Woo Kim*
- Developed a dynamic model of the Sendzimir mill (Z-mill) by using its geometry and force transitions between rolls.
  - Identified the unknown parameters of the Z-mill by using the operation data.
  - Constructed a linear mill matrix from the operation data by using a least square method.
  - Developed a model-based flatness control algorithm of the Sendzimir mill system.
  - Developed a graphic user interface that comprehends system identification and dynamic simulation with a controller by using MATLAB Appdesigner.
- May'16-      **Welding point detection algorithm of lighting for vision system for automatic welding**  
Aug'16      **in shipbuilding process**  
*Collaborated with **Samsung Heavy Industries**      Supervisor: Prof. Sang Woo Kim*
- Developed an end-point-detection algorithm for noisy images obtained from a lighting vision system.
  - Proposed a morphological-operation-based ellipsoid fitting for detecting the welding point and the proposed algorithm is robust and accurate in detecting the points compared to the points-based least square algorithm.
- Dec'14-      **Real-time control of finishing mill for lateral movement of a strip by using programmable**  
Sep'15      **logic controller**  
*Collaborated with **POSCO**      Supervisor: Prof. Sangchul Won*
- Developed a hardware in the loop simulator for 7-stand finishing mill with PLC.
  - Proposed an active disturbance rejection control for lateral movement of finishing mill to cope with model uncertainty and disturbances and applied it to the real plant.
  - Developed a graphic user interface for the developed hardware in the loop simulator.
  - Proposed a sensor fault detection algorithm by using proportional-integral observer and successfully detected the sensor fault of the finishing mill simultaneously.

- Oct'13-  
Oct'14      **Design of an embedded controller and control algorithm for heat pump systems**  
*Collaborated with BnF Solution*      *Supervisor: Prof. Sangchul Won*
- Designed an embedded control system with a microcontroller unit (MCU) for a two-stage heat pump to regulate the superheat temperature of a refrigerant and to control the water temperature.
  - Designed a windows API-based monitoring program of the heat pump with a communication by using RS-232 modbus protocol between PC and MCU.
  - Proposed an optimal energy consumption algorithm for an on/off-controlled heat pump system and reduced electric power consumption achieving satisfied level of water temperature.
- Jan'13-  
Sep'13      **Estimation of 3-dimensional temperature distribution for indoor air-flow control**  
*Collaborated with LG Electronics*      *Supervisor: Prof. Sangchul Won*
- Developed a temperature measurement and monitoring system with a thermopile array sensor by using LabVIEW.
  - Proposed an estimation algorithm of temperature distribution in a room by using adaptive-network-based fuzzy inference system (ANFIS).
  - Proposed an online human-detection algorithm by using temperatures obtained from a thermopile array sensor.
- Feb'12-Jul'13      **Active torque control for 1-Piston rotary compressor**  
*Collaborated with LG Electronics*      *Supervisor: Prof. Sangchul Won*
- Designed a disturbance observer-based algorithm for reducing the vibration of 1-piston rotary compressor of an air conditioner.
  - Proposed an adaptive time-delay compensation method to compensate unknown time-delay on phase measurement induced by the sensorless algorithm for motor speeds.
- Mar'11-  
Sep'11      **Development of sensing and control algorithm of a quadrotor UAV**  
*Undergraduate Design Project*      *Supervisor: Prof. Suk-Kyo Hong*
- Developed a low cost IMU sensor system by using a 3-axis gyro in Wii MotionPlus and 3-axis accelerometer.
  - Proposed parallel core processors to perform controlling rotors and processing sensor signal simultaneously.

## Publications & talks

### JOURNAL ARTICLES

1. **Stability and Stabilization of Singular Hybrid Linear Systems: An LMI Approach**  
Jaepil Ban, Sang Woo Kim  
(Under preparation)
2. **Controllability and Observability of Singular Hybrid Linear Systems**  
Jaepil Ban, Sang Woo Kim  
(Under preparation)

3. **Attention-based RNN Diagnosis Method for Interturn Short-Circuit Fault in PMSMs**  
Hojin Lee, Hyeyun Jeong, Gyokwon Koo, Jaepil Ban, Sang Woo Kim  
*IEEE Transactions on Industrial Electronics* (Under review)
4.  **$\mathcal{H}_2$  Reset Controller Design for Linear Systems**  
Jaepil Ban, Minseok Seo, Sang Woo Kim  
*Automatica* (Under review)
5. **Improved co-design of event-triggered dynamic output feedback controllers for linear systems**  
Jaepil Ban, Minseok Seo, Taedong Goh, Hyeyun Jeong, Sang Woo Kim  
*Automatica* 111, 2020
6. **Robust  $H_\infty$  finite-time control for discrete-time polytopic uncertain switched linear systems**  
Jaepil Ban, Wookyoung Kwon, Sang Woo Kim  
*Nonlinear Analysis: Hybrid Systems* 20: 348-367, 2018
7. **Mold Oscillation Feedforward Control Algorithm for Sinusoidal Oscillation of Various Asymmetries**  
Seung Hoon Kim, Minseok Seo, Jaepil Ban, Nam Woong Kong, Sang Woo Kim  
*ISIJ International* 57.11: 2016-2021, 2017
8. **Multicriteria adaptive observers for singular systems with unknown time-varying parameters**  
Wookyoung Kwon, Jaepil Ban, Soo Hee Han, Changsoo Lee, Sangchul Won  
*Mathematical Problems in Engineering*, 2017

#### CONFERENCES

1. **Optimal Power Flow for Microgrids with Faulty Generators**  
Jaepil Ban, Hojin Lee, Hyeyun Jeong, Sang Woo Kim  
*2019 9th International Conference on Power and Energy Systems, IEEE, Perth, Australia, 2019*
2. **Vertex-wise NLMS Algorithm for Signal Reconstruction of DC Power Flow**  
Minseok Seo, Jaepil Ban, Sang Woo Kim  
*IEEE PES Asia-Pacific Power and Energy Engineering Conference, Macao, China, 2019*
3. **Design of Reset Control for SISO Linear Systems**  
Jaepil Ban, Sang Woo Kim  
*IEEE International Conference on Control and Automation, Edinburg, Scotland, 2019.*
4. **Stability and  $\mathcal{L}_2$ -gain analysis of Impulsive Switched Systems with Average Dwell Time: Application to Hybrid Control**  
Jaepil Ban, Wookyoung Kwon, Sang Woo Kim  
*American Control Conference, Seattle, USA, 2017.*

5. **Localization of slab identification numbers using deep learning**  
Sang Jun Lee, Jaepil Ban, Hyeyeon Choi, Sang Woo Kim  
*2016 16th International Conference on Control, Automation and Systems (ICCAS)*, IEEE, 2016.
6. **Decentralized  $H_\infty$  control of large-scale descriptor systems using proportional-plus-derivative state feedback**  
Sungbin Kim, Wookyoung Kwon, Jaepil Ban, Sangchul Won  
*2015 15th International Conference on Control, Automation and Systems (ICCAS)*, IEEE, 2015.
7. **Proportional multiple-integral observer based sliding mode control for linear systems with mismatched disturbance**  
Hyung Woong Lee, Jaepil Ban, Sangchul Won  
*2015 15th International Conference on Control, Automation and Systems (ICCAS)*, IEEE, 2015.
8. **Fault estimation and fault-tolerant control of vapor compression cycle systems**  
Jaepil Ban, Wookyoung Kwon, Sangchul Won  
*2015 41st Annual Conference of the Industrial Electronics Society, IECON*, IEEE, 2015.
9. **Generalized complex projective synchronization of chaotic complex systems with unknown parameters**  
Jaepil Ban, Jinwoo Lee, Sangchul Won  
*2014 14th International Conference on Control, Automation and Systems (ICCAS)*, IEEE, 2014.
10. **Synchronization of two different chaotic systems using terminal sliding mode with disturbance observer**  
Jaepil Ban, Jinwoo Lee, Sangchul Won  
*In Proceedings of SICE Annual Conference 2013*, pp. 2575-2580.

## Grants, honors & awards

2009-2	Self-development Scholarship, Ajou University
2010-2011	Honor Scholarships for four semesters, Ajou University

## Computer languages

MATLAB, Simulink, Appdesigner, Python, Tensorflow, Keras, OpenAI Gym, PowerWorld Simulator, C, Windows API, PLC programming, LabView, OrCAD, PSpice,  $\text{\LaTeX}$