



Control Systems On Automatic Wheelchair Using Robust and Adaptive Control

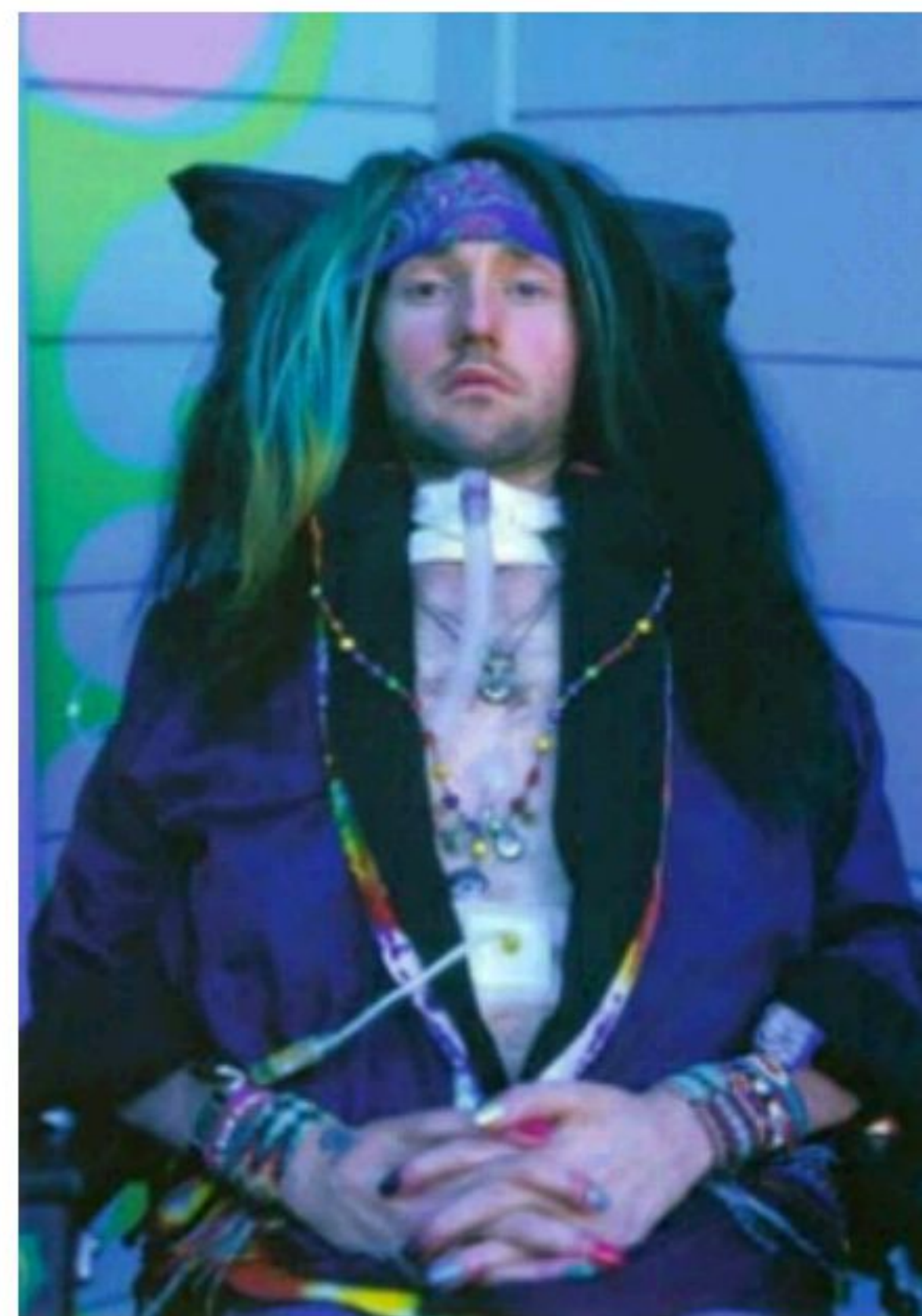
Augie Widyotriatmo, Ph.D.
Instrumentation and Control
Faculty of Industrial Technology
ITB

28 June 2013

Disabled among Us



Prof. Stephen Hawking



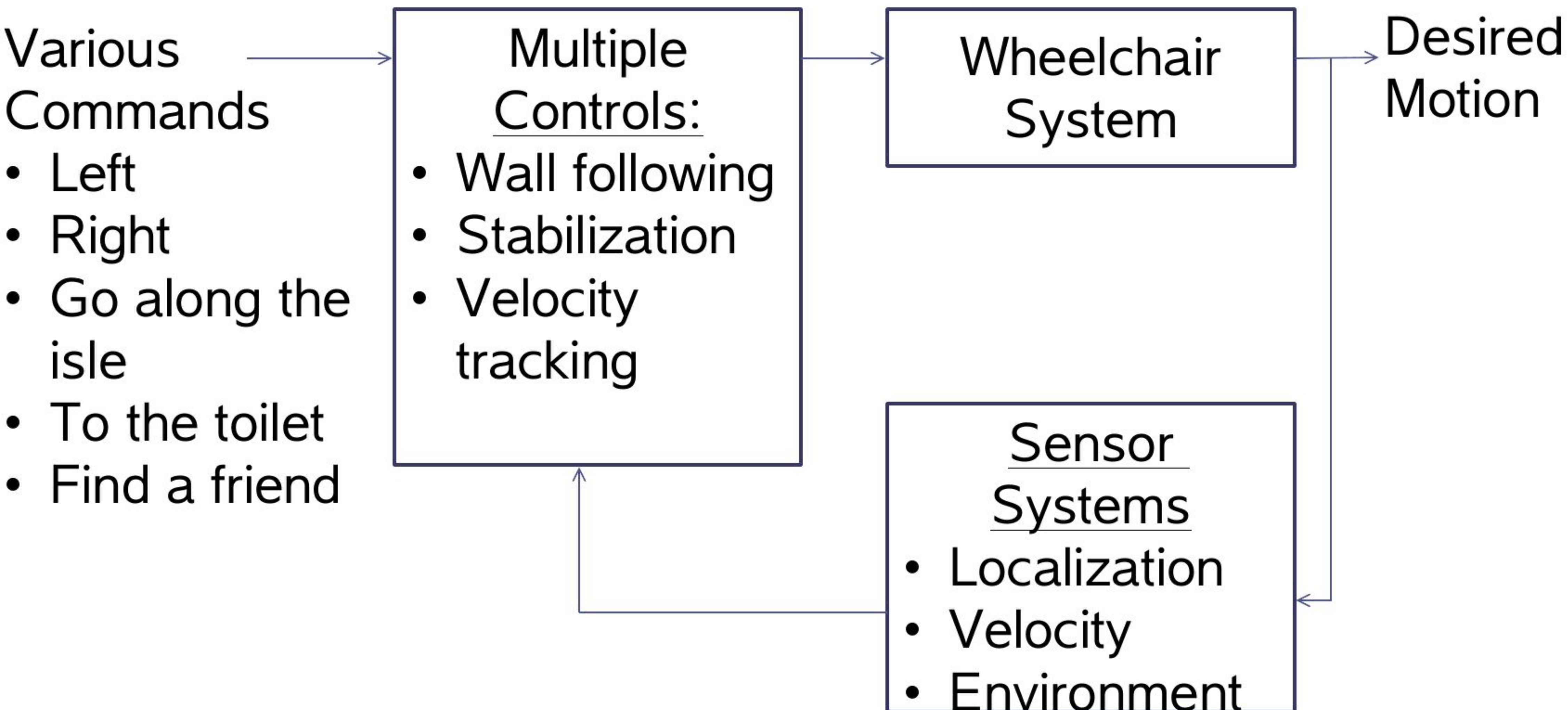
Jason Becker

Autonomous Wheelchair Research

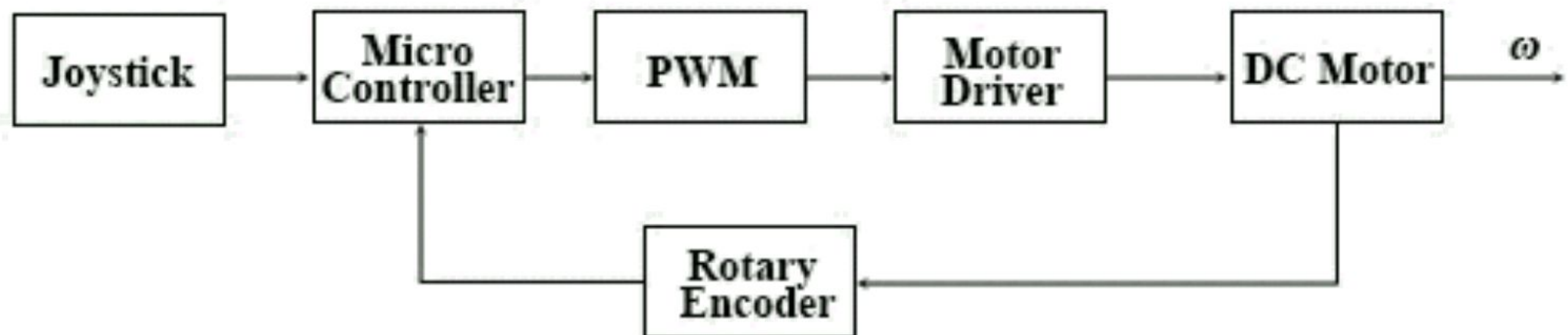
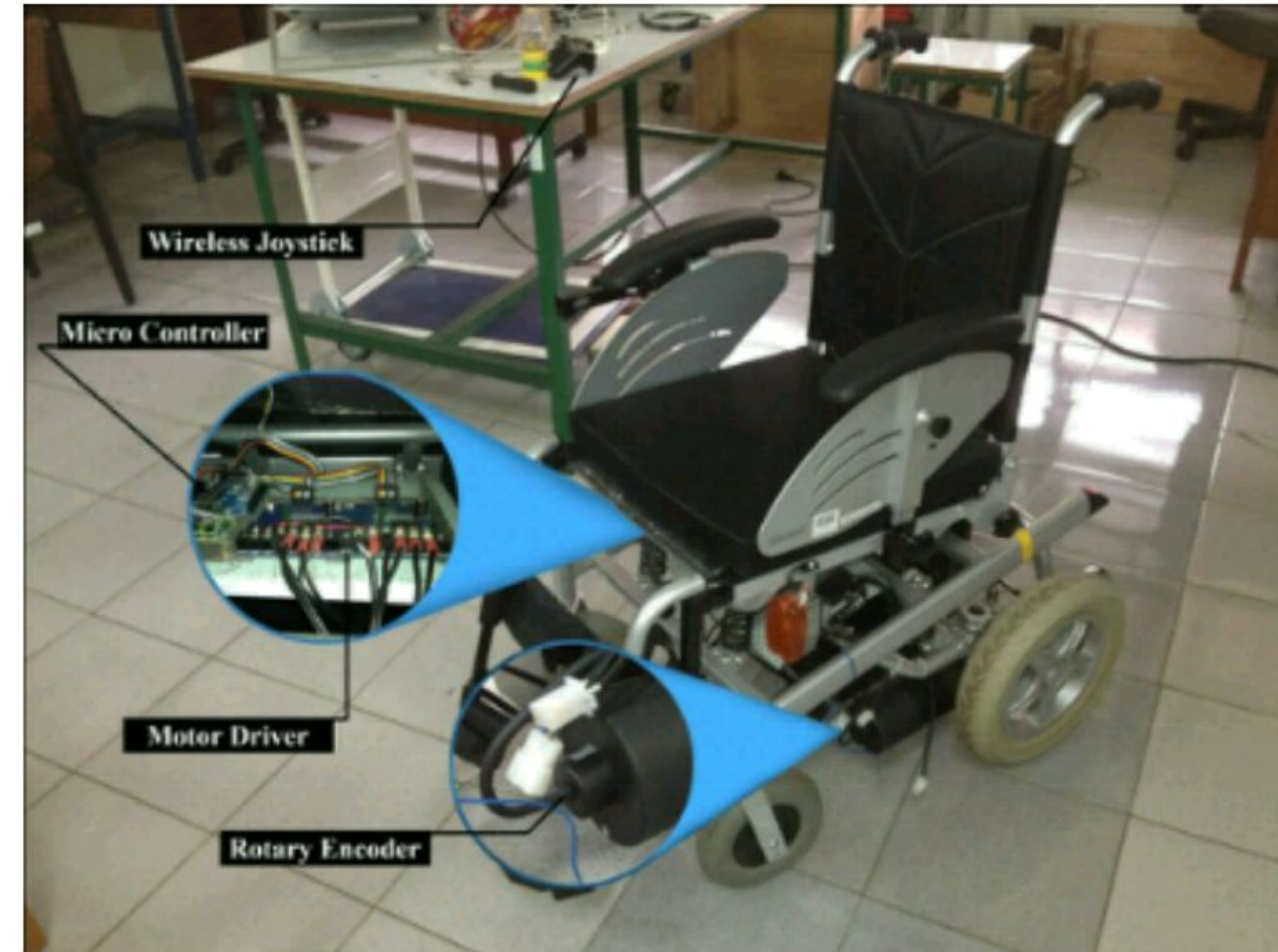
- **MIT**: wheelchair that listens
- **Freie Universität**: smart wheelchair
- **RIKEN Brain Inst.**: brain controlled
- **ITB**: synergized commands and controls for autonomous wheelchair



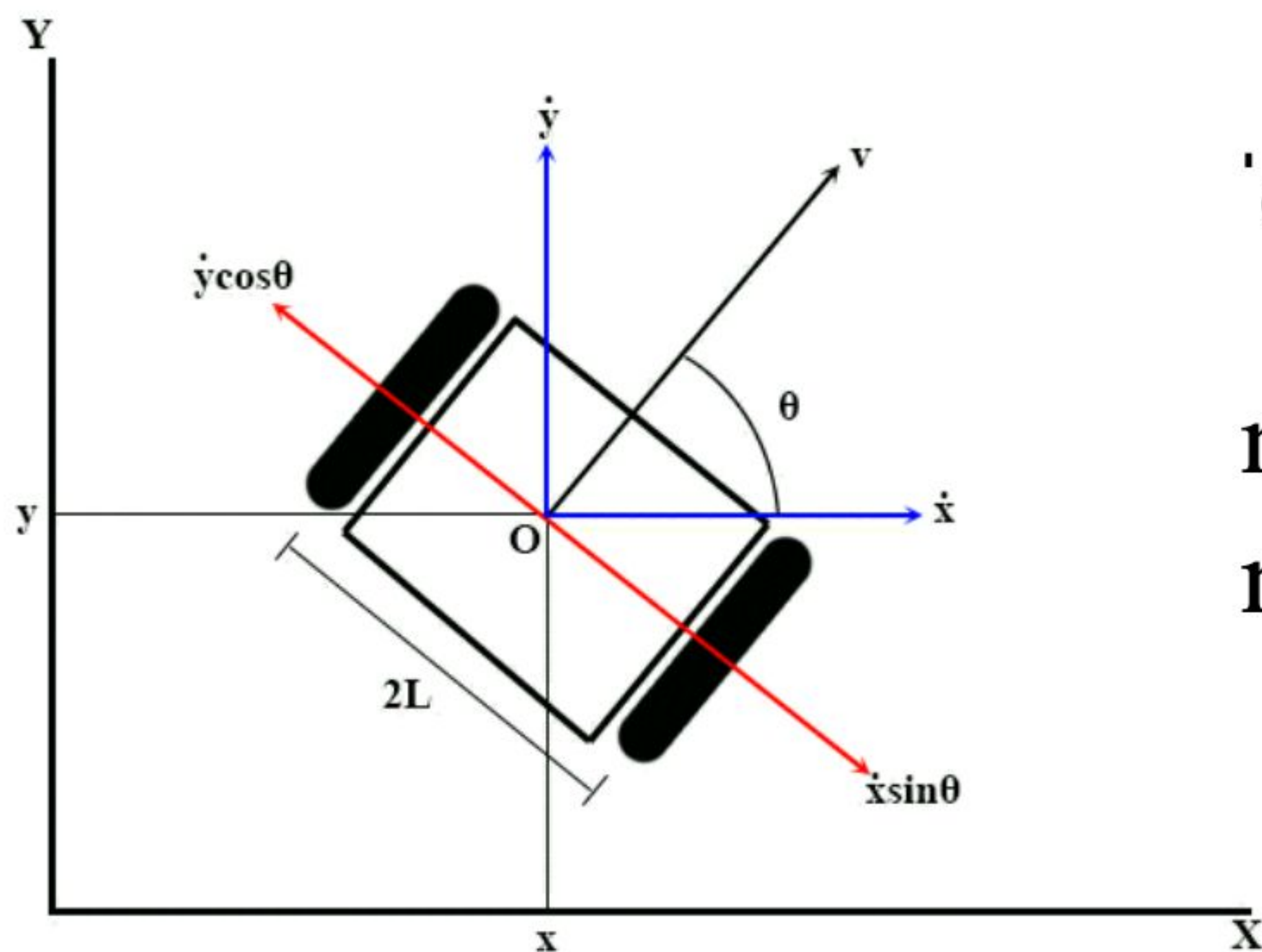
Command and Control → Desired Motion



Research Results #1: Automatic Wheelchair Platform



Research Result #2: Wheelchair Modeling



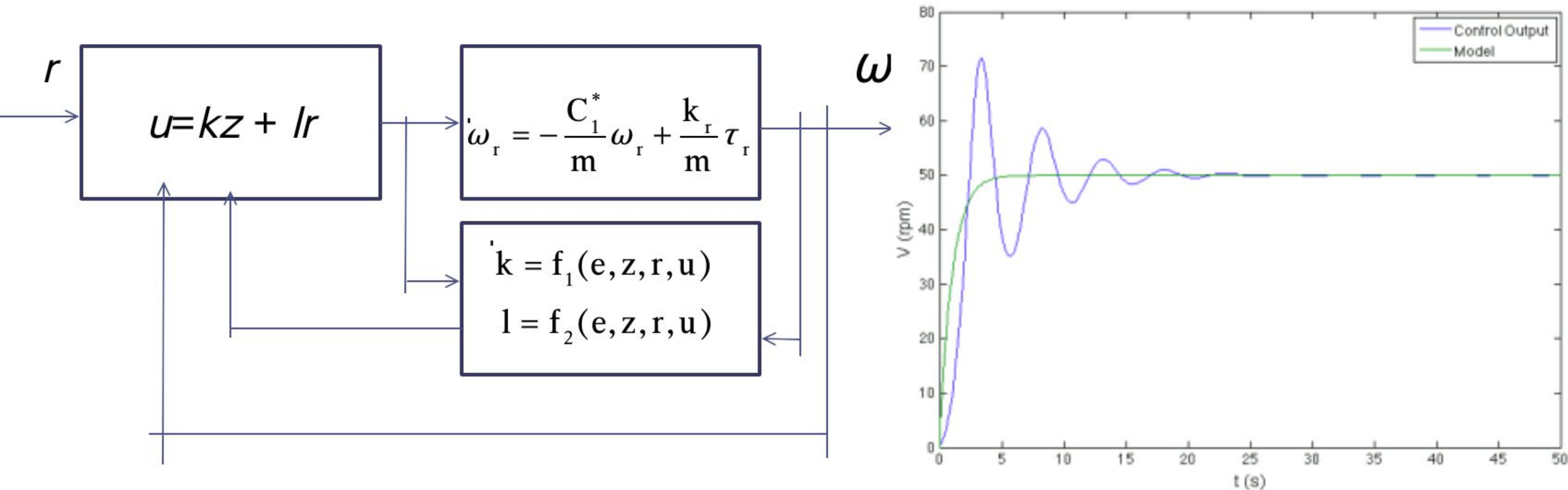
$$\dot{q} = S^T(q)v = \begin{bmatrix} \cos \theta & 0 \\ \sin \theta & 0 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} v \\ \omega \end{bmatrix}$$

$$m \dot{\omega}_R + C^* \omega_R = k_R \tau_R$$

$$m \dot{\omega}_L + C^* \omega_L = k_L \tau_L$$

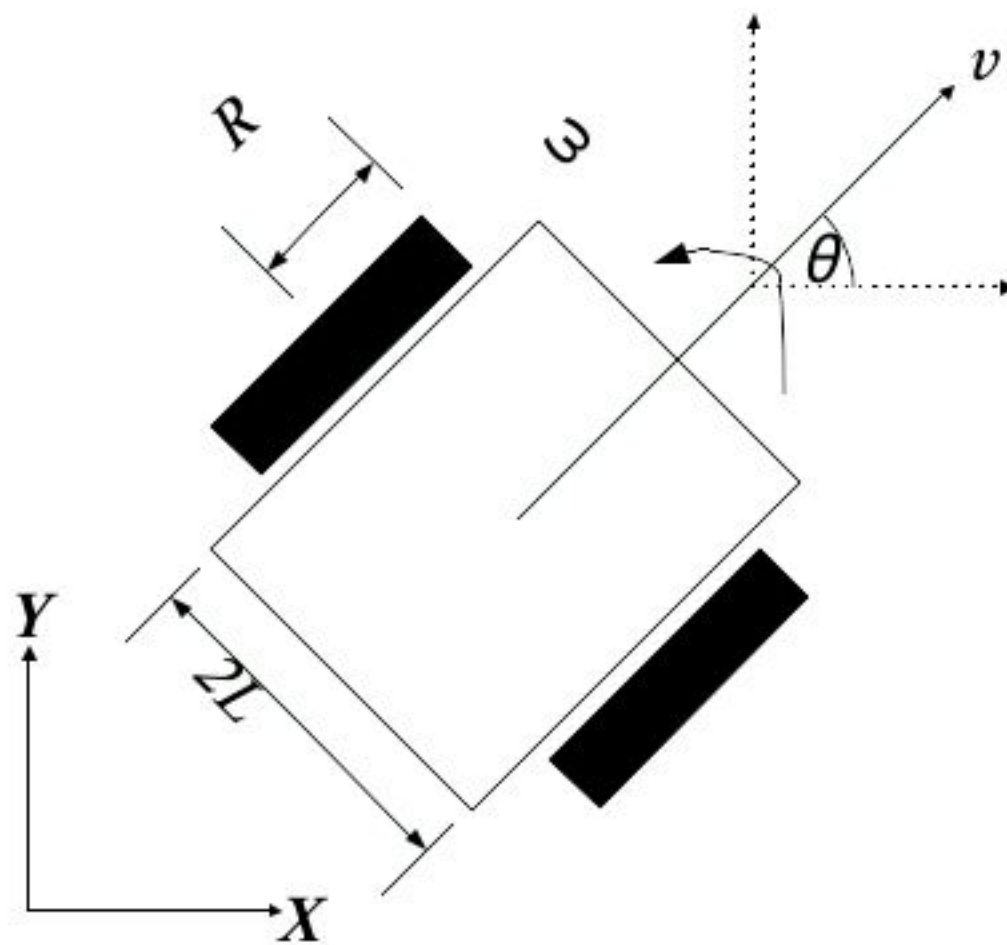
A. Widyotriatmo, S. K. Rauzanfiqr, and Suprijanto, "A modified PID algorithm for dynamic control of an automatic wheelchair," *IEEE Conference Systems, Control, and Industrial Infomatics Control*, Sep. 2012

Research Result #3: Adaptive Control Velocity Tracking

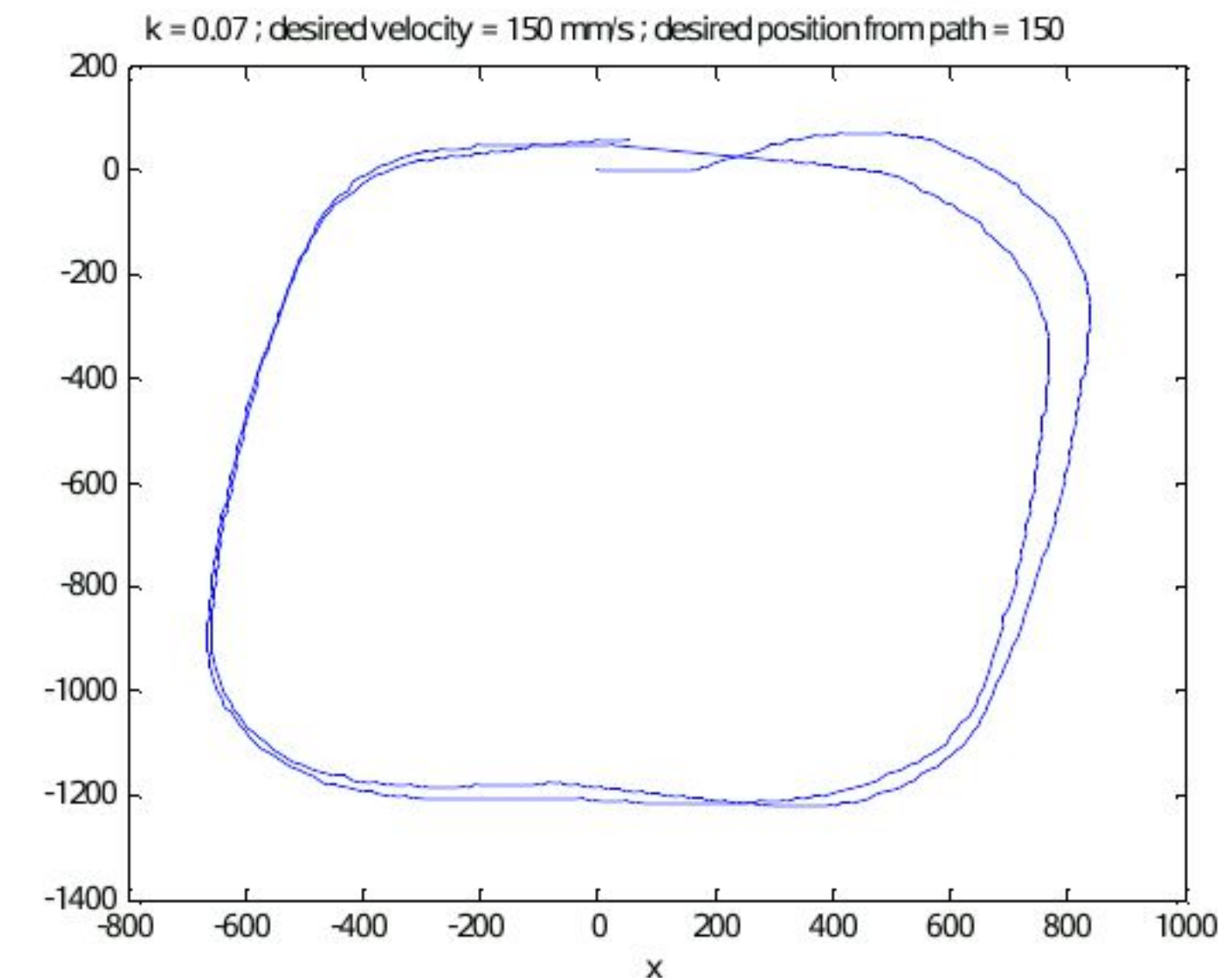


E. Claresta, A. A. Wardhana, A. Widyotriatmo, Suprijanto, "Adaptive control for velocity control of an electric wheelchair," Submitted to *International Conference on Instrumentation, Control, and Automation*, Aug 2013

Research Results #4: Wall Following Control



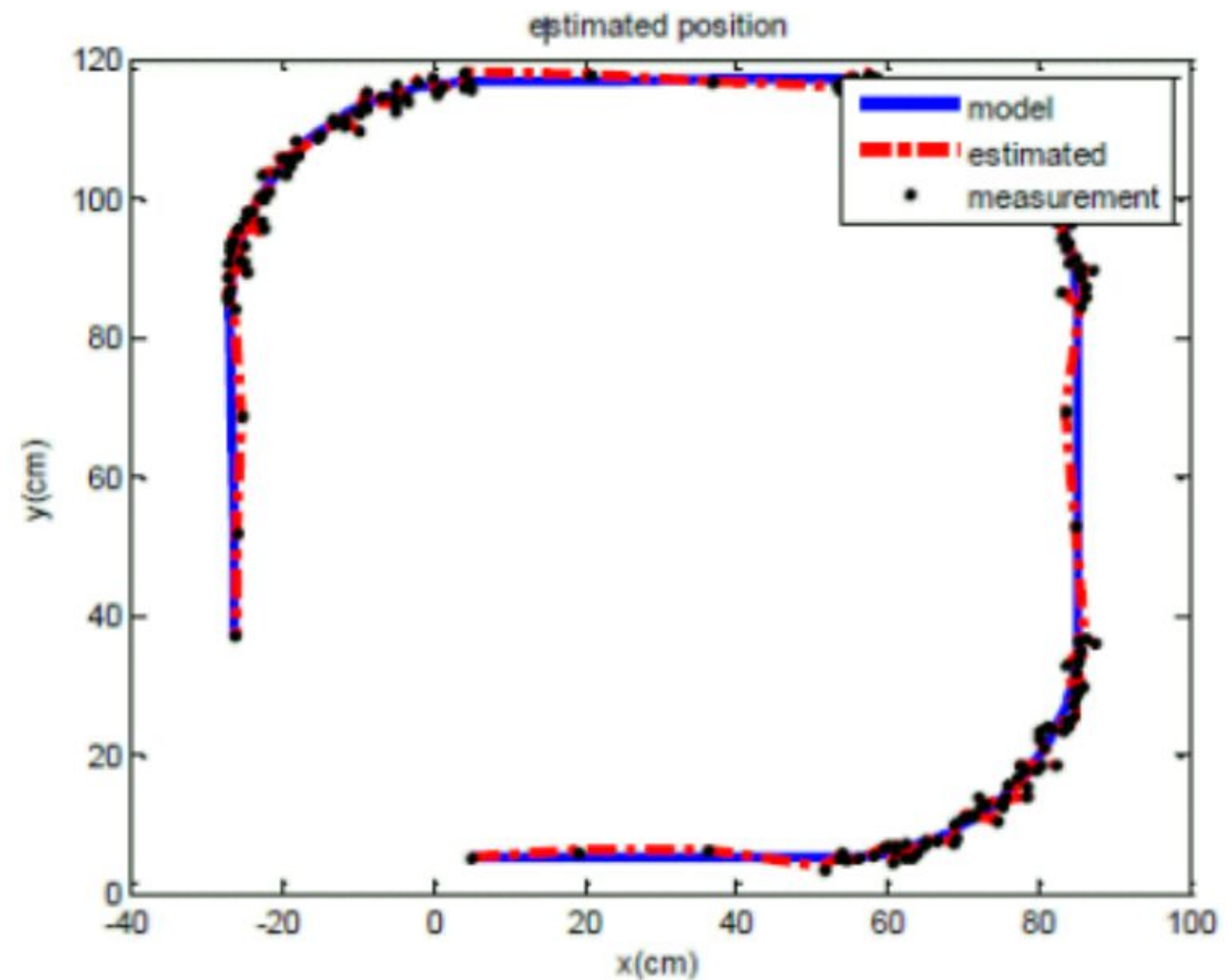
$$\omega = \frac{vk^2 y(t)}{\sqrt{v^2 - (ky(t))^2}}$$



A. A. Wardhana, E. Claresta, A. Widyotriatmo, Suprijanto, "Wall following control of a mobile robot with no orientation sensor," *will be published at International Conference on Instrumentation, Control, and Automation, Aug 2013*

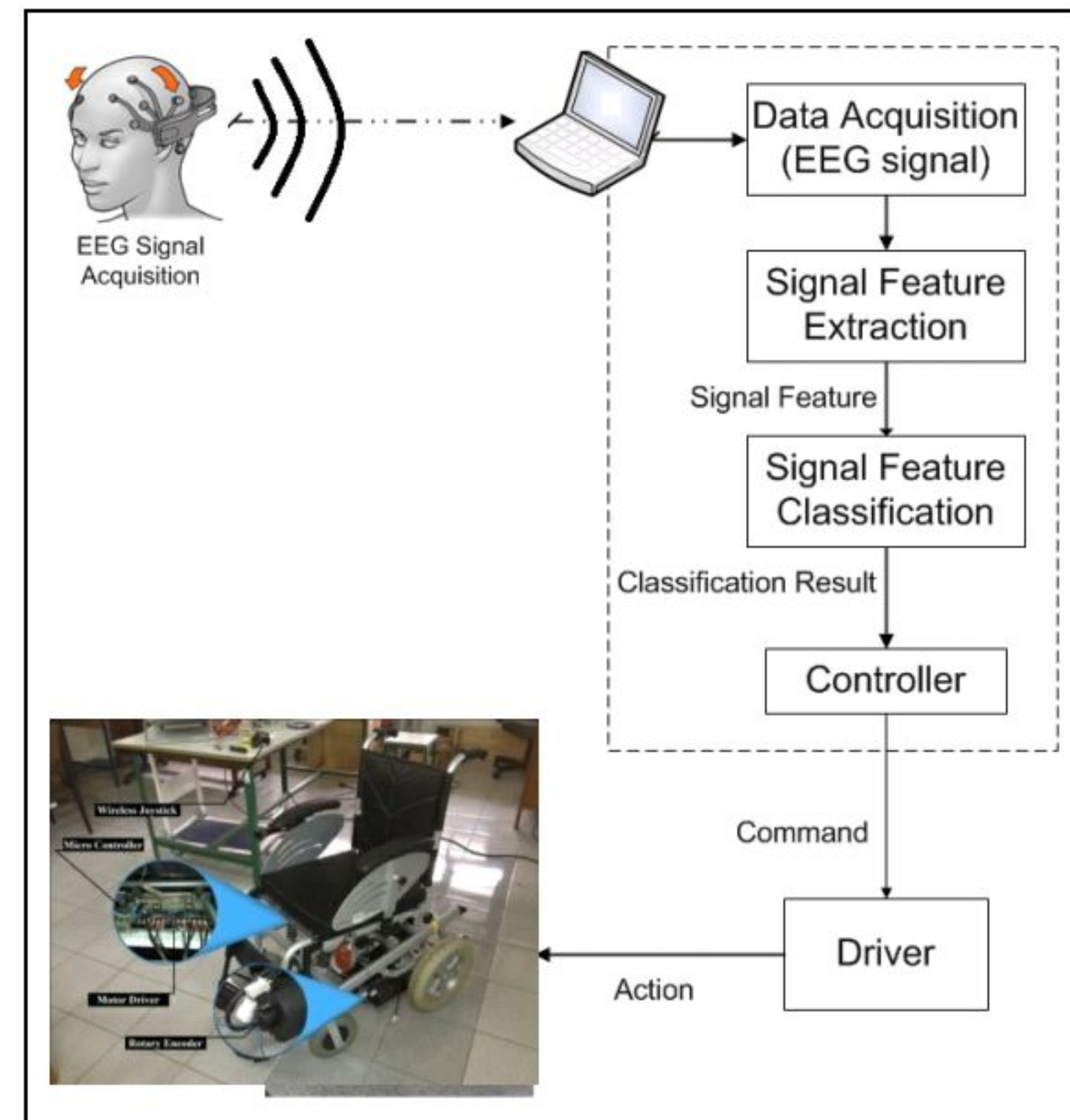
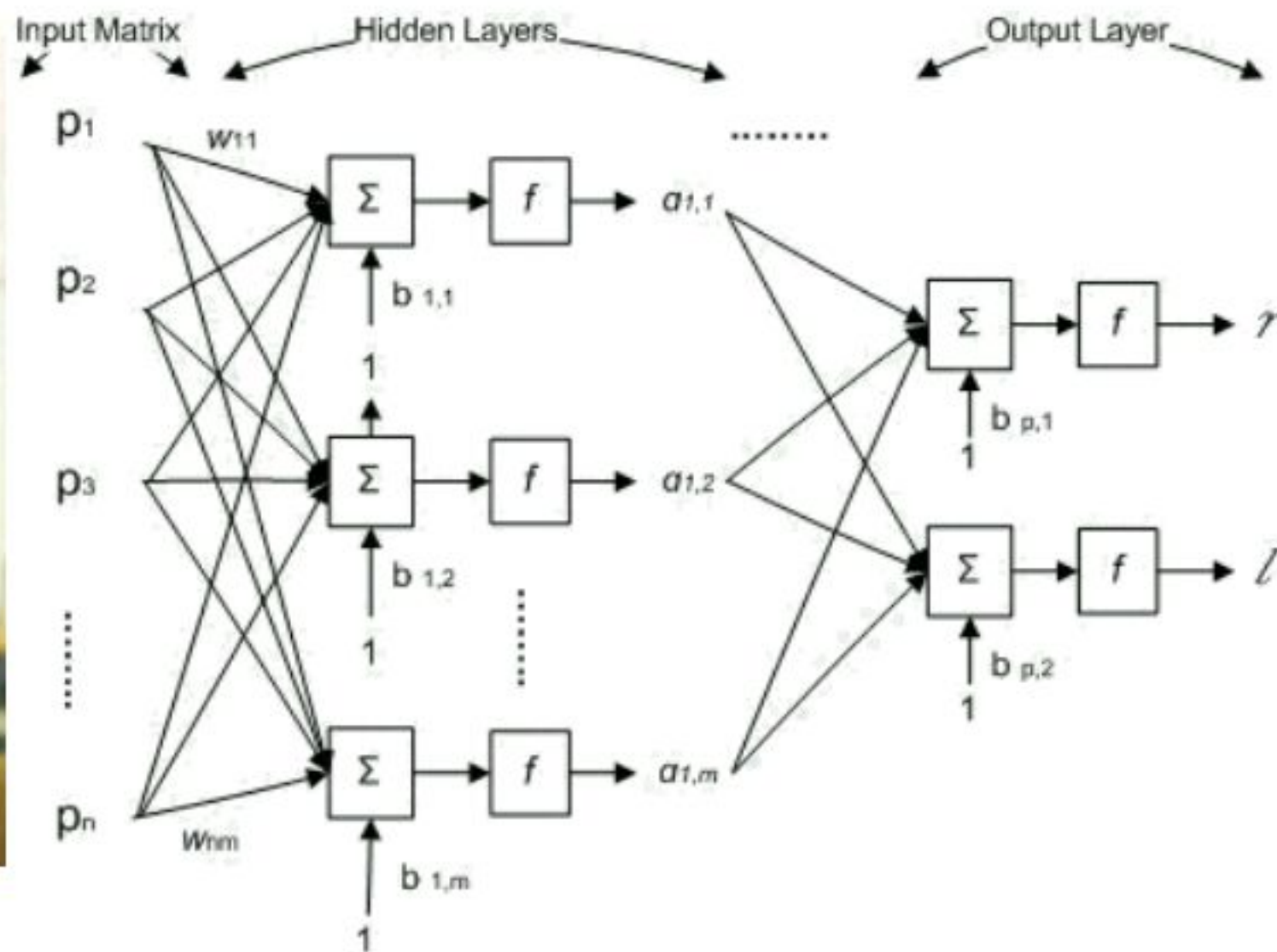
Research Result #5: Particle Filter Localization Algorithm

- Fusion sensors:
rotary encoder dead
reckoning + image-
based localization



A. A. Wardhana, E. Claresta, A. Widyotriatmo, Suprijanto, "Localization of mobile robot using a modified particle filter," *submitted to International Conference on Instrumentation, Control, and Automation, Aug 2013*

Research Result #6: Brain-Controlled Wheelchair



A. Kaysa, Suprijanto, A. Widyotriatmo, "Design of Brain-Computer Interface Platform for Semi Real-Time Commanding Electrical Wheelchair Simulator Movement," *will be published at International Conference on Instrumentation, Control, and Automation, Aug 2013*

Brain Controlled Wheelchair Experiment



Seminar on Brain Controlled Robots

- December 21, 2012

Seminar on Intelligent Wheelchair:

Towards Brain Controlled Robots

Friday, December 21, 2012

Speakers:
1. Augie Widyotriatno, ST, MT, Ph.D.
2. Dr. Supriyanto, ST, MT

Research Assistants:
1. Ayu Garota Risengtjani, ST, MT3, Alfan Keyse
Saqi Rhuul Fauzanfiq, ST4, Ananta Adhi Wardhana

13:30 - 14:15 with
Robotics: Command and Control
(Augie Widyotriatno, ST, MT, Ph.D.)

14:15 - 15:00 with
**Brain Signal Processing:
Features Extraction and Classification
for Movement Activities**
(Dr. Supriyanto, ST, MT)

af THE ASAHI GLASS FOUNDATION

Researchers

- Augie Widyotriatmo, Ph.D.
- Dr. Suprijanto
- Ayu Garetha, ST, MT
- M. Salehuddin ST
- Saqi Rauzanfiqr, ST.
- Affan Kaysa
- Ananta Adhi Wardana
- Evan Clearesta

Terima Kasih

