

# Toshihiko FUKUSHIMA

Robotics Researcher & Automotive Engineer



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## HARD SKILLS

- Robotics** Soft robot, Bio-inspired robot, Legged robot, **Musculoskeletal robot**, Biomechanics, **Biomimetics**, Control system, Statics, Machine learning, Embodied intelligence, Locomotion, Aerial righting, Soft actuator, Pneumatic actuator, Electrostatic actuator, **Artificial muscle**, **HASEL**, Data processing, Lidar, **Sensor fusion**
- Mechatronics** **Mechanical modeling**, CAE, **Circuit design**, PCB, Electrical modeling, **BLDC motor**, Field Oriented (vector) Control, T-Motor, DYNAMIXEL, **Embedded system**, Arduino, ESP32, STM32, SPI, I2C, SSI
- Sim. & CAD** Matlab, Simulink, Simscape, OpenHRP3, MuJoCo, DeepLabCut, **Solidworks**, CATIA, ADAMS
- Automobile** Chassis system, **Steering system**, Suspension system, **Vehicle dynamics**, **By-wire system**, Engine, EV-motor, Transmission system, **NVH**, **HiL**, **SiL**, **System bench**, **Vehicle test**, **MBD**, Rapid-ECU, System stability, Battery management, Heat management, Lifetime management, **Functional safety**, ISO26262
- Auto. soft.** dSPACE, MicroAutobox, ControlDesk, **ModelDesk**, RTI, ASM, **CarSim**, ATLAS, Romax, SharcNT
- IT** **Illustrator**, **Premiere Pro**, UNIX, Ubuntu, CentOS, DNS, Apache, Samba, OpenSSH, HTML5, CSS, Bootstrap

## SOFT SKILLS

- Communication** worked in **international teams** (6yrs) and coordinated global companies and institutions (6yrs)
- Management** experienced **global coordination** (6yrs), **project management** (10yrs), team management (3yrs)
- Innovation** have **interdisciplinary background** and created the **first legged robot with HASEL technology**. was selected in MPG research highlights 2024 (**12 selected papers among 15,000+ publications**)
- Productivity** published 12x papers (**Nat. Commun.**, **ICRA**, **Humanoids**), received **Young Investigation Excellence Award**
- Presentation** received a **presentation award**. conducted 6x robotic demonstrations and automotive demos individually to **2x Exec. Vice Presidents of Toyota**. presented in **5x TV shows**, 3x radios, 4x magazines, **200+ news articles**

## LANGUAGES

- Native: Japanese ●●●●●●
- Professional: English ●●●●○
- Beginner: German ●○●○●○  
Chinese ●○●○●○

## SOFTWARE LANGUAGES

- matlab, TeX ●●●●●●
- Python, Simulink, Arduino ●●●●●○
- HTML5, CSS, CAPL, Processing ●●●●○
- C, OpenCV, Shell script ●●●○●○
- C++, JavaScript, PHP, Go ●○●○●○

## WORKING EXPERIENCE



Mar. 2023 – Present

### Associated fellow

Max Planck ETH Center for Learning Systems (CLS), Stuttgart, Germany

#### Research embodied intelligence in soft robotics

- > collaborate with international institutions and universities
- > supervise master and bachelor students and guide junior PhD students
- > reach out to the media and public domains to share the research outcomes with society

Robotics Soft robotics Embodied intelligence Networking Team management Public relations Press release  
Media reaching Media interview Public speech Outreach Export control Event management Web development

### Doctoral Researcher

Max Planck Institute for Intelligent Systems, Stuttgart, Germany

#### Research soft robotics with soft electrohydraulic actuators (HASELs)

- > develop musculoskeletal robotic legs and proved their agile, adaptive, yet energy-efficient locomotion
- > develop compact sensing & control devices for high voltage robots (10kV) to optimize the system efficiencies
- > develop optimized controllers for electrostatic-based systems using electro-mechanical coupling

Robotics Bio-inspired robot Soft robot Musculoskeletal robot Embodied intelligence Dynamic locomotion Legged robot  
Soft actuator Electrostatic actuator Electrohydraulic actuator HASEL BLDC motor Field Oriented (vector) Control T-Motor  
DYNAMIXEL Mechanical modeling Electrical modeling Solidworks Robot experiment Sensor fusion Data processing  
Circuit design PCB Matlab Simulink Simscape MuJoCo Genesis DeepLabCut Python Arduino STM32 ESP32  
SPI I2C SSI HTML5 Modern CSS Hugo Blox Bootstrap



Sep. 2020 – Present



Sep. 2020 –  
Mar. 2021

## Research Engineer

*Max Planck Institute for Intelligent Systems, Stuttgart, Germany*

### Research morphological intelligence of animals and deploy them to robotic systems

- > developed bio-inspired robots (squirrel, gecko, fish) and tested them to understand their locomotion
- > built dynamic robotic models and explored optimized controls in simulation studies
- > published 3 journal papers and presented a poster in an international conference

Robotics   Mechatronics   Mechanics   Control system   Electronics   Electrostatics   Biomechanics   Bio-inspired robot  
 Soft robot   Dynamic locomotion   Soft actuator   Morphological intelligence   Climbing   Perching   Swimming   Aero-righting  
 Dynamics modeling   Robot experiment   Data visualization   Sensor fusion   Matlab   Simulink   Simscape   Python   Arduino



Oct. 2019 –  
Sep. 2021

## Application Engineer

*NTN Wälzlager (Europa) GmbH, Stuttgart & Erkrath, Germany*

### Develop bearing systems for automotive customers

- > developed the bearing systems through model studies, prototyping, testing and quality control
- > developed software for NVH analysis and data visualization
- > coordinate worldwide development teams and managed customer requirements and their deliveries

Automobile   Bearing   Steering system   Transmission system   EV motor   Project management   Requirements management  
 Quality management   Heat management   Lifetime management   System testing   NVH   CAE   Romax   SharcNT   Python



Feb. 2017 –  
Jan. 2018

## Control System Engineer

*Toyota Motorsport GmbH (TOYOTA GAZOO Racing GmbH), Cologne, Germany*

### Develop an Active Suspension System and coordinate international branches (Feb. 2017 – Jan. 2018)

- > modeled vehicles and suspension systems via dSPACE ASM, and test tracks via integrating GPS & LIDAR data
- > tested and validated vehicles and systems using HiL
- > developed vehicle simulation environment together with suspension in the loop system
- > Coordinate international branches and teams, and integrate multi-located systems

Automobile   Suspension system   Vehicle dynamics   MBD   HiL   SiL   Lidar   Linear actuator   Vehicle test   System test  
 Sensor fusion   CAN communication   dSPACE   ModelDesk   ControlDesk   RTI   MATLAB   Simulink   CarSim   ATLAS



Apr. 2014 –  
Oct. 2018

## Chassis System Engineer

*Toyota Motor Corporation, Susono & Toyota, Japan*

### Develop a steering-by-wire system for concept cars (Feb. 2018 – Oct. 2018)

- > developed test benches and HiLs integrated with rapid ECU systems for fail injection
- > developed a driving simulator to evaluate human-machine system during system fails
- > defined fail modes and functional safety concept of the system (ISO26262)

### Develop a steering and leaning by-wire system for a 3-wheeled ultra compact EV (Jan. 2016 – Jan. 2017)

- > developed system-vehicle simulations by integrating ADAMS and Simulink to evaluate vehicle stability
- > developed test benches and HiLs systems and their operations for heat, NVH and battery management

### Develop Electric Power Steering Systems (EPS) for mass production cars (Jun. 2014 – Dec. 2015)

- > developed steering system models (Mech. and E/E) and analyzed their system stability
- > analyzed NVH transfer paths by integrating ECU, accelerometer and microphone data
- > tested systems and vehicles for debugging and evaluating newly developed mechanisms and controllers

Automobile   Chassis system   Steering system   By-wire system   Vehicle dynamics   Vehicle simulation   Vehicle test   System test  
 NVH   MBD   BLDC-motor   Battery management   Heat management   System stability   Functional Safety   ISO26262   ECU  
 HiL   SiL   rapid ECU   CAN communication   MATLAB   Simulink   dSPACE   MicroAutoBox   CANoe   CarSim   CATIA   ADAMS



Apr. 2012 –  
Mar. 2013

## Technical Assistant

*The University of Tokyo, Tokyo, Japan*

### Manage UNIX servers and renewed a website in the laboratory

- > installed physical servers and maintained DNS, mail, HTTP and Samba servers
- > designed and developed the website via Twitter Bootstrap and PHP

IT   DNS   Apache   Samba   OpenSSH   Shell script   UNIX   Ubuntu   CentOS   HTML   CSS   PHP   Twitter Bootstrap



Feb. 2011 –  
Mar. 2011

## Internship

*Toyota Boshoku Corporation, Kariya, Japan*

### develop a charging and discharging system for a small electric vehicle

- > built a simulation system and developed a prototype for the system

Simulink   Electrical engineering   Ladder Control   Logic gate



Mar. 2021 – Present

### PhD (Robotics)

*Max Planck Institute for Intelligent Systems, Stuttgart, Germany*

Robotic Materials Department | Prof. Christoph Keplinger | Major: Robotics

- > research **soft robotics** with **soft electrohydraulic actuators** (HASELs)
- > develop **musculoskeletal robotic legs** and prove their agile, adaptive, yet energy-efficient locomotion
- > develop sensing and controlling devices for **high voltage systems** ( 10kV) to optimize system efficiencies
- > develop optimized controllers for electrostatic-based systems using **electro-mechanical coupling**
- > published **1 Journal paper**, took **5 robotic demos**, **10 media interviews**, and shown in **over 200 news articles** in **over 12 languages**

Robotics Soft robotics Mechatronics Mechanics Electronics Electrical engineering Computer science Statics Physics  
Material science Control system Biomechanics Biomimetics Locomotion Musculoskeletal robot Electrostatic actuator  
Electrohydraulic actuator HASEL



Apr. 2012 – Mar. 2014

### Master of Arts and Sciences (Interdisciplinary Information Studies)

*The University of Tokyo, Tokyo, Japan*

Intelligent Systems and Informatics Laboratory | Prof. Yasuo Kuniyoshi | Major: Robotics

thesis: “Active bending motion of pole vault robot to improve vaulting height”

- > developed a hypothesis in **pole vaulting** and automated simulation system for a robot with an **elastic pole**
- > developed a pole vaulting robot from **scratch** using **pneumatic actuators** (SH board + C)
- > developed **2 human interaction robots** and exhibit in events (Arduino + processing, OpenCV)
- > performed robot experiments for **2 pole vaulting**, **1 humanoid** and **2 animal robot** with **pneumatic muscle**
- > published **2 Journal papers**, **4 International conference papers**, **6 domestic conference papers**, **2 exhibitions** and took **3 awards**

Robotics Mechatronics Computer science Mechanics Electronics Control system Biomechanics Bio-inspired robot  
Pneumatic muscle Locomotion Musculoskeletal robot Sport biomechanics Dynamics Sensor fusion Embedded system  
Arduino motion capture Statics Machine learning MATLAB C C++



Apr. 2007 – Mar. 2012

### Bachelor of Engineering

*Toyota Technological Institute, Nagoya, Japan*













Control System Laboratory, | Prof. Tatsuo Narikiyo | Major: Control system

thesis: “Gait stabilization of passive dynamic walker by foot shape optimization”

- > developed cross-functional simulation system for shape optimization in a **passive dynamic walker**
- > developed a **prototype** of the passive dynamic walker
- > published **1 Journal paper**, **1 domestic conference paper** and took **1 award**

Mechatronics Mechanics Control system Robotics Computer science Electronics Production system  
Passive dynamic walking Optimization Genetic algorithm MATLAB C BASIC OpenHRP3

## MEDIA EXPOSURE

- > 7x TV shows: *BBC News* , *3sat*   , *SWR* , *YTN* , *WKYT* , *TNN* , *KBS* 
- > 3x Radio programs: *NDR* , *rbb24* , *Radio Eins* 
- > 4x Magazines: *National Geographic Deutschland*, *Wirtschafts Woche*, *Stuttgarter Maschinenbau*, *Max Planck Society Year book*
- > 200+ News articles in **12+ languages**: *REUTERS*, *AFP*, *heise*, *EL Economista*, *The National Tribune*, *THE HINDU*, *人民日报*, etc.

## HONORS

- > **Research highlights 2024**, *Max Planck Society*, selected 12 research articles out of 15,000+ publications in the year.
- > **Editors’ Highlights**, *nature communications*, 2024.
- > **Video Friday**, *IEEE Spectrum*, 2024.
- > **Young Investigation Excellence Award**, *The Robotics Society of Japan*, 2014.
- > **Scholarship for Students with Outstanding Achievements**, *Japan Student Services Organization (JASSO)*, 2014.
- > **Student travel grant**, *6th International Symposium on Adaptive Motion of Animals and Machines (AMAM)*, 2013.
- > **Presentation award**, *The 13th SICE System Integration Division Annual Conference (SICE SI)*, 2012.

## PUBLICATIONS

- > 9 journal papers (nature communications, PNAS, etc)
- > 5 international conference papers (ICRA, Humanoids, etc)
- > 7 Japanese conference papers

Details are shown in another document.