

# 2024 Summer internship recruitment theme

## ① Research area (Information/Mathematics)

Toyota Central R&D Labs. Inc.

T:National Institute of Technology (KOSEN) student, B:Undergraduate student, M:Master's course student, D:Doctoral course student

Num.	Research theme	Research content	Basic knowledge required	Number of people recruiting		Work location	Target students			
				Date 8/19~30	Date 9/2~13		T	B	M	D
A 1	Pedestrian Avoidance Behavior Modeling	Estimating parameters of avoidance behavior model for crowd density using VR experiment	Python	1person		Nagakute	○	○	○	○
A 2	Wireless communication performance measurement in real environments for realising multimodal communication	In this internship, we evaluate wireless communication performance in real environment utilizing various medium such as Local 5G, WiFi, and LPWA	Python	1person		Nagakute	○	○	○	○
A 3	Photon emission dynamics simulation	By using a simulator of photon-atom system, we analyze a photon emission phenomena and discuss its potential of applications.	Python	1person		Tokyo			○	○
A 4	Development of network simulator for V2X scenario evaluation	Utilize a network simulator to evaluate V2X scenarios and examine their basic performance.	C/C++		1person	Tokyo			○	○
A 5	Exploration of applications that promote city walking using geospatial information	Devise and prototype a mobile app that promotes city walking, and evaluate it by actually walking around the city. (Created by improving an app prepared in advance)	Python, Javascript	1person		Tokyo			○	○
A 6	Exploration of applications that promote city walking using geospatial information	Devise and prototype a mobile app that promotes city walking, and evaluate it by actually walking around the city. (Created by improving an app prepared in advance)	Python, Javascript		1person	Tokyo			○	○
A 7	Scenario analysis toward carbon neutrality	Statistical Analysis of the CO2 Emissions Trading Market in Europe	Statistical processing		1person	Nagakute			○	○
A 8	Scenario analysis toward carbon neutrality	Impact Assessment of Battery Resources on Decarbonization Measures in the Transportation Sector	Statistical processing		1person	Nagakute			○	○
A 9	Analysis of transportation mode choices	Explore an analysis of transportation mode choices under the subscription-based fare of public transit, using existing questionnaire data.	Statistical processing	1person		Nagakute			○	○
A 1 0	Material Synthesis Using Robotic Systems	Materials synthesis using robots and/or automated material synthesis equipment. Data analysis of the synthesized materials.	Material synthesis, MI, Robot control programming	1person		Nagakute			○	○
A 1 1	Calculation on spin qubit materials	Simulation of fundamental properties of spin quantum materials as a basic research for the exploration of quantum functional materials.	Quantum mechanics, Quantum chemistry	1person		Nagakute			○	○
A 1 2	An experimental study on group decision making problems using web apps	We run an experiment for group decision making problems using web apps such as oTree et al.			1person	Nagakute			○	
A 1 3	Survey of causal analysis methods	Compare and evaluate the performance of the latest causal analysis methods.	Python		1person	Nagakute			○	
A 1 4	Study of highly efficient AI using structured matrices	Investigate the performance of matrices with special structures and their application to machine learning models (especially neural networks).	Linear algebra		1person	Nagakute			○	○
A 1 5	Examination of Extraction of Various Information by Improving Vision Language Models	The goal is to add and train models based on the vision language model CLIP to extract a greater variety of information than previously possible.	Python	1person		Nagakute			○	○
A 1 6	Examination of Extraction of Various Information by Improving Vision Language Models	The goal is to add and train models based on the vision language model CLIP to extract a greater variety of information than previously possible.	Python		1person	Nagakute			○	○
A 1 7	Robot Control Using Digital Twins and Machine Learning	Utilize the digital environment on Nvidia Omniverse to design control systems, then implement these systems in real robots and evaluate their performance.	Python	1person		Nagakute			○	○
A 1 8	Validation of Crowd Control by Transportation Scheduling	Optimization and validation of traffic schedule for controlling human flow during crowded events	C++, Python		1person	Nagakute			○	○
A 1 9	Building surrogate models using CAE results	We will identify factors that strongly affect prediction accuracy of surrogate models and apply the models for optimization.	Machine learning, Mathematical optimization, Programming	1person		Nagakute			○	○
A 2 0	Study on prompt engineering for solving combinatorial optimization problems.	We study methodology on large language model for solving job-shop problems which are typical combinatorial optimization problems.	Python	1person		Nagakute			○	○
A 2 1	Application of mathematical optimization to factory equipment layout design	We will consider the way to apply mathematical optimization to realize a design that balances a close layout of equipments in a factory and installation of passages with high transport efficiency.	Mathematical optimization, Programming		1person	Nagakute			○	○
A 2 2	Development of a method for the mathematical modelling and evaluation of vehicle design information.	The study proposes useful evaluation methods and new structures by analysing the design information of automotive components into matrix information.	Python, MATLAB, Linear algebra		1person	Nagakute			○	○

# 2024 Summer internship recruitment theme

## ② Research area (Materials)

Toyota Central R&D Labs. Inc.

T:National Institute of Technology (KOSEN) student, B:Undergraduate student, M:Master's course student, D:Doctoral course student

Num.	Research theme	Research content	Basic knowledge required	Number of people recruiting		Work location	Target students			
				Date 8/19~30	Date 9/2~13		T	B	M	D
B 1	Carbon dioxide reduction reaction with molecular catalyst	Synthesis of multi-electron reduced products by electrochemical CO2 reduction using molecular catalysts	Inorganic/Organic chemistry		1person	Nagakute			○	○
B 2	Evaluation of Hansen solubility parameters (HSP) for high-cohesive energy materials	The intern will engage in fundamental study for HSP determination of high-cohesive materials, HSPs of which have never been measured with reasonable accuracy, through physicochemical analyses combined with data mining.	Chemical experiments	1person		Nagakute			○	○
B 3	Analysis of rheological behavior and microstructure on electrode slurries for lithium ion batteries	Characterization of flow behavior and microstructure for model electrode slurries by advanced rheological method	Chemical experiments	1person		Nagakute			○	○
B 4	Analysis of rheological behavior and microstructure on electrode slurries for lithium ion batteries	Characterization of flow behavior and microstructure for model electrode slurries by advanced rheological method	Chemical experiments		1person	Nagakute			○	○
B 5	Study on the simulation technology in lithium ion battery electrode manufacturing process	Reproduction and verification of the actual electrode manufacturing process (powder mixing, wet mixing, coating, drying, press, etc.) using computational techniques	Computational technology	1person		Nagakute			○	○
B 6	Study on the simulation technology in lithium ion battery electrode manufacturing process	Reproduction and verification of the actual electrode manufacturing process (powder mixing, wet mixing, coating, drying, press, etc.) using computational techniques	Computational technology		1person	Nagakute			○	○
B 7	Study of battery pretreatment technology to promote battery recycling and reuse	Study of processing conditions and observation of recovery behavior in battery capacity recovery technology using redox mediator	Chemical experiments	1person		Nagakute			○	○
B 8	Electrochemical characterization for advanced lithium-ion batteries	Fabrication of small-sized batteries of advanced electrode materials and their electrochemical characterization	Batteries with their materials		1person	Nagakute			○	○
B 9	Optimization of the microstructure of fuel cell electrode	Analyses of resistance in a fuel cell electrode by simulation			1person	Nagakute			○	○
B 1 0	Fabrication and analysis of fuel cell electrodes	Analyses of catalyst ink in fabricating fuel cell electrodes		1person		Nagakute			○	○
B 1 1	Application of machine learning for materials analysis	Machine learning applied to the measurement results of materials for electrification to analyze the characteristics.	Machine learning		1person	Nagakute			○	○
B 1 2	Development of predictive technology for metal 3D printing	Simulate part of the fabrication process using laser heat source for metal 3D printing	Computational technology		1person	Nagakute			○	○
B 1 3	Development of Microstructure Control for Metal Additive Manufacturing.	Developing Fe-based alloy powders, optimization technologies of building conditions, and analytical technologies to realize microstructure control unique to metal 3D printing	Microstructure analysis of metallic materials	1person		Nagakute			○	○
B 1 4	Upgrade of aluminum scrap	Removal of dissolved impurities in molten aluminum alloy scrap using thermodynamic approach	Phase diagram	1person		Nagakute			○	○
B 1 5	Power generation in aluminum recycling	Increase of power generation in chemical battery of aluminum scrap and copper ions.	Battery, Electric circuits	1person		Nagakute			○	○
B 1 6	Improving the reliability of bonding interface of EV power modules ~ Investigation of adhesive bonding interface of electronic components	Basic research on joining quality by cross-sectional microscopic observation of electronic component model samples.	Micro polishing, Microscopes	1person		Nagakute			○	○
B 1 7	Improving the reliability of bonding interface of EV power modules ~ Verification on adhesive bonding mechanism of electronic components	Based on the results of basic studies assuming electronic components, we will research model verification to improve the joining strength.	Material testing, Micro polishing, Microscopes		1person	Nagakute			○	○
B 1 8	Synthesis and Evaluation of Functional Inorganic Particles	Synthesis, Evaluation, and Fundamental Investigation of Functional Inorganic Particles for Enhanced Functionality.	Inorganic materials, Materials Synthesis, Materials Evaluation		1person	Nagakute			○	○
B 1 9	Numerical simulation of polymer flow	Perform a basic investigation for the development of polymer flow simulation.	Continuum mechanics, Programming	1person		Nagakute			○	○
B 2 0	Synthesis and evaluation of physical properties of novel recyclable polymers	Synthesize recyclable polymers by decomposition under specific conditions, and evaluate their mechanical properties.	Organic chemistry		1person	Nagakute			○	○
B 2 1	Metal-resin direct bonding with easy dismantling	Organic synthesis of metal surface treatment agents, bonding by resin injection molding, and evaluation of tensile strength.	Organic chemistry, Materials engineering	1person		Nagakute			○	○

2024 Summer internship recruitment theme

③ Research area (Energy, Environments, Mechanical engineering)

Toyota Central R&D Labs. Inc.

T:National Institute of Technology (KOSEN) student, B:Undergraduate student, M:Master's course student, D:Doctoral course student

Num.	Research theme	Research content	Basic knowledge required	Number of people recruiting		Work location	Target students			
				Date 8/19~30	Date 9/2~13		T	B	M	D
C1	Study of measuring the tooth surface temperature at high-speed gear	A fundamental study on the optimal lubrication method of high-speed gear will be investigated to measure the tooth surface temperature of it.	Mechanical experiments		1person	Nagakute	○		○	○
C2	Visualization of carbon neutral fuel combustion using optically accessible engines	Parts modification /assembly of optically accessible engines, and combustion visualization and analysis using a high-speed camera	Machine design, Machining	1person		Nagakute	○			
C3	Basic design and production for manufacturing	Machine parts design using CAD/CAE, processing and assembly using machine tools, and functional confirmation of prototypes	Machine design, Machining	1person		Nagakute	○			
C4	Basic design and production for manufacturing	Machine parts design using CAD/CAE, processing and assembly using machine tools, and functional confirmation of prototypes	Machine design, Machining		1person	Nagakute	○			
C5	Combustion reaction analysis of carbon neutral fuels	Analyzing the combustion reaction mechanism of carbon neutral fuels such as ammonia and hydrogen by chemila kinetic simulation	Fuel and Combustion	1person		Nagakute			○	○
C6	Estimation of gas temperature in engine-intake system using a model that combines physics and machine learning	We will verify the effectiveness of considering physical laws by comparing and analyzing a model that combines physics and machine learning and a model composed only of machine learning with gas temperature in engine intake system as the target.	Thermodynamics, Fluid mechanics	1person		Nagakute			○	○
C7	Materials research on electrochemical reduction of CO <sub>2</sub>	Synthesis of electrochemical catalysts, preparation of electrodes, electrochemical operation, and product analyses	Electrochemistry or Inorganic synthesis	1person		Nagakute			○	○
C8	Materials research on electrochemical reduction of CO <sub>2</sub>	Synthesis of electrochemical catalysts, preparation of electrodes, electrochemical operation, and product analyses	Electrochemistry or Inorganic synthesis		1person	Nagakute			○	○
C9	Building an energy management system that takes into account prediction uncertainty	We will examine energy management systems that take into account uncertainties in predicted values of energy demand and supply.	Mathematical optimization, Programming		1person	Nagakute			○	○
C10	Screening of adsorbents using machine learning potential	By calculating adsorption energy using machine learning potential, we will screen adsorbents suitable for specific applications.	Machine learning, Programming		1person	Nagakute			○	○
C11	Study on Electric Vehicle dynamics control and power consumption	Simulation about the Electric Vehicle dynamics control that reduced power consumption	MATLAB Programming	1person		Nagakute			○	○
C12	Study on Electric Vehicle dynamics control and power consumption	Simulation about the Electric Vehicle dynamics control that reduced power consumption	MATLAB Programming		1person	Nagakute			○	○

2024 Summer internship recruitment theme

④ Research area (Electronics, Biotechnology, Human and Life sciences)

Toyota Central R&D Labs. Inc.

T:National Institute of Technology (KOSEN) student, B:Undergraduate student, M:Master's course student, D:Doctoral course student

Num.	Research theme	Research content	Basic knowledge required	Number of people recruiting		Work location	Target students			
				Date 8/19~30	Date 9/2~13		T	B	M	D
D1	Building a safe experimental environment using image recognition	Design, implement, and evaluate a monitoring system that combines image recognition and safety equipment using Raspberry Pi.	Electronic circuits, programming	1person		Nagakute	○			
D2	Building a safe experimental environment using image recognition	Design, implement, and evaluate a monitoring system that combines image recognition and safety equipment using Raspberry Pi.	Electronic circuits, programming		1person	Nagakute	○			
D3	Data-driven modeling of semiconductor manufacturing process	Create and verify a semiconductor manufacturing process model using various data obtained during the semiconductor manufacturing process.	Python	1person		Nagakute	○	○	○	
D4	Evaluation and analysis of silicon photonic devises	Evaluation experiment of basic elements of silicon photonics and analysis of results by device simulation.	Physical optics		1person	Nagakute	○	○	○	○
D5	High-precision 3-axis gyroscope	Dynamic/static performance evaluation of the 3-axis gyroscope for expecting automotive use	MATLAB, Simulink		1person	Nagakute		○	○	
D6	Measuring technology for soil properties using wireless underground communication	Observation of microwave response underground and basic study of measurement technology for moisture content, EC, etc.	Signal processing, programming		1person	Nagakute		○	○	○
D7	Basic studies of biogas sensing devices and systems	To understand the performances of low concentration gas sensors, their basic properties are studied.	Materials engineering	1person		Nagakute		○	○	○
D8	Basic studies of human fatigue sensing technology	Basic studies of human fatigue sensing by bio-impedance measurements.	Electronic circuits, Electromagnetics	1person		Nagakute		○	○	○
D9	Integrated nanophotonics; simulation and measurements	Simulation and measurements related to nonlinear optics and nanophotonics	Physics experiments		1person	Nagakute			○	○
D10	Crystal growth of GaN by vapor-phase growth method	Investigation of crystal growth of GaN using CVD equipment	Material synthesis and analysis	1person		Nagakute			○	○
D11	Co-creation by multiple AI agents	Develop a brainstorming system involving multiple LLM-based AI agents and validate its effectiveness	Python	1person		Nagakute			○	○
D12	Co-creation by multiple AI agents	Develop a brainstorming system involving multiple LLM-based AI agents and validate its effectiveness	Python		1person	Nagakute			○	○
D13	Evaluation and Modeling of Techniques for Switching Losses in Multi-level Converter	Develop technology to automatically measure switching losses of high-voltage MOSFETs operating under various conditions. And evaluate and improve the loss model.	Switching circuits	1person		Nagakute			○	○
D14	Simulation model building for a wide bandgap semiconductor device	Evaluate the electrical characteristics of wide bandgap semiconductor devices (transistors or diodes) and build device simulation models.	Semiconductor devices (transistors)		1person	Nagakute			○	○
D15	Analysis of brain activity during video viewing	Study the relation between brain activity and visual feature of the stimulus.	MATAB, Python	1person		Nagakute			○	○
D16	Design and Simulation of Microfluidic Channels	Simulate the behavior of droplets in microfluidic channels and design optimal channels.	Microfluidics, Fluid simulation	1person		Nagakute				○
D17	Genome mapping and comparative genomics	Mapping the genome sequence of mutants and performing comparative analysis to search for mutations and structural changes.	Bioinformatics		1person	Nagakute			○	○
D18	Biodiversity monitoring using environmental DNA	Environmental DNA analysis	Life science	1person		Nagakute			○	○
D19	Synchronous Analysis of Electroencephalogram and Creativity	Simultaneous analysis of multiple people's Electroencephalogram	Human science		1person	Nagakute			○	○