

Statement of Purpose

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CMU Robotics Institute Summer Scholars (RISS) Program

I build robotic systems by integrating hardware and software into working physical machines, as demonstrated by leading a team to success at an international robotics competition. Through this experience, I became interested in research on coordinated systems, where multiple components work together to achieve a single physical goal. At RISS, I want to study such systems as real machines and develop them as research.

At RoboCup, an international robotics competition, I led a team to first place by building a reliable robotic system. In a real-world setting, I helped turn an idea into a robust physical platform that could be evaluated. I contributed across hardware and mechanical integration, low-level control, and software implementation. For example, I designed a custom low-latency communication architecture using RS485 and ZigBee to achieve synchronized real-time behavior across 12 robots, comprising over 50 microcontrollers.

Through competition, I gained experience designing and implementing solutions for well-defined problems. I am now interested in research problems where the correct answer and evaluation criteria are not predefined, and where the questions themselves must be designed and validated.

This perspective on coordinated physical systems is reflected in several research projects at the Robotics Institute.

PuzzleBots, developed by Zeynep Temel and Katia Sycara, explores systems where multiple robots cooperate, including through physical connections. In this work, a global goal is divided into local roles and actions that each robot can perform.

In Solid Knitting, led by James McCann (though not listed, I have a strong interest in his lab), simple elements such as needles and stitches are used to build three-dimensional objects. I am drawn to how complex physical structures emerge from many simple actions through tight integration of software and machines.

In Linear Delta Arrays, studied by Zeynep Temel and Oliver Kroemer, many small delta robots work together to manipulate objects. I am especially interested in how coordination among many robots makes it possible to control physical contact with objects.

Across these examples, I see a common challenge: making coordinated systems work as real physical machines. I am also interested in platforms such as RoboLoom by Melisa Orta Martinez and Modular EigenBots by Howie Choset, which explore coordinated physical

systems through fabrication tools and reconfigurable robot modules. At RISS, I want to contribute to this challenge by helping design, build, and test such systems, and by turning them into publishable research results.

Beyond technical implementation, I am also committed to contributing to the developer community, as demonstrated by founding a student robotics expo in Japan to connect young developers with experts.

I am especially interested in the RISS program because it focuses on short-term, project-based research with clear outcomes. I want to contribute as a hands-on researcher who can quickly turn ideas into working physical systems, especially in projects that require close integration of hardware, low-level control, and software. Based on my experience building reliable robotic systems with many components, I am ready to take responsibility for system-level implementation while working closely with faculty mentors.

Through RISS, I hope to learn how coordinated robotic systems can be developed into research contributions suitable for publication within a limited time, as preparation for pursuing a PhD.