Future Research Plan

Tetsuo Harada

I am particularly interested in operator inequalities involving convex and concave functions, such as Jensen ' s inequality and the AG-mean inequality. Some of these inequalities have extremely simple forms, yet it remains unknown whether they hold. I aim to contribute to resolving such open problems.

In recent years, my focus has expanded to developing unified approaches that can derive multiple operator inequalities simultaneously, rather than proving them individually. This structural perspective connects naturally with other fields such as functional analysis and harmonic analysis, suggesting broad interdisciplinary potential.

Currently, I am studying how to construct large matrices using symmetric and anti-symmetric tensor products. These constructions often lead to intriguing patterns in eigenvalues, traces, and norms, and they align well with majorization-type inequalities. I have already proven several inequalities using this method, and I believe there is much more to explore.

In addition, over the past two years, I have been engaged in data analysis projects aimed at applying mathematics to industry. A major task has been to provide "mathematical validation" for results produced by AI —essentially, building mathematical models that justify AI outcomes. This has led me to a deeper interest in understanding and interpreting neural networks through mathematics. By analyzing their structure, node computations, and optimization methods, I hope to contribute to more effective design and training of AI models.

I am also involved in collaborative research with Prof. Kenji Kimura of Matsue National College of Technology, focusing on equations of motion for robots. My experience working with industry has highlighted the value of applying mathematics across disciplines. Recently, I collaborated with Associate Professor Yoichi Mototake of Hitotsubashi University on problems in physics, and I hope to continue such interdisciplinary research in the future.