Division of Electrical, Information and Communication Engineering	Research field	Emergent Mathematical Engineering	Lab. ID EI34
Laboratory web site			

Research subjects

Informational geometry is a branch of mathematics that analyzes probability distributions and statistical models by introducing geometric structures into them. It is characterized by approaching statistical problems from a geometric perspective, which enables an intuitive and theoretical understanding of the fundamental structures underlying statistical inference and machine learning algorithms.

In information geometry, by introducing the parameters of a probability distribution as coordinates, the entire set of probability distributions is treated as a single space. This space is called a statistical model, and it is known mathematically to possess a smooth structure known as a manifold. By viewing statistical models as manifolds, analysis using the framework of differential geometry becomes possible, leading to a deeper theoretical understanding of statistical inference.

In particular, the Fisher information inherent in statistical models can be interpreted as a Riemannian metric that defines the “distance” between two points. This leads to the interesting feature that the accuracy of parameter estimation and the properties of estimators manifest as geometric structures, such as curvature. Furthermore, basic statistical models known as the exponential family possess rich geometric structures, such as dual flatness with respect to connections, and we will use these to elucidate statistical models.

Master/Doctor course: Education policy, curriculum, typical activity in the laboratory

In the Master course, students learn the fundamentals of probability theory, statistics, and differential geometry through seminar-style discussions, and engage in specific research projects utilizing concepts from computational geometry. In the Doctor course, students delve into more theoretical aspects, aiming to elucidate the geometric structures of statistical models and construct new theories.

Daily life in the laboratory, etc.

Within the theoretical disciplines, this lab falls under mathematics, and research activities are not constrained by location or time. However, since seminar presentations require a significant amount of preparation, I think a strong sense of self-discipline is essential.

Message or comments by the laboratory faculty staffs

I welcome students who are interested in mathematics and wish to gain a deep understanding of the theoretical foundations of statistics, data analysis, and machine learning.

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