論 文 の 内 容 の 要 旨

論文題目　Algorithmic Study on Randomness in Graphs
（グラフのランダムネスに関するアルゴリズムの研究）

氏　名　清水　伸高

We investigate the properties of a typical object. To state it more formally, we consider a random object drawn from a specific distribution and evaluate the probability that the random object satisfies a certain property. In particular, we focus on random graphs and randomized graph algorithms.

First, we consider the biclique subgraphs counting problem and show a sharp threshold result: As a positive result, we present an algorithm that solves the problem for any input. As a negative result, we prove that any slightly faster algorithm fails to solve the problem on most of the random graph under a widely-investigated conjecture. At the heart of this result, we present a general framework of fine-grained hardness amplification, which is inspired by the classical technique from average-case complexity.

The next topic is a voting process that is a certain type of randomized distributed algorithms on a graph. Voting processes are known as simple models of consensus dynamics. We consider voting processes on the stochastic block model and obtain a phase transition result regarding the consensus dynamics. We then introduce a new notion of quasi-majority functional voting that contains several previously-known voting processes. We then prove that the dynamics of any quasi-majority functional voting on expander graphs consists converge to consensus quickly.

The third topic is random walks on growing networks. A random walk on dynamic networks has gathered special attention since real-world networks change their structure over time. We propose a new model of random walks on a growing graph and then study their performance.

Finally, we explore the average distance and diameter of dense random regular graphs. The average distance and diameter of regular graphs attract special attention in the area of high-performance computing. In particular, we prove that

the diameter of a random regular graph is likely to be asymptotically optimal under a certain mild condition of the degree.