先端科学技術研究科　修士論文要旨

<table>
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<tr><td>論文題目</td><td colspan="3">A Study on Almost Time-Optimal Loosely-Stabilizing Leader Election over Arbitrary Graphs in the Population Protocol Model</td></tr>
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要旨

We consider the population protocol model, introduced by Angluin et al.¥ (2006), in which there are n agents that form a communication network. We assume that the network is an arbitrary anonymous graph.
A self-stabilizing leader election protocol elects a unique leader from any initial configuration. Unfortunately, there is no such protocol on arbitrary graphs unless the exact number of agents, n, is given.
To break this impossibility, Sudo et al.¥ (2012) proposed the concept of loose-stabilization, which is a relaxation of the closure property of self-stabilization.
A loosely-stabilizing leader election protocol elects a unique leader from any initial configuration within a relatively short time and maintains the leader for a relatively long time.
In a prior study, it was shown that the lower bound of the convergence time for achieving a holding time of $¥Omega(e^N)$ is $¥Omega(mN)$, where m denotes the number of edges in a graph and N denotes an upper bound on n.
There are three settings: agents have unique identifiers, agents can generate random numbers, and agents have neither.
Sudo et al.¥ (2019) proposed an almost time-optimal protocol that uses unique identifiers and converges within $O(mN¥log n)$ expected steps. However, in other settings, there is no protocol that achieves convergence within that time.
In this paper, we propose protocols that do not require unique identifiers. These protocols achieve convergence times close to the lower bound with increasing memory usage.
Specifically, given N and an upper bound $¥Delta$ for the maximum degree, we propose two protocols whose convergence times are $O(mN¥log n)$ and $O(mN¥log N)$ both in expectation and with high probability. The former protocol uses random numbers, while the latter does not require them. Both protocols utilize $O(¥Delta ¥log N)$ bits of memory and hold the specification for $¥Omega(e^{2N})$ expected steps.