Research statement

Ayaka SHIMIZU
January 12, 2024

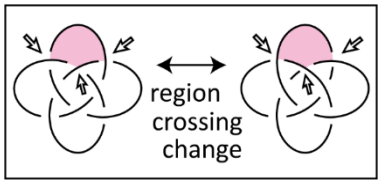
Warping degree

The warping degree, defined by Kawauchi, is a numerical value representing a complexity of a knot diagram. I have studied warping degree and characterized prime alternating knots. I also created new matrix representations for knots. While the warping degree is a quantity based on over/under information of crossings of a knot diagram, I found that the warping degree works on knot projections as well. Then I defined the “minimal warping degree” for knots and the “alternating warping degree” for knot projections, which may be useful to measure some kind of softness of knots.

Region crossing change

The region crossing change, defined by Kishimoto, is a local move on a knot or link diagram. I have studied region crossing change and proved that any single crossing change on a knot diagram can be realized by a finite number of region crossing changes. Using the fact, I defined a knot invariant, the “region unknotting number,” and showed some inequalities with respect to the crossing number. Recently I succeeded in organizing series of the studies of region crossing change and related topics using the Boolean algebra.

I have also studied region crossing changes on link and spatial-graphs and found some properties and behaviors. Recently I applied a study of origami to define a new link invariant regarding region crossing change.



Reductivity

I defined the “reductivity” which represents how reduced a knot projection is. Considering unavoidable sets of parts of a knot projection, I showed that any knot projection has reductivity four less. At the moment, however, no examples of a knot projection of reductivity four have been found. One of my goals is to solve the problem about the existence of a knot projection with reductivity four. While addressing the problem, I have found further interesting unavoidable sets.