Research achievements　Ayaka Shimizu

I have studied knot and link diagrams by considering the warping degrees, warping polynomials, and other invariants. I have also studied local moves of links.

Warping degree of a knot diagram

The study of alternating knots is very important in knot theory. The warping degree of an oriented link diagram, defined by Kawauchi, represents a complexity of the diagram.　I showed in [1] an inequality of the warping degree and the crossing number of a knot diagram, and showed that the equality holds if and only if the diagram is alternating. I also defined a knot invariant via the warping degree, and showed an inequality of the invariant and the crossing number of a knot, which characterizes a prime and alternating knot.
In [2], I generalized the results in [1] to links, and defined the warp-linking degree of a link diagram as a restricted warping degree. I characterized a equilibrial link by the warp-linking degree (cf. [4]).

Warping polynomial of a knot diagram

I defined the warping polynomial of an oriented knot diagram via warping degrees. The polynomial has a lot of information of a diagram (e.g., the crossing number), and characterizes an alternating diagram and a one-bridge diagram. I have characterized the warping polynomial, and estimated the dealternating number of a knot by considering the minimal span of the polynomial in [6].
I also defined the warping crossing polynomial as a joint work with A. Kawauchi, and studied the state sum in [7]. We also showed canonical orientations of a knot projection in [7].

Complete splitting number of a lassoed link

In knot theory, the splittability is one of basic concepts. In [3], I defined lassoing, which is a local move on a link, and showed the upper bound and the lower bound of the complete splitting number of a lassoed link. By the result, the complete splitting number of a link obtained from any knot by r iterated lassoings is just r, and we can construct a link which is algebraically completely splittable and whose complete splitting number is r by lassoings. I showed in [3] formulae for the Conway polynomial and the Alexander polynomial with respect to a lassoing.

Region crossing change on knot diagrams

In [5], I gave the positive answer for Kishimoto's question asking "Is a region crossing change on a knot diagram an unknotting operation?" Then I defined the region unknotting number of a knot diagram and a knot, and showed that for any non-negative integer n, there exists a knot whose region unknotting number is n. I also showed an equality of the region unknotting number and the crossing number of a knot. As an application, I created with Kawauchi and Kishimoto the games "Region Select" and "Region Lighten" and applied Japanese patents.

Half –twisted splice on knot projections

I showed in [8] as a joint work with Ito that any nontrivial reduced knot projection can be obtained from a trefoil projection by a finite sequence of half-twisted splices without becoming a reducible projection.