Ph.D. Thesis

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A Sequence of Degree One Vassiliev Invariants for Virtual Knots

Abstract

For ordinary knots in 3-space, there are no degree one Vassiliev invariants. For virtual knots, however, the space of degree one Vassiliev invariants is infinite dimensional. We introduce a sequence of three degree one Vassiliev invariants of virtual knots of increasing strength. We demonstrate that the strongest invariant is a universal Vassiliev invariant of degree one for virtual knots in the sense that any other degree one Vassiliev invariant can be recovered from it by a certain natural construction. To prove these results, we extend the based matrix invariant introduced by Turaev for virtual strings to the class of singular flat virtual knots with one double-point. We also introduce invariants for virtual links, find the range of values of each of our invariants, and discuss applications to virtual unknotting and unlinking numbers.