

Is there a Hilbert's Nullstellensatz for finite type invariants of links?

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Let k be an algebraically closed field and let I be an ideal in the polynomial ring $k[x_1, \dots, x_n]$. The Hilbert Nullstellensatz (see e.g. [E]) says that the ideal of polynomials in $k[x_1, \dots, x_n]$ that vanish on the variety defined by the common zeros of all polynomials in I is the radical of I .

Problem: Is there a similar statement for finite type invariants of links? Let I be an ideal in the algebra V of finite type invariants of links. Let Z be the set of links that are annihilated by all members of I , and let J be the ideal in V of all invariants that vanish on Z . Clearly, J always contains the radical of I . Are they always equal?

Example: Let I be the ideal generated by linking numbers. In this case, Z is the set of algebraically split links. Is it true that every finite type invariant that vanishes on algebraically split links is a sum of multiples of linking numbers by arbitrary other finite type invariants of links? I believe it is true, and I believe it follows from the results of Appleboim [A], but I'm afraid Appleboim's paper is incomplete and while I believe it I cannot vouch for its validity.

Remark: One may also ask, "what is the Zariski closure of a given set of links?". I believe that in the light of the paragraphs above the meaning of this question should be clear. I know of at least one interesting example: In [N] Ng shows that the Zariski closure of the set of ribbon knots is the set of knots whose Arf invariant vanishes.

References:

[A]

E. Appleboim, *Finite type invariants of links with fixed linking matrix*, [arXiv:math.GT/9906138](https://arxiv.org/abs/math/9906138).

[E]

D. Eisenbud, *Commutative Algebra With a View Toward Algebraic Geometry*, Graduate Texts in Mathematics **150**, Springer-Verlag, 1994.

[N]

K. Y. Ng, *Groups of ribbon knots*, [arXiv:q-alg/9502017](https://arxiv.org/abs/q-alg/9502017).