A generalization of Rasmussen’s invariant, with applications to surfaces in some four-manifolds

Abstract:

Building on previous work of Rozansky and Willis, we generalise Rasmussen’s s-invariant to links in connected sums of $S^1 \times S^2$. Such an invariant can be computed by approximating the Khovanov-Lee complex of a link in $\#^r S^1 \times S^2$ with that of appropriate links in $S^3$. We use the approximation result to compute the s-invariant of a family of links in $S^3$ which seems otherwise inaccessible, and use this computation to deduce an adjunction inequality for null-homologous surfaces in a (punctured) connected sum of $CP^2$. This inequality has several consequences: first, the s-invariant of a knot in the three-sphere does not increase under the operation of adding a null-homologous full twist. Second, the s-invariant cannot be used to distinguish $S^4$ from homotopy 4-spheres obtained by Gluck twist on $S^4$. We also prove a connected sum formula for the s-invariant, improving a previous result of Beliakova and Wehrli. We define two s-invariants for links in $\#^r S^1 \times S^2$. One of them gives a lower bound to the slice genus in $\#^r S^1 \times B^3$ and the other one to the slice genus in $\#^r D^2 \times S^2$. Lastly, we give a combinatorial proof of the slice Bennequin inequality in $\#^r S^1 \times S^2$. 

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