Publication List and Research Themes
Ryan C. Blair

My research focus is knot theory and low-dimensional topology. I study structure problems for 3-manifolds by analyzing the knots and surfaces they contain. My approach could be described as neoclassical in that I apply modern techniques such as thin position and distance in the curve complex to classical constructions such as Heegaard splittings, Dehn surgery and diagrammatic knot invariants.

Research Themes

High Distance Surfaces and Dehn Surgery. The study of Dehn surgery is of central importance in the study of 3-manifolds and a vast amount of work over the last several decades has produced deep connections between the combinatorics of Dehn surgery and the geometric structure of 3-manifolds. Recently, high distance surfaces have been used to construct counter examples to several well known conjectures in knot theory and 3-manifold topology. In recent work, my collaborators and I have resolved several classical conjectures in Dehn surgery, such as the Berge Conjecture and the Cabling Conjecture, for knots that contain high distance surfaces. The first theme of my research is to develop the theory of high distance surfaces and to explore these new connections between high distance surfaces and Dehn Surgery.

High Distance Bridge Surfaces. (with M. Tomova and M. Yoshizawa)
Arxiv:1203.4294

Bridge Distance, Heegaard Genus, and Exceptional Surgeries. (with M. Campisi, J. Johnson, S. Taylor, M. Tomova)
Arxiv:1209.0197

Genus Bounds Bridge Number for High Distance Knots (with M. Campisi, J. Johnson, S. Taylor, M. Tomova)
ArXiv:1211.4787

Distance Two Knots (with M. Campisi, J. Johnson, S. Taylor, M. Tomova)
In Preparation

Width and Bridge Number of Knots. Width and bridge number are invariants of knots and links in the 3-sphere that have important implications for the topology of the knot exterior. Width has played an integral part in several celebrated results in 3-manifold topology including Gabai's solution to the property R conjecture, Gordon and Leuke's solution to the knot complement problem and Thompson's solution to the recognition problem for S^3. Bridge number is the classical precursor to width and measures the inherent complexity in certain universal constructions of knots. Despite many successful applications of these invariants, fundamental questions regarding their behavior remain unanswered. The second theme of my research is to develop a greater understanding of the behavior of width and bridge number with an eye toward broadening the applications of these invariants to general 3-manifolds.

Bridge Number and Conway Products.
Algebr. Geom. Topol. **10**: 789-823 (electronic), 2010.

Companions of the Unknot and Width Additivity. (with M. Tomova)
Journal of Knot Theory and its Ramifications, **20**: 497-511, 2011.

Width is Not Additive. (with M. Tomova)
ArXiv:1005.1359 To appear in Geometry & Topology

Bridge Number and Tangle Products
Arxiv:1108.5640 To appear in Algebraic & Geometric Topology

Thin Knots with Compressible Thin Levels (with A. Zupan)
In Preparation.

Topology of Knot Exteriors Via Knot Diagrams. Knot diagrams are two-dimensional representations of knots that completely encode the 3-dimensional topology of the knot. Several very old open conjectures in knot theory relate the combinatorics of the knot diagram to the topology of the knot exterior. In recent work, my collaborators and I have shown a strong connection between certain combinatorial complexities of knot diagrams and the existence of essential surfaces in knot exteriors. These connections produce examples of knots with interesting topological properties and are likely to extend to surfaces that are not essential, such as Heegaard surfaces. The third theme of my research is to develop the connection between knot diagrams and the topology of knot exteriors.

Alternating Augmentations of Links.
Journal of Knot Theory and its Ramifications, **18**: 67-73, 2009.

Complexity Bounds for Knot Diagrams Via Essential Surfaces (with D. Futer and M. Tomova)
In Preparation.

Studying the String Link Monoid via 3-Manifold Techniques. String links are an alternative incarnation of links that allow for an interesting binary operation known as stacking. Under this operation, string links form a monoid. In general, almost nothing is known about the algebraic structure of this monoid. However, in ongoing work, my collaborators and I have applied 3-manifold techniques to the study of this monoid with significant success. Beginning with the recent work of Budney, the study of the space of all long knots and the space of all string links has seen great advancements due to the application of geometrically inspired operands. Progress on the study of the string link monoid promises to have implications for the study of relevant operands and, thus, the space of all string links. The final theme of my research is to make explicit the algebraic structure of the string link monoid and to use this structure to study the space of all string links.

The String Link Monoid (with R. Koytcheff and J. Burke)
In Preparation.