Geometric Knot Theory

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Geometric knot theory studies how geometric properties of space curves relate to their topological knot type. We will give a survey of the field, starting with one of the earliest results, the Fáry/Milnor theorem relating total curvature to bridge number. Work in recent decades has been partly motivated by applications to the shapes of knotted polymers like DNA molecules. One interesting problem with some surprising answers asks for the shapes of knots and links tied tight in rope of fixed thickness. We will consider this ropelength problem, describing for instance an explicit shape for the tight Borromean rings, as well as analogous problems for periodic links in space and for knot diagrams in the plane. Finally, we will also mention elastic knots, Gromov's notion of distortion, and the second hull of a knot or link.