



$$\left(\frac{\partial \vec{r}(s)}{\partial s} \right)^2 = 1$$

Unit tangent vector

$$\left(\frac{\partial^2 \vec{r}(s)}{\partial s^2} \right)^2 = \frac{1}{R^2}$$

Chain curvature

$$E_{bend} = \frac{k_B T l_p}{2} \int_0^L ds \left(\frac{\partial^2 \vec{r}(s)}{\partial s^2} \right)^2$$

Bending deformation energy