

MATH 1336: Calculus III

Section 3.3: TNB Frame

TNB Frame:

At any point on a smooth curve, $\vec{r}(t)$, where $\vec{T}'(t) \neq \vec{0}$, we can define the following set of vectors. Note that these vectors all have unit length, and are all mutually orthogonal.

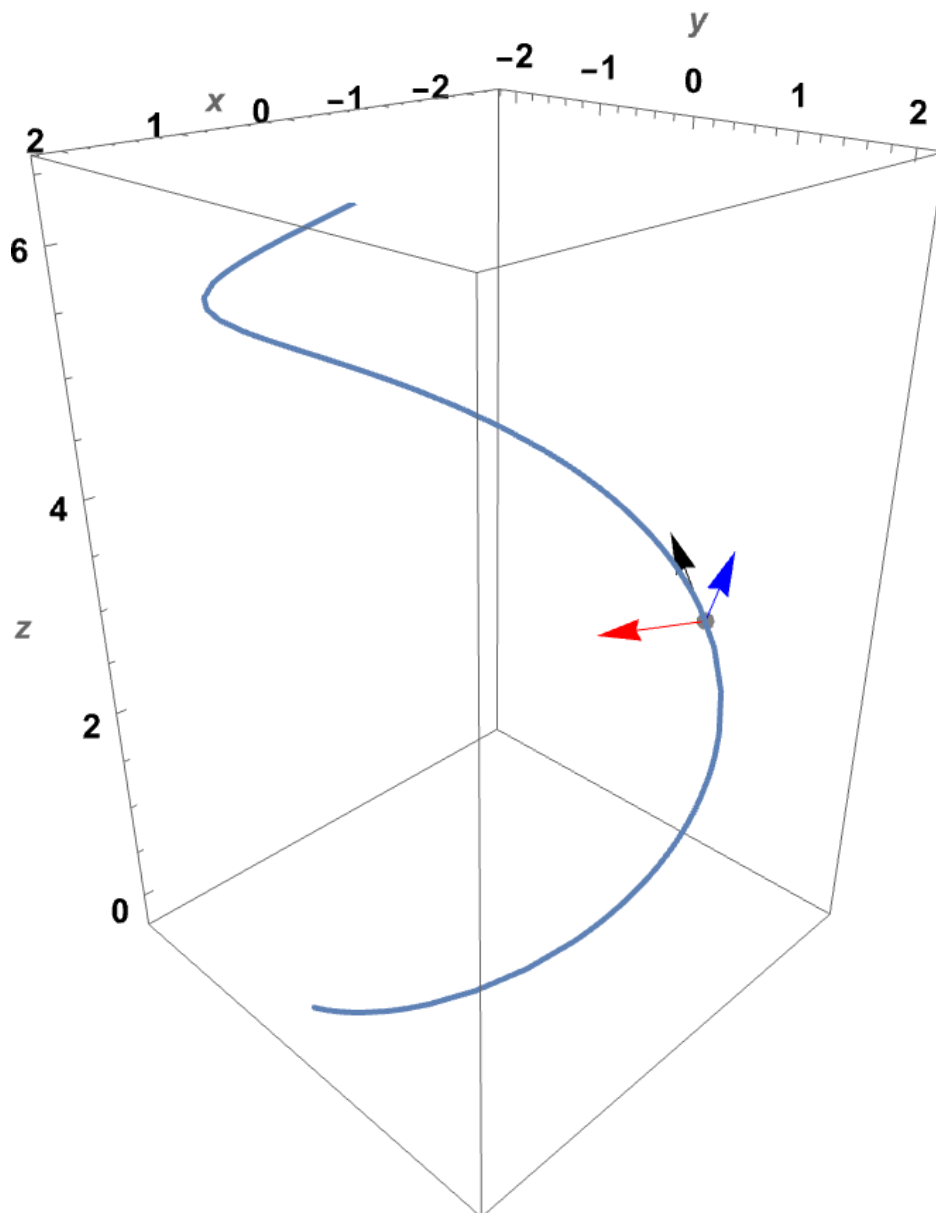


Figure 1: TNB Frame plotted at a point along the helix from the Chapter 3, Part 1 Worksheet.

Unit Tangent Vector:

$$\vec{T}(t) = \frac{\vec{r}'(t)}{\|\vec{r}'(t)\|}$$

Unit Normal Vector:

$$\vec{N}(t) = \frac{\vec{T}'(t)}{\|\vec{T}'(t)\|}$$

Binormal Vector:

$$\vec{B}(t) = \vec{T}(t) \times \vec{N}(t)$$

The **TNB Frame**, also known as the **Frenet frame of reference**, is the the three-dimensional frame of reference formed by the unit tangent vector, \vec{T} , the unit normal vector, \vec{N} , and the binormal vector, \vec{B} . They form a moving reference frame at any point on a given smooth curve.

Note that the **osculating circle** lies in the plane determined by the vectors \vec{T} and \vec{N} .

(See Mathematica demonstration)