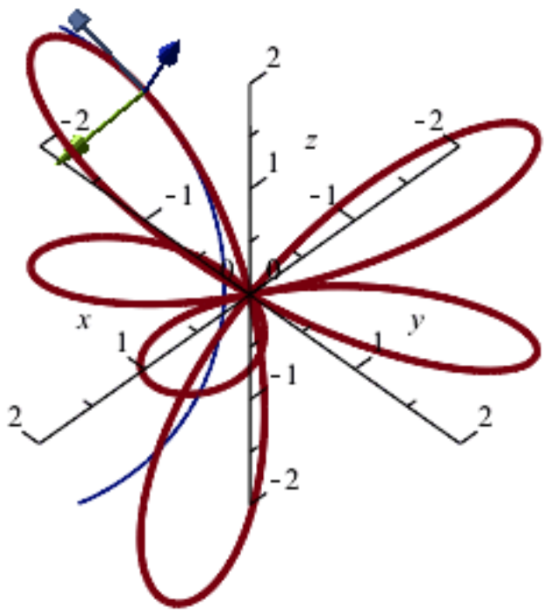

PLOT #4: TNB vectors with osculating circle on <2*sin(3 t)*cos(t),2*sin(3 t)*sin(t),sin(3 t)>

Section 1-8 : Tangent, Normal And Binormal Vectors

In this section we want to look at an application of derivatives for vector functions. Actually, there are a couple of applications, but they all come back to needing the first one.

In the past we've used the fact that the derivative of a function was the slope of the tangent line. With vector functions we get exactly the same result, with one exception.

Given the vector function, $\vec{r}\,(t)$, we call $\vec{r}^{\,\prime}\,(t)$ the **tangent vector** provided it exists and provided $\vec{r}^{\,\prime}\,(t) \neq \vec{0}$. The tangent line to $\vec{r}\,(t)$ at P is then the line that passes through the point P and is parallel to the tangent vector, $\vec{r}^{\,\prime}\,(t)$. Note that we really do need to require $\vec{r}^{\,\prime}\,(t) \neq \vec{0}$ in order to have a tangent vector. If we had

$$\vec{r}^{\,\prime}\,(t) = \vec{0}$$

we would have a vector that had no magnitude and so couldn't give us the direction of the tangent.

Also, provided $\vec{r}^{\,\prime}\,(t) \neq \vec{0}$, the **unit tangent vector** to the curve is given by,

$$\vec{T}\,(t) = \frac{\vec{r}^{\,\prime}\,(t)}{\left\|\vec{r}^{\,\prime}\,(t)\right\|}$$