Velocity and Acceleration

Lecture for 6/12

Definition of Velocity and Acceleration

- Suppose $\mathbf{r}(t)$ is our vector function
- Then $\mathbf{v}(t) = \mathbf{r}'(t)$ and $\mathbf{a}(t) = \mathbf{r}''(t)$

Decomposition of Acceleration

- Recall unit tangent **T** and unit normal **N**
- We can express $\mathbf{a} = a_T\mathbf{T} + a_N\mathbf{N}$
- Define $s = \|\mathbf{v}\|$ as speed
- $a_T = s' = (\mathbf{r}' \cdot \mathbf{r}'')/\|\mathbf{r}'\|$
- $a_N = \kappa s^2 = \|\mathbf{r}' \times \mathbf{r}''\|/\|\mathbf{r}'\|$

Formula Derivation Scratchwork

Extra Space

Practice

One big problem

- If the acceleration is given by $\mathbf{a} = (1, 2, 6t)$, find the position r given that $\mathbf{v}(0) = (0, 1, -1)$ and $\mathbf{r}(0) = (1, -2, 3)$
- Find the unit tangent and unit normal for $\mathbf{r}$
- Find the tangential and normal components of acceleration

Find the tangential and normal components of acceleration for the object whose position is $\mathbf{r}(t) = (\cos(2t), -\sin(2t), 4t)$

Scratch Work

Extra Space