Orthogonal Projection of $\mathbf{u}$ onto $\mathbf{v}$

$$\text{proj}_{\mathbf{v}}\mathbf{u} = |\mathbf{u}| \cos\theta \left(\frac{\mathbf{v}}{|\mathbf{v}|}\right) = \left(\frac{\mathbf{u}\cdot\mathbf{v}}{\mathbf{v}\cdot\mathbf{v}}\right)\mathbf{v}$$

Scalar component of $\mathbf{u}$ in the direction of $\mathbf{v}$

$$\text{scal}_{\mathbf{v}}\mathbf{u} = |\mathbf{u}| \cos\theta = \frac{\mathbf{u}\cdot\mathbf{v}}{|\mathbf{v}|}$$

Equation of the line passing through (x_0, y_0, z_0) parallel to $\mathbf{v} = \langle a, b, c\rangle$

$$\mathbf{r}(t) = \langle x_0, y_0, z_0\rangle + t\,\langle a, b, c\rangle$$

Arc Length of $\mathbf{r}(t) = \langle f(t), g(t), h(t)\rangle$ for $a \le t \le b$

$$\int_a^b \sqrt{f'(t)^2 + g'(t)^2 + h'(t)^2}\, dt$$

Unit tangent vector, curvature, and principal unit normal vector of $\mathbf{r}(t)$

$$\mathbf{T}(t) = \frac{\mathbf{r}'(t)}{|\mathbf{r}'(t)|} \qquad \kappa(t) = \frac{|\mathbf{T}'(t)|}{|\mathbf{r}'(t)|} \qquad \mathbf{N}(t) = \frac{\mathbf{T}'(t)}{|\mathbf{T}'(t)|}$$

Normal and tangential components of acceleration for $\mathbf{r}(t)$

$$a_N = \kappa|\mathbf{v}|^2 = \frac{|\mathbf{a}\times\mathbf{v}|}{|\mathbf{v}|} \qquad a_T = \frac{\mathbf{a}\cdot\mathbf{v}}{|\mathbf{v}|}$$

Plane containing point (x_0, y_0, z_0) with normal vector $\mathbf{n} = \langle a, b, c\rangle$

$$a(x - x_0) + b(y - y_0) + c(z - z_0) = 0$$