SECTION 1 MATHEMATICS

1.1 Linear Algebra

[TBD]

1.1.1 Gauss-Jordan Elimination (Reduced Row Echelon Form)

[TBD]

1.1.2 Matrix Inverse

[TBD]

1.1.3 Eigenvalues & Eigenvectors

[TBD]

1.1.4 Singluar Value Decomposition

[TBD]

1.2 Trigonometry

1.2.1 Trigonometric Identities

Basic identities

$$\tan(t) = \frac{\sin(t)}{\cos(t)} \qquad \sec(t) = \frac{1}{\cos(t)}$$
$$\cot(t) = \frac{1}{\tan(t)} \qquad \csc(t) = \frac{1}{\sin(t)}$$

Trig functions in terms of their complements

$$\sin(t) = \cos\left(\frac{\pi}{2} - t\right) \qquad \sec(t) = \csc\left(\frac{\pi}{2} - t\right)$$
$$\cos(t) = \sin\left(\frac{\pi}{2} - t\right) \qquad \csc(t) = \sec\left(\frac{\pi}{2} - t\right)$$
$$\tan(t) = \cot\left(\frac{\pi}{2} - t\right) \qquad \cot(t) = \tan\left(\frac{\pi}{2} - t\right)$$

Negative angles of trig functions

$$\sin(-t) = -\sin(t)$$
$$\cos(-t) = \cos(t)$$
$$\tan(-t) = -\tan(t)$$

Pythagorean Theorem for trig functions

$$\sin^2(t) + \cos^2(t) = 1$$
$$\sec^2(t) = 1 + \tan^2(t)$$

Sum and difference formulas for trig functions

$$\sin(s+t) = \sin(s)\cdot\cos(t) + \cos(s)\cdot\sin(t)$$
$$\cos(s+t) = \cos(s)\cdot\cos(t) - \sin(s)\cdot\sin(t)$$
$$\tan(s+t) = \frac{\tan(s) + \tan(t)}{1 - \tan(s)\cdot\tan(t)}$$

$$\sin(s-t) = \sin(s)\cdot\cos(t) - \cos(s)\cdot\sin(t)$$
$$\cos(s-t) = \cos(s)\cdot\cos(t) + \sin(s)\cdot\sin(t)$$
$$\tan(s-t) = \frac{\tan(s) - \tan(t)}{1 + \tan(s)\cdot\tan(t)}$$

Double angle formulas

$$\sin(2t) = 2\sin(t)\cdot\cos(t)$$
$$\tan(2t) = \frac{2\cdot\tan(t)}{1-\tan^2(t)}$$

$$\begin{aligned}\cos(2t) &= \cos^2(t) - \sin^2(t) \\ &= 2\cdot\cos^2(t) - 1 \\ &= 1 - 2\cdot\sin^2(t)\end{aligned}$$

Triple angle formulas

$$\sin(3t) = 3\cdot\sin(t) - 4\cdot\sin^3(t)$$
$$\cos(3t) = 4\cdot\cos^3(t) - 3\cdot\cos(t)$$
$$\tan(3t) = \frac{3\tan(t) - \tan^3(t)}{1 - 3\tan^2(t)}$$

Half angle formulas

$$\sin\left(\frac{1}{2}t\right) = \pm\sqrt{\frac{1-\cos(t)}{2}}$$
$$\cos\left(\frac{1}{2}t\right) = \pm\sqrt{\frac{1+\cos(t)}{2}}$$
$$\tan\left(\frac{1}{2}t\right) = \frac{\sin(t)}{1+\cos(t)} = \frac{1-\cos(t)}{\sin(t)}$$

Product sum identities

$$\sin(s) + \sin(t) = 2\cdot\sin\left(\frac{s+t}{2}\right)\cdot\cos\left(\frac{s-t}{2}\right)$$
$$\sin(s) - \sin(t) = 2\cdot\sin\left(\frac{s-t}{2}\right)\cdot\cos\left(\frac{s+t}{2}\right)$$

$$\cos(s) + \cos(t) = 2\cdot\cos\left(\frac{s+t}{2}\right)\cdot\cos\left(\frac{s-t}{2}\right)$$
$$\cos(s) - \cos(t) = -2\cdot\sin\left(\frac{s+t}{2}\right)\cdot\sin\left(\frac{s-t}{2}\right)$$

Product identities

$$\sin(s)\cdot\sin(t) = \frac{\cos(s-t)\cdot\cos(s+t)}{2}$$
$$\cos(s)\cdot\cos(t) = \frac{\cos(s+t)\cdot\cos(s-t)}{2}$$
$$\sin(s)\cdot\cos(t) = \frac{\sin(s+t)\cdot\sin(s-t)}{2}$$

1.3 Calculus

1.3.1 Derivative Rules

1.3.1.1 Chain Rule

$$f\left(g(x)\right)' = \frac{df}{dx} = \frac{df}{dg} \cdot \frac{dg}{dx}$$

$$y = (Ax^2 + Bx + C)^3$$

$$\frac{dy}{dx} = 3 \cdot (Ax^2 + Bx + C)^2 \cdot (2Ax + B)$$

[TBD]

1.3.1.2 Quotient Rule

$$\left(\frac{f(x)}{g(x)}\right)' = \frac{f(x)'g(x) - g(x)'f(x)}{g(x)^2}$$

[TBD]

1.3.1.3 Product Rule

$$\left(f(x) \cdot g(x)\right)' = f(x) \cdot g(x)' + f(x)' \cdot g(x)$$

[TBD]

1.4 References

1 Joyce, David E., *Clark University – Department of Mathematics and Computer Science*, "Summary of Trigonometric Identities", http://www.clarku.edu/~djoyce/trig/identities.html