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*Matrices, Quaternions, Rotations, and Orientation in  $R^3$ .*

In this talk paths along which objects travel will be created by parametric curves in  $R^2$  and  $R^3$ . The parametric curves are based on Bezier curves and polar equations. The orientation of the objects along the paths will then be created by using rotation matrices and quaternions. Problems with the orientation of the objects along paths, such as Gimbal lock and wrap-around infinities will then be studied. Gimbal lock occurs when a rotation about one axis causes a loss of ability to rotate about one of the three coordinate axes. Wrap-around infinities occur where the x, y, or z partial derivatives along the path become undefined. As orientations are based on the inverse tangent, an object can perform a rotation from  $-\pi$  to  $\pi$  or  $\pi$  to  $-\pi$  at such points. A problem where both Gimbal lock and wrap-around infinity occurred in actual practice will be illustrated. Techniques for dealing with Gimbal lock and wrap-around infinities will be discussed. The concepts discussed will be illustrated using the 3D graphics packages Studio 3D Max, Carrara, Poser and the programming language Python. (Received August 17, 2014)