



## DESCRIBING ROTATIONS OF THREE DIMENSIONAL OBJECTS USING QUATERNIONS

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In the field of Mathematics, Quaternions plays a major role in enlarging complex numbers. Presently, there are diverse practical applications of Quaternions involving Geometry, Game developing, Flight simulations. Euler angles and Matrices are the two existing methods available for describing rotations of any object. However, as many matrix multiplications are essential in describing rotations, these methods are relatively time consuming and less accurate in practical scenarios. As a result of that it is important to utilize a more accurate method. Describing rotations by Quaternions can be considered as a better implementing method to describe rotations rather than Matrices and Euler angles. Multiplication of three matrices gives the next position when Euler angles are concerned. So if Euler angles are used to describe rotations, it may give some deviations from the correct position after it's rotated. In other words an error can be occurred because of matrix multiplications and it consumes more time relative to Quaternion rotations. Therefore if a target is there to be reached, Quaternions is the more efficient method to calculate rotations.

A computer program to explain Quaternion rotation of a three dimensional object has been developed using MATLAB 7 software. The inputs of the program are rotating axis and coordinates of a particular vertex point on the object. New coordinates of the vertex point is calculated by multiples of five degrees when it is rotated around the given axis. When the object is rotated around the axis  $\hat{x} + \hat{y} + \hat{z}$  by 60 degrees, the initial vertex on the object which is (0.5, 1, 1) becomes (0.6667 1.1667 0.6667). Consequently, the results are verified via manual calculations. Finding of this study adds simplified, effective and accurate method for industrial applications where rotations of objects are used. Therefore, when compared with existing methods, Quaternions method is the most effective regarding time and accuracy. When computer games and video animations were designed, rotations had been described mostly by matrix method and Euler angles. Since Quaternions method is more effective, it can be implemented more frequently in practical scenarios.

**Keywords:** Quaternion rotations, Matrices, Euler angles