# Quaternion Rotations

Given pure quaternion and quaternion rotation where

where is a pure, unit quaternion [pg. 203],

and quaternion multiplication

The rotation of by is

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Where **\*** is the conjugate of

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Because

Since will always be orthogonal to .

Because,

By Lagrange’s Triple Product Formula

By the trig identities

# Quaternion Rotation Combinations

Let there be two Quaternion Rotations,

Here, this equation can be split into two parts, the scalar and the Quaternion,

After defining a new, third Quaternion Rotation,

This new rotation can also be split into it’s scalar and quaternion parts

Setting the sets of scalars and Quaternions equal to each other,

Reorganizing to get the relevant angle of rotation and rotation quaternion,

We can then use this information to construct the relevant new Quaternion Rotation,