QuaternionsHM datasheet

QuaternionsHM is a Wolfram Language package that adds quaternion capabilities to Mathematica.
Focus is on quaternions as representing rotations and coordinate frame orientations in 3D.
Nine inbuilt functions are expanded to handle quaternions, and six new functions are added.
Function arguments can be numeric or symbolic. An exception is the function `quatToFromEulerZYX`, which requires numeric arguments.

Inbuilt functions

Multiplication (non commutative) and reciprocal. Conjugate, norm and normalization.
Exponential, logarithm and raising a quaternion to a scalar power. Multiplication and addition with scalar.

quat is the head of a quaternion expression.
Syntax is quat[*q0, q1, q2, q3*].
If a normalized quaternion is interpreted as a rotation then *q0* is cosine
of half the rotation angle, while {*q1, q2, q3*} is a vector along the axis of rotation.
Functionality for quat is added to 9 inbuilt functions:
– Non commutative multiplication, quat ** quat.
– Power, quat^p. The exponent p has to be a scalar.
– Conjugate
– Norm
– Normalize
– Exp
– Log
– Times, multiplication of quat with scalar
– Plus, addition of quat with scalar and quat with quat

New functions

quatToFromList

Converts a quaternion to list, or vice verse.

quatToFromList[*quat*]. Returns list.
quatToFromList[*list*]. Returns quaternion.

quatToFromθV

Conversion of the representation of a rotation. Between quaternion and angle / axis of rotation.
The axis of rotation is a 3D vector. As input it can have any length. As output it has unit length.
Symbolic input of quaternion or axis vector is assumed to be normalized.

quatToFromθV[*quat*]. Returns {angle,vector}.
quatToFromθV[*angle,vector*]. Returns quaternion.
quatToFromθV[{*angle,vector*}]. Returns quaternion.

quatToFromMatrix

Converts a quaternion to matrix, or vice verse.
An input matrix where all elements are numeric has to be righthanded.
An input matrix where all elements are explicit numbers does not have to be normalized.

quatToFromMatrix[*quat*]. Returns matrix.
quatToFromMatrix[*matrix*]. Returns quaternion

quatRotateVector

Rotation of a 3D vector, with rotation expressed as quaternion.

quatRotateVector[*quat,vector*]. Returns rotated vector.

quatToFromEulerZYX

Converts a quaternion to Euler ZYX angles, or vice verse.
Numeric input only. Input and output angles in decimal degrees.

quatToFromEulerZYX[*quat*]. Returns a table with the possible angle sequences.
quatToFromEulerZYX[*angle z, angle y, angle x*]. Returns quaternion.
quatToFromEulerZYX[{*angle z, angle y, angle x*}]. Returns quaternion.

quatFromAlignedMatrix

A matrix is selected by interactive dialogs and converted to quaternion.
Matrices that can be selected represent a rotated coordinate frame where all axes
are colinear with axes of the reference frame. Matrix elements from the set {−1,0,1}.

quatFromAlignedMatrix[ ]. No arguments. Returns quaternion.

How to install and load

Where to store package on PC?
The folder is given by evaluating FileNameJoin[{$UserBaseDirectory, "Applications"}].
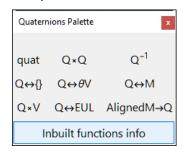Copy the file **QuaternionsHM.wl** to that folder.

How to load the package in a Mathematica session?
In a notebook evaluate Needs@"QuaternionsHM`".
Note the backtick as last character.

Palette

This palette can be useful

Hans Milton, April 2022