ASBR THA 1 Functions Documentation

Daniyal Maroufi and Anas Yousaf

`rotmat2zyz`

Converts a rotation matrix into its corresponding ZYZ Euler angles.

Inputs: - `R` - 3x3 rotation matrix - `prev_theta` - (optional) previous value of theta to resolve ambiguity (default: $\pi/2$)

Outputs: - `phi` - first ZYZ Euler angle in radians - `theta` - second ZYZ Euler angle in radians - `psi` - third ZYZ Euler angle in radians

Author: Daniyal Maroufi

`rotmat2rollpitchyaw`

Converts a rotation matrix into its corresponding roll, pitch, and yaw angles.

Inputs: - `R` - 3x3 rotation matrix - `prev_theta` - (optional) previous value of theta to resolve ambiguity (default: 0)

Outputs: - `phi` - roll angle in radians - `theta` - pitch angle in radians - `psi` - yaw angle in radians

Author: Daniyal Maroufi

`rotmat2quaternion`

Converts a rotation matrix into its corresponding quaternion representation.

Inputs: - `R` - 3x3 rotation matrix

Outputs: - `q` - 4-element column vector representing the quaternion $[q_0; q_1; q_2; q_3]$

Author: Daniyal Maroufi

`rotmat2axisangle`

Converts a rotation matrix into its corresponding axis-angle representation.

Inputs: - `R` - 3x3 rotation matrix

Outputs: - `axis` - 3-element column vector representing the axis of rotation - `angle` - scalar value representing the angle of rotation in radians

Author: Daniyal Maroufi

quaternion2rotmat

Converts the quaternion representation of a rotation in a 3D space into its corresponding rotation matrix.

Inputs: - `scalar` - scalar value of quaternion or 4-element column vector quaternion - `vector` - 3-element column vector of quaternion

Outputs: - `rotmat` - 3x3 rotation matrix

Author: Anas Yousaf

axisangle2rotmat

Converts the axis-angle representation of a rotation in a 3D space into its corresponding rotation matrix.

Inputs: - `axis` - 3-element column vector representing the axis of rotation - `angle` - scalar radian representing the angle of rotation

Outputs: - `rotmat` - 3x3 rotation matrix

Author: Anas Yousaf

is_valid_rotation_matrix

Checks if the input matrix is a valid rotation matrix.

Inputs: - `R` - 3x3 matrix to be checked - `check_identity` - (optional) boolean flag to check if the matrix is the identity matrix (default: true)

Outputs: - `is_valid` - boolean indicating whether the input matrix is a valid rotation matrix

Author: Daniyal Maroufi

isequal_tol

Checks if two matrices are equal within a specified tolerance.

Inputs: - `A` - first matrix - `B` - second matrix - `tol` - (optional) tolerance value (default: 1×10^{-6})

Outputs: - `isEqual` - boolean indicating whether the matrices are equal within the specified tolerance

Author: Daniyal Maroufi

transfmat2screw

Converts the transformation matrix of a transformation in a 3D space into its corresponding screw axis representation.

Inputs: - `transfmat` - 4x4 transformation matrix

Outputs: - `point` - 3-element vector describing the point on the rotation axis - `axis` - 3-element vector describing the rotation axis - `pitch` - scalar element describing the pitch of the screw axis - `angle` - scalar angle in radians describing the distance along the screw

Author: Anas Yousaf

screw2transfmat

Converts the screw axis representation of a transformation in a 3D space into its corresponding transformation matrix.

Inputs: - `point` - 3-element vector describing the point on the rotation axis - `axis` - 3-element vector describing the rotation axis - `pitch` - scalar element describing the pitch of the screw axis - `angle` - scalar angle in radians describing the distance along the screw

Outputs: - `transfmat` - 4x4 transformation matrix

Author: Anas Yousaf

plotTransformAxes

Plots the axes of a frame defined by the input transformation matrix.

Inputs: - `transfmat` - 4x4 transformation matrix

Outputs: - `axes` - column vector for each axis that is plotted

Author: Anas Yousaf

plotScrewAxis

Plots the screw axis defined by the input in a 3D space.

Inputs: - `point` - 3-element vector describing the point on the rotation axis - `axis` - 3-element vector describing the rotation axis - `pitch` - scalar element describing the pitch of the screw axis

Outputs: - `axes` - column vector for each axis that is plotted

Author: Anas Yousaf

inputTransfmatScrew

Takes in an initial screw axis, distance, and transformation matrix and finds the final transformation configuration. Plots the initial, intermediate, and final transformation configurations. Calculates and returns the screw axis and distance to return the final configuration to the origin.

Inputs: - `T_initial` - 4x4 transformation matrix of original configuration - `p` - 3-element vector describing the initial point on the rotation axis - `s_hat` - 3-element vector describing the initial rotation axis - `h` - scalar element describing the pitch of the initial screw axis - `theta` - scalar angle in radians describing the initial distance

Outputs: - `T_final` - 4x4 transformation matrix of final configuration - `T_intermediate` - cell array containing initial, intermediate, and final transformation matrices - `point` - 3-element vector describing the point on the rotation axis - `s_axis` - 3-element vector describing the rotation axis - `pitch` - scalar element describing the pitch of the screw axis - `angle` - scalar angle in radians describing the distance along the screw

Author: Anas Yousaf

`is_valid_transform_matrix`

Determines if an input matrix is a valid 4x4 homogeneous transformation.

Inputs: - `transfmat` - 4x4 transformation matrix

Outputs: - `result` - returns true if valid matrix, false otherwise

Author: Anas Yousaf