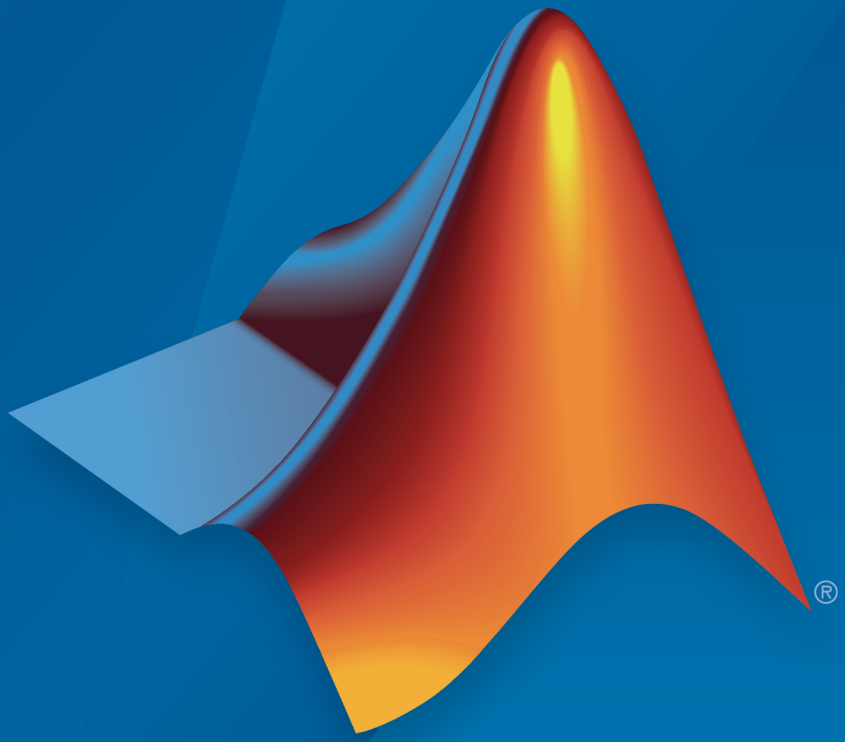
Robotics System Toolbox™

Reference



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Robotics System Toolbox™ Reference

Revision History

March 2015	Online only	New for Version 1.0 (Release R2015a)

Contents

Classes — Alphabetical List

robotics.BinaryOccupancyGrid class

Package: robotics

Create occupancy grid with binary values

Description

`BinaryOccupancyGrid` creates a 2-D occupancy grid object, which you can use to represent and visualize a robot workspace, including obstacles. The integration of sensor data and position estimates create a spatial representation of the approximate locations of the obstacles.

Occupancy grids are used in robotics algorithms such as path planning. They are also used in mapping applications, such as for finding collision-free paths, performing collision avoidance, and calculating localization. You can modify your occupancy grid to fit your specific application.

Each cell in the occupancy grid has a value representing the occupancy status of that cell. An occupied location is represented as `true (1)` and a free location is represented as `false (0)`.

The two coordinate systems supported are world and grid coordinates. The world coordinates origin is defined by `GridLocationInWorld`, which defines the bottom-left corner of the map. The number and size of grid locations are defined by the `Resolution`. Also, the first grid location with index `(1,1)` begins in the top-left corner of the grid.

Construction

`map = robotics.BinaryOccupancyGrid(width,height)` creates a 2-D binary occupancy grid representing a work space of width and height in meters. The default grid resolution is one cell per meter.

`map = robotics.BinaryOccupancyGrid(width,height,resolution)` creates a grid with `resolution` specified in cells per meter. The map is in world coordinates by default. You can use any of the arguments from previous syntaxes.

`map = robotics.BinaryOccupancyGrid(rows,cols,resolution,'grid')` creates a 2-D binary occupancy grid of size (`rows`,`cols`).

`map = robotics.BinaryOccupancyGrid(p)` creates a grid from the values in matrix p. The size of the grid matches the size of the matrix, with each cell value interpreted from its location in the matrix. p contains any numeric or logical type with zeros (0) and ones (1).

`map = robotics.BinaryOccupancyGrid(p,resolution)` creates a `BinaryOccupancyGrid` object with `resolution` specified in cells per meter.

Input Arguments

`width` — Map width

double in meters

Map width, specified as a double in meters.

Data Types: `double`

`height` — Map height

double in meters

Map width, specified as a double in meters.

Data Types: `double`

`resolution` — Grid resolution

1 (default) | double in cells per meter

Grid resolution, specified as a double in cells per meter.

Data Types: `double`

`p` — Input occupancy grid

matrix of ones and zeros

Input occupancy grid, specified as a matrix of ones and zeros. The size of the grid matches the size of the matrix. Each matrix element corresponds to an occupied location (1) or free location (0).

Properties

`GridSize` — Number of rows and columns in grid

two-element horizontal vector

Number of rows and columns in grid, stored as a two-element horizontal vector of the form `[rows cols]`. This value is read only.

`Resolution` — Grid resolution

1 (default) | scalar in cells per meter

Grid resolution, stored as a scalar in cells per meter. This value is read only.

Data Types: `double`

`XWorldLimits` — Minimum and maximum values of *x*-coordinates

two-element vector

Minimum and maximum values of *x*-coordinates, stored as a two-element horizontal vector of the form `[min max]`. These values indicate the world range of the *x*-coordinates in the grid. This value is read only.

`YWorldLimits` — Minimum and maximum values of *y*-coordinates

two-element vector

Minimum and maximum values of *y*-coordinates, stored as a two-element vector of the form `[min max]`. These values indicate the world range of the *y*-coordinates in the grid. This value is read only.

`GridLocationWorld` — `[x,y]` world coordinates of grid

[0 0] (default) | two-element vector

`[x,y]` world coordinates of the bottom-left corner of the grid, specified as a two-element vector.

Data Types: `double`

Methods

Examples

Create and Modify Binary Occupancy Grid

Create a 10m x 10m empty map.

```
map = robotics.BinaryOccupancyGrid(10,10,10);
```

Set occupancy of world locations and show map.

```
map = robotics.BinaryOccupancyGrid(10,10,10);
x = [1.2; 2.3; 3.4; 4.5; 5.6];
y = [5.0; 4.0; 3.0; 2.0; 1.0];

setOccupancy(map, [x y], ones(5,1))
figure
show(map)
```

Inflate occupied locations by a given radius.

```
inflate(map, 0.5)
figure
show(map)
```

Get grid locations from world locations.

```
ij = world2grid(map, [x y]);
```

Set grid locations to free locations.

```
setOccupancy(map, ij, zeros(5,1), 'grid')
figure
show(map)
```

- “Updating an Occupancy Grid From Range Sensor Data”

See Also

`robotics.PRM` | `robotics.PurePursuit`

More About

- “Occupancy Grids”

Introduced in R2015a

robotics.PRM class

Package: robotics

Create probabilistic roadmap path planner

Description

`PRM` creates a roadmap path planner object for the environment map specified in the `Map` property. The object uses the map to generate a roadmap, which is a network graph of possible paths in the map based on free and occupied spaces. You can customize the number of nodes, `NumNodes`, and the connection distance, `ConnectionDistance`, to fit the complexity of the map and find an obstacle-free path from a start to an end location.

After the map is defined, the `PRM` path planner generates the specified number of nodes throughout the free spaces in the map. A connection between nodes is made when a line between two nodes contains no obstacles and is within the specified connection distance.

After defining a start and end location, to find an obstacle-free path using this network of connections, use the `findpath` method. If `findpath` does not find a connected path, it returns an empty array. By increasing the number of nodes or the connection distance, you can improve the likelihood of finding a connected path, but tuning these properties is necessary. To see the roadmap and the generated path , use the visualization options in `show`. If you change any of the `PRM` properties, call `update`, `show`, or `findpath` to recreate the roadmap.

Construction

`planner = robotics.PRM` creates an empty roadmap with default properties. Before you can use the roadmap, you must specify a `robotics.BinaryOccupancyGrid` object in the `Map` property.

`planner = robotics.PRM(map)` creates a roadmap with map set as the `Map` property, where map is an object of the `robotics.BinaryOccupancyGrid` class.

`planner = robotics.PRM(map,numnodes)` sets the maximum number of nodes, numnodes, to the `NumNodes` property.

`planner = robotics.PRM( ___ ,Name,Value)` provides additional options specified by one or more `Name,Value` pair arguments. `Name` is the property name and `Value` is the corresponding value. `Name` must appear inside single quotes (`' '`). You can specify several name-value pair arguments in any order as `Name1,Value1,...,NameN,ValueN`.

Input Arguments

`map` — Map representation

`BinaryOccupancyGrid` object

Map representation, specified as a `robotics.BinaryOccupancyGrid` object. This object represents the environment of the robot. The object is a matrix grid with binary values indicating obstacles as `true` (1) and free locations as `false` (0).

`numnodes` — Maximum number of nodes in roadmap

50 (default) | scalar

Maximum number of nodes in roadmap, specified as a scalar. By increasing this value, the complexity and computation time for the path planner increases.

Properties

`'ConnectionDistance'` — Maximum distance between two connected nodes

`inf` (default) | scalar in meters

Maximum distance between two connected nodes, specified as the comma-separated pair consisting of `'ConnectionDistance'` and a scalar in meters. This property controls whether nodes are connected based on their distance apart. Nodes are connected only if no obstacles are directly in the path. By decreasing this value, the number of connections is lowered, but the complexity and computation time decreases as well.

`'Map'` — Map representation

`BinaryOccupancyGrid` object

Map representation, specified as the comma-separated pair consisting of 'Map' and a `robotics.BinaryOccupancyGrid` object. This object represents the environment of the robot. The object is a matrix grid with binary values indicating obstacles as `true` (1) and free locations as `false` (0).

`'NumNodes'` — Maximum distance between two connected nodes

`inf` (default) | scalar

Maximum distance between two connected nodes, specified as the comma-separated pair consisting of `'NumNodes'` and a scalar. By increasing this value, the complexity and computation time for the path planner increases.

Methods

See Also

`robotics.BinaryOccupancyGrid` | `robotics.PurePursuit`

Related Examples

- "Path Planning in Environments of Different Complexity"

Introduced in R2015a

robotics.PurePursuit class

Package: robotics

Create controller to follow set of waypoints

Description

`PurePursuit` creates a controller object used to make a differential drive robot follow a set of waypoints. The object computes the linear and angular velocities for the robot. Given the current pose of the robot, you can calculate these velocities using the `step` method. Successive calls to `step` with updated poses provide updated velocity commands for the robot to follow a path along a desired set of waypoints. Use the `MaxAngularVelocity` and `DesiredLinearVelocity` properties to update the velocities based on the robot's performance.

The `LookaheadDistance`property computes a look-ahead point on the path, which is a local goal for the robot. The angular velocity command is computed based on this point. Changing `LookaheadDistance` has a significant impact on the performance of the algorithm. A higher look-ahead distance results in a smoother trajectory for the robot, but can cause the robot to cut corners along the path. Too low of a look-ahead distance can result in oscillations in tracking the path, causing unstable behavior. For more information on the pure pursuit algorithm, see "Pure Pursuit Controller".

Construction

`controller = robotics.PurePursuit` creates a pure pursuit object, controller, that uses the pure pursuit algorithm to compute the linear and angular velocity inputs for a differential drive robot.

`controller = robotics.PurePursuit(Name, Value)` creates a pure pursuit object with additional options specified by one or more `Name,Value` pairs. Name is the property name and Value is the corresponding value. Name must appear inside single quotes (`' '`). You can specify several name-value pair arguments in any order as `Name1,Value1,...,NameN,ValueN`. Properties not specified retain their default values.

Properties

`'DesiredLinearVelocity'` — Desired constant linear velocity

0.1 (default) | scalar in meters per second

Desired constant linear velocity, specified as the comma-separated pair consisting of `'DesiredLinearVelocity'` and a scalar in meters per second. The controller assumes that the robot drives at a constant linear velocity and that the computed angular velocity is independent of the linear velocity.

Data Types: `double`

`'LookaheadDistance'` — Look-ahead distance

1.0 (default) | scalar in meters

Look-ahead distance, specified as the comma-separated pair consisting of `'LookaheadDistance'` and a scalar in meters. The look-ahead distance changes the response of the controller. A robot with higher look-ahead distance produces smooth paths but takes larger turns at corners. A robot with smaller look-ahead distance follows the path closely and takes sharp turns, but can produce oscillations in the path.

Data Types: `double`

`'MaxAngularVelocity'` — Maximum angular velocity

1.0 (default) | scalar in radians per second

Maximum angular velocity, specified as the comma-separated pair consisting of `'MaxAngularVelocity'` and a scalar in radians per second. The controller saturates the absolute angular velocity output at the given value.

Data Types: `double`

`'Waypoints'` — Waypoints

[ ] (default) | *n*-by-2 array

Waypoints, specified as an *n*-by-2 array of `[x y]` pairs, where *n* is the number of waypoints. You can generate the waypoints from the `PRM` class or from another source.

Data Types: `double`

Methods

See Also

`robotics.BinaryOccupancyGrid` | `robotics.PRM`

Related Examples

- “Path Following for a Differential Drive Robot”

More About

- “Pure Pursuit Controller”

Introduced in R2015a

Functions — Alphabetical List

angdiff

Difference between two angles

Syntax

```
delta = angdiff(alpha,beta)
```

```
delta = angdiff(alpha)
```

Description

`delta = angdiff(alpha,beta)` calculates the difference between the angles alpha and beta. This function subtracts alpha from beta with the result wrapped on the interval `[-pi,pi]`. You can specify the input angles as single values or as arrays of angles that have the same number of values.

`delta = angdiff(alpha)` returns the angular difference between adjacent elements of alpha along the first dimension whose size does not equal 1. The first entry is subtracted from the second, the second from the third, etc. The output, delta, will be a matrix of size *m-1*-by-*n* given that alpha is a *m*-by-*n* matrix and *m* is greater than 1 and *n* is greater than zero.

Examples

Calculate Difference Between Two Angles

```
d = angdiff(pi,2*pi)
```

```
d =

    3.1416
```

Calculate Difference Between Two Angle Arrays

```
d = angdiff([pi/2 3*pi/4 0],[pi pi/2 -pi])
```

```
d =
```

```
    1.5708   -0.7854   -3.1416
```

Calculate Angle Differences of Adjacent Elements

```
angles = [pi pi/2 pi/4 pi/2];
d = angdiff(angles)
```

```
d =

   -1.5708   -0.7854    0.7854
```

Input Arguments

`alpha` — Angle in radians

scalar | vector | matrix | multidimensional array

Angle in radians, specified as a scalar, vector, matrix, or multidimensional array. This is the angle that is subtracted from beta when specified.

Example: `pi/2`

`beta` — Angle in radians

scalar | vector | matrix | multidimensional array

Angle in radians, specified as a scalar, vector, matrix, or multidimensional array of the same size as alpha. This is the angle that alpha is subtracted from when specified.

Example: `pi/2`

Output Arguments

`delta` — Difference between two angles

scalar | vector | matrix | multidimensional array

Angular difference between two angles, returned as a scalar, vector, or array. delta is wrapped to the interval `[-pi,pi]`.

See Also

`deg2rad` | `rad2deg`

Introduced in R2015a

apply

Transform message entities into target frame

Syntax

```
tfentity = apply(tfmsg,entity)
```

Description

`tfentity = apply(tfmsg,entity)` applies the transformation represented by the `'TransformStamped'` ROS message to the input message object entity.

This function determines the message type of entity and apples the appropriate transformation method to it. If the object cannot handle a particular message type, then MATLAB® displays an error message.

If you only want to use the most current transformation, call `transform` instead. If you want to store a transformation message for later use, call`getTransform` and then call `apply`.

Examples

Apply Transformation to a Point

```
tfPoint = apply(transform,point);
```

Input Arguments

`tfmsg` — Transformation message

`TransformStamped` ROS message handle

Transformation message, specified as a `TransformStamped` ROS message handle. The tfmsg is a ROS message of type: `geometry_msgs/TransformStamped`.

`entity` — ROS message
`Message` object handle

ROS message, specified as a `Message` object handle.

Supported messages are:

- `geometry_msgs/PointStamped`
- `geometry_msgs/PoseStamped`
- `geometry_msgs/PointCloud2Stamped`
- `geometry_msgs/QuaternionStamped`
- `geometry_msgs/Vector3Stamped`

Output Arguments

`tfentity` — Transformed ROS message
`Message` object handle

Transformed ROS message, returned as a `Message` object handle.

See Also

`getTransform` | `transform`

Introduced in R2015a

axang2quat

Convert axis-angle rotation to quaternion

Syntax

```
quat = axang2quat(axang)
```

Description

`quat = axang2quat(axang)` converts a rotation given in axis-angle form, axang, to quaternion, quat.

Examples

Convert Axis-Angle Rotation to Quaternion

```
axang = [1 0 0 pi/2];
quat = axang2quat(axang)
```

```
quat =

    0.7071    0.7071         0         0
```

Input Arguments

`axang` — Rotation given in axis-angle form

n-by-4 matrix

Rotation given in axis-angle form, specified as an *n*-by-4 matrix of *n* axis-angle rotations. The first three elements of every row specify the rotation axis, and the last element defines the rotation angle (in radians).

Example: `[1 0 0 pi/2]`

Output Arguments

`quat` — Unit quaternion

n-by-4 matrix

Unit quaternion, returned as an *n*-by-4 matrix containing *n* quaternions. Each quaternion, one per row, is of the form $q = [w\ x\ y\ z]$, with w as the scalar number.

Example: `[0.7071 0.7071 0 0]`

See Also

`quat2axang`

Introduced in R2015a

axang2rotm

Convert axis-angle rotation to rotation matrix

Syntax

```
rotm = axang2rotm(axang)
```

Description

`rotm = axang2rotm(axang)` converts a rotation given in axis-angle form, axang, to an orthonormal rotation matrix, rotm. When using the rotation matrix, premultiply it with the coordinates to be rotated (as opposed to postmultiplying).

Examples

Convert Axis-Angle Rotation to Rotation Matrix

```
axang = [0 1 0 pi/2];
rotm = axang2rotm(axang)
```

```
rotm =

    0.0000         0    1.0000
         0    1.0000         0
   -1.0000         0    0.0000
```

Input Arguments

`axang` — Rotation given in axis-angle form

n-by-4 matrix

Rotation given in axis-angle form, specified as an *n*-by-4 matrix of *n* axis-angle rotations. The first three elements of every row specify the rotation axis, and the last element defines the rotation angle (in radians).

Example: `[1 0 0 pi/2]`

Output Arguments

`rotm` — Rotation matrix

3-by-3-by-n matrix

Rotation matrix, returned as a 3-by-3-by-n matrix containing n rotation matrices. Each rotation matrix has a size of 3-by-3 and is orthonormal. When using the rotation matrix, premultiply it with the coordinates to be rotated (as opposed to postmultiplying).

Example: `[0 0 1; 0 1 0; -1 0 0]`

See Also

`rotm2axang`

Introduced in R2015a

axang2tform

Convert axis-angle rotation to homogeneous transformation

Syntax

```
tform = axang2tform(axang)
```

Description

`tform = axang2tform(axang)` converts a rotation given in axis-angle form, axang, to a homogeneous transformation matrix, tform. When using the transformation matrix, premultiply it with the coordinates to be transformed (as opposed to postmultiplying).

Examples

Convert Axis-Angle Rotation to Homogeneous Transformation

```
axang = [1 0 0 pi/2];
tform = axang2tform(axang)
```

```
tform =

    1.0000         0         0         0
         0    0.0000   -1.0000         0
         0    1.0000    0.0000         0
         0         0         0    1.0000
```

Input Arguments

axang — Rotation given in axis-angle form

n-by-4 matrix

Rotation given in axis-angle form, specified as an *n*-by-4 matrix of *n* axis-angle rotations. The first three elements of every row specify the rotation axis, and the last element defines the rotation angle (in radians).

Example: `[1 0 0 pi/2]`

Output Arguments

`tform` — Homogeneous transformation

4-by-4-by-*n* matrix

Homogeneous transformation matrix, specified by a 4-by-4-by-*n* matrix of *n* homogeneous transformations. When using the transformation matrix, premultiply it with the coordinates to be formed (as opposed to postmultiplying).

Example: `[0 0 1 0; 0 1 0 0; -1 0 0 0; 0 0 0 1]`

See Also

`tform2axang`

Introduced in R2015a

call

Call the ROS service server and receive a response

Syntax

```
response = call(serviceclient)
response = call(serviceclient,requestmsg)
response = call( ___ ,Name,Value)
```

Description

`response = call(serviceclient)` sends a default service request message and waits for a service `response`. The default service request message is an empty message of type `serviceclient.ServiceType`.

`response = call(serviceclient,requestmsg)` specifies a service request message, requestmsg, to be sent to the service.

`response = call( ___ ,Name,Value)` provides additional options specified by one or more `Name,Value` pair arguments, using any of the arguments from the previous syntaxes. `Name` must appear inside single quotes (`''`). You can specify several name-value pair arguments in any order as `Name1,Value1,...,NameN,ValueN`.

Examples

Create Service Client and Call for Response Using Default Message

```
client = rossvcclient('/gazebo/get_model_state');
response = call(client);
```

Call for Response Using Specific Request Message

```
reqmessage = rosmessage(client);
```

```
response = call(client,reqmessage);
```

Wait for Response Using Timeout of Five Seconds

```
response = call(client,reqmessage,'TimeOut',5);
```

Input Arguments

`serviceclient` — Service client
`ServiceClient` object handle

Service client, specified as a `ServiceClient` object handle.

`requestmsg` — Request message
`Message` object handle

Request message, specified as a `Message` object handle. The default message type is `serviceclient.ServiceType`.

Name-Value Pair Arguments

Specify optional comma-separated pairs of Name,Value arguments. `Name` is the argument name and `Value` is the corresponding value. `Name` must appear inside single quotes (`' '`). You can specify several name and value pair arguments in any order as `Name1,Value1,...,NameN,ValueN`.

Example: `'TimeOut',5`

`'TimeOut'` — Timeout for service response in seconds
inf (default) | scalar

Timeout for service response in seconds, specified as a comma-separated pair consisting of `'Timeout'` and a scalar. If the service client does not receive a service response and the timeout period elapses, `call` displays an error message and lets MATLAB continue running the current program. The default value of `inf` blocks MATLAB from running the current program until the service client receives a service response.

Output Arguments

`response` — Response message
`Message` object handle

llResponse message sent by the service server, returned as a `Message` object handle.

See Also

`rossvcclient`

Introduced in R2015a

cart2hom

Convert Cartesian coordinates to homogeneous coordinates

Syntax

```
hom = cart2hom(cart)
```

Description

`hom = cart2hom(cart)` converts a set of points in Cartesian coordinates to homogeneous coordinates.

Examples

Convert 3-D Cartesian Points to Homogeneous Coordinates

```
c = [0.8147 0.1270 0.6324; 0.9058 0.9134 0.0975];
h = cart2hom(c)

h =

    0.8147    0.1270    0.6324    1.0000
    0.9058    0.9134    0.0975    1.0000
```

Input Arguments

`cart` — Cartesian coordinates

n-by-(*k*–1) matrix

Cartesian coordinates, specified as an *n*-by-(*k*–1) matrix, containing *n* points. Each row of cart represents a point in (*k*–1)-dimensional space. *k* must be greater than or equal to 2.

Example: `[0.8147 0.1270 0.6324; 0.9058 0.9134 0.0975]`

Output Arguments

`hom` — Homogeneous points

n-by-*k* matrix

Homogeneous points, returned as an *n*-by-*k* matrix, containing *n* points. *k* must be greater than or equal to 2.

Example: `[0.2785 0.9575 0.1576 0.5; 0.5469 0.9649 0.9706 0.5]`

See Also

`hom2cart`

Introduced in R2015a

definition

Retrieve definition of ROS message type

Syntax

```
def = definition(msg)
```

Description

`def = definition(msg)` returns the ROS definition of the message type associated with the message object, msg. The details of the message definition include the structure, property data types, and comments from the authors of that specific message.

Examples

Access ROS Message Definition for Message

Create a `Point` Message.

```
point = rosmessage('geometry_msgs/Point');
```

Access the definition.

```
def = definition(point)
```

```
def =

% This contains the position of a point in free space
double X
double Y
double Z
```

Input Arguments

`msg` — ROS message

`Message` object handle

ROS message, specified as a `Message` object handle. This message can be created using the `rosmessage` function.

Output Arguments

`def` — Details of message definition

string

Details of the information inside the ROS message definition, returned as a string.

See Also

`rosmessage` | `rosmsg`

Introduced in R2015a

deg2rad

Convert angles from degrees to radians

Syntax

```
angleInRadians = deg2rad(angleInDegrees)
```

Description

`angleInRadians = deg2rad(angleInDegrees)` converts angle units from degrees to radians for each element of angleInDegrees. This is both an angle conversion function and a distance conversion function, since arc length can be a measure of distance in either radians or degrees, provided that the radius is known.

Examples

Compute tangent of 45-degree angle

```
tan(deg2rad(45))
```

```
ans =

    1.0000
```

Input Arguments

`angleInDegrees` — Angles in degrees

numeric scalar or array

Angles in degrees, specified as a numeric scalar or array. In the case of complex input, `deg2rad` converts the real and imaginary parts separately.

Example: `cos(deg2rad(45))`

Data Types: `single | double`

Complex Number Support: Yes

Output Arguments

`angleInRadians` — Angle in radians

numeric scalar or vector

Angle in radians, returned as a numeric scalar or array, the same size and class as the input value.

See Also

`rad2deg`

del

Delete a ROS parameter

Syntax

```
del(ptree,paramname)
```

Description

`del(ptree,paramname)` deletes a parameter with name paramname from the parameter tree, ptree. The parameter is also deleted from the ROS parameter server. If the specified paramname does not exist, the function displays an error.

Examples

Delete Parameter on ROS Master

Create parameter tree, 'MyParam' parameter, and check existence.

```
ptree = rosparam;
set(ptree,'MyParam','test')
has(ptree,'MyParam')
```

```
ans =

     1
```

Delete parameter and check existence.

```
del(ptree,'MyParam')
has(ptree,'MyParam')
```

```
ans =
```

```
0
```

Input Arguments

`ptree` — Parameter tree

`ParameterTree` object handle

Parameter tree, specified as a `ParameterTree` object handle. Create this object using the `rosparam` function.

`paramname` — ROS parameter name

string

ROS parameter name, specified as a string. This string must match the parameter name exactly.

See Also

`has` | `rosparam` | `set`

Introduced in R2015a

eul2quat

Convert Euler angles to quaternion

Syntax

```
quat = eul2quat(eul)
quat = eul2quat(eul,sequence)
```

Description

`quat = eul2quat(eul)` converts a given set of Euler angles, eul, to the corresponding quaternion, quat. The default order for Euler angle rotations is `'ZYX'`.

`quat = eul2quat(eul,sequence)` converts a set of Euler angles into a quaternion. The Euler angles are specified in the axis rotation sequence, sequence. The default order for Euler angle rotations is `'ZYX'`.

Examples

Convert Euler Angles to Quaternion

```
eul = [0 pi/2 0];
qZYX = eul2quat(eul)
```

```
qZYX =

    0.7071         0    0.7071         0
```

Convert Euler Angles to Quaternion Using Default ZYZ Axis Order

```
eul = [pi/2 0 0];
qZYZ = eul2quat(eul,'ZYZ')
```

```
qZYZ =
```

```
    0.7071         0         0    0.7071
```

Input Arguments

`eul` — Euler rotation angles

n-by-3 matrix

Euler rotation angles in radians, specified as an *n*-by-3 array of Euler rotation angles. Each row represents one Euler angle set.

Example: `[0 0 1.5708]`

`sequence` — Axis rotation sequence

`'ZYX'` (default) | `'ZYZ'`

Axis rotation sequence for the Euler angles, specified as one of these strings:

- `'ZYX'` (default) – The order of rotation angles is *z*-axis, *y*-axis, *x*-axis.
- `'ZYZ'` – The order of rotation angles is *z*-axis, *y*-axis, *z*-axis.

Output Arguments

`quat` — Unit quaternion

n-by-4 matrix

Unit quaternion, returned as an *n*-by-4 matrix containing *n* quaternions. Each quaternion, one per row, is of the form $q = [w\ x\ y\ z]$, with w as the scalar number.

Example: `[0.7071 0.7071 0 0]`

See Also

`quat2eul`

Introduced in R2015a

eul2rotm

Convert Euler angles to rotation matrix

Syntax

```
rotm = eul2rotm(eul)
rotm = eul2rotm(eul,sequence)
```

Description

`rotm = eul2rotm(eul)` converts a set of Euler angles, eul, to the corresponding rotation matrix, rotm. When using the rotation matrix, premultiply it with the coordinates to be rotated (as opposed to postmultiplying). The default order for Euler angle rotations is `'ZYX'`.

`rotm = eul2rotm(eul,sequence)` converts Euler angles to a rotation matrix, rotm. The Euler angles are specified in the axis rotation sequence, sequence. The default order for Euler angle rotations is `'ZYX'`.

Examples

Convert Euler Angles to Rotation Matrix

```
eul = [0 pi/2 0];
rotmZYX = eul2rotm(eul)
```

```
rotmZYX =

    0.0000         0    1.0000
         0    1.0000         0
   -1.0000         0    0.0000
```

Convert Euler Angles to Rotation Matrix Using ZYZ Axis Order

```
eul = [0 pi/2 pi/2];
rotmZYZ = eul2rotm(eul,'ZYZ')
```

```
rotmZYZ =

    0.0000   -0.0000    1.0000
    1.0000    0.0000         0
   -0.0000    1.0000    0.0000
```

Input Arguments

`eul` — Euler rotation angles

n-by-3 matrix

Euler rotation angles in radians, specified as an *n*-by-3 array of Euler rotation angles. Each row represents one Euler angle set.

Example: `[0 0 1.5708]`

`sequence` — Axis rotation sequence

`'ZYX'` (default) | `'ZYZ'`

Axis rotation sequence for the Euler angles, specified as one of these strings:

- `'ZYX'` (default) – The order of rotation angles is *z*-axis, *y*-axis, *x*-axis.
- `'ZYZ'` – The order of rotation angles is *z*-axis, *y*-axis, *z*-axis.

Output Arguments

`rotm` — Rotation matrix

3-by-3-by-*n* matrix

Rotation matrix, returned as a 3-by-3-by-*n* matrix containing *n* rotation matrices. Each rotation matrix has a size of 3-by-3 and is orthonormal. When using the rotation matrix, premultiply it with the coordinates to be rotated (as opposed to postmultiplying).

Example: `[0 0 1; 0 1 0; -1 0 0]`

See Also

`rotm2eul`

Introduced in R2015a

eul2tform

Convert Euler angles to homogeneous transformation

Syntax

```
eul = eul2tform(eul)
tform = eul2tform(eul,sequence)
```

Description

`eul = eul2tform(eul)` converts a set of Euler angles, eul, into a homogeneous transformation matrix, tform. When using the transformation matrix, premultiply it with the coordinates to be transformed (as opposed to postmultiplying). The default order for Euler angle rotations is `'ZYX'`.

`tform = eul2tform(eul,sequence)` converts Euler angles to a homogeneous transformation. The Euler angles are specified in the axis rotation sequence, sequence. The default order for Euler angle rotations is `'ZYX'`.

Examples

Convert Euler Angles to Homogeneous Transformation Matrix

```
eul = [0 pi/2 0];
tformZYX = eul2tform(eul)
```

```
tformZYX =

    0.0000         0    1.0000         0
         0    1.0000         0         0
   -1.0000         0    0.0000         0
         0         0         0    1.0000
```

Convert Euler Angles to Homogeneous Transformation Matrix Using ZYZ Axis Order

```
eul = [0 pi/2 pi/2];
```

```
tformZYZ = eul2tform(eul,'ZYZ')

tformZYZ =

    0.0000   -0.0000    1.0000         0
    1.0000    0.0000         0         0
   -0.0000    1.0000    0.0000         0
         0         0         0    1.0000
```

Input Arguments

`eul` — Euler rotation angles

n-by-3 matrix

Euler rotation angles in radians, specified as an *n*-by-3 array of Euler rotation angles. Each row represents one Euler angle set.

Example: `[0 0 1.5708]`

`sequence` — Axis rotation sequence

`'ZYX'` (default) | `'ZYZ'`

Axis rotation sequence for the Euler angles, specified as one of these strings:

- `'ZYX'` (default) – The order of rotation angles is *z*-axis, *y*-axis, *x*-axis.
- `'ZYZ'` – The order of rotation angles is *z*-axis, *y*-axis, *z*-axis.

Output Arguments

`tform` — Homogeneous transformation

4-by-4-by-*n* matrix

Homogeneous transformation matrix, specified by a 4-by-4-by-*n* matrix of *n* homogeneous transformations. When using the rotation matrix, premultiply it with the coordinates to be rotated (as opposed to postmultiplying).

Example: `[0 0 1 0; 0 1 0 0; -1 0 0 0; 0 0 0 1]`

See Also

`tform2eul`

Introduced in R2015a

get

Get ROS parameter value

Syntax

```
pvalue = get(ptree,paramname)
```

Description

`pvalue = get(ptree,paramname)` gets the value of the parameter with the name paramname from the parameter tree object ptree.

Examples

Set and Get Parameter Value

Create the parameter tree.

```
ptree = rosparam;
```

Set the parameter value.

```
set(ptree,'DoubleParam',1.0)
```

Get the parameter value.

```
get(ptree,'DoubleParam')
```

```
ans =

     1
```

Input Arguments

`ptree` — Parameter tree

`ParameterTree` object handle

Parameter tree, specified as a `ParameterTree` object handle. Create this object using the `rosparam` function.

`paramname` — ROS parameter name
string

ROS parameter name, specified as a string. This string must match the parameter name exactly.

Output Arguments

`pvalue` — Parameter value
int32 | logical | char | double | cell array

Parameter value, returned as either a `int32`, `logical`, `double`, `char`, or `cell array`. `pvalue` matches the value of the specified`paramname` and the supported data type in `ParameterTree`. Currently, Base64–encoded binary data and iso8601 data from ROS are not supported.

See Also
`rosparam` | `set`

Introduced in R2015a

getTransform

Retrieve the transformation between two coordinate frames

Syntax

```
tf = getTransform(tftree,targetframe,sourceframe)
```

Description

`tf = getTransform(tftree,targetframe,sourceframe)` returns the latest known transformation between two coordinate frames. Transformations are structured as a 3-D translation (3-element vector) and a 3-D rotation (quaternion).

Examples

Get Transformation

```
tf = gettransform(tftree,'/camera_depth_frame','/base_link');
```

Input Arguments

`tftree` — ROS transformation tree

`TransformationTree` object handle

ROS transformation tree, specified as a `TransformationTree` object handle. You can create a transformation tree by calling the `rostf` function.

`targetframe` — Target coordinate frame

string

Target coordinate frame, specified as a string. You can view the available frames for transformation by calling `tftree.AvailableFrames`.

`sourceframe` — Initial coordinate frame

string

Initial coordinate frame, specified as a string. You can view the available frames for transformation by calling `tftree.AvailableFrames`.

Output Arguments

`tf` — Transformation between coordinate frames

`TransformStamped` object handle

Transformation between coordinate frames, returned as a `TransformStamped` object handle. Transformations are structured as a 3-D translation (3-element vector) and a 3-D rotation (quaternion).

See Also

`transform` | `waitforTransform`

Introduced in R2015a

has

Check if ROS parameter name exists

Syntax

```
exists = has(ptree,paramname)
```

Description

`exists = has(ptree,paramname)` checks if the parameter with name paramname exists in the parameter tree, ptree.

Examples

Check If ROS Parameter Exists

Create a parameter tree and check for the 'MyParam' parameter.

```
ptree = rosparam;
```

```
has(ptree,'MyParam')
```

```
ans =

     0
```

Create a ‘MyParam’ parameter and verify that it exists.

```
set(ptree,'MyParam','test')
```

```
has(ptree,'MyParam')
```

```
ans =
```

1

Input Arguments

`ptree` — Parameter tree

`ParameterTree` object handle

Parameter tree, specified as a `ParameterTree` object handle. Create this object using the `rosparam` function.

`paramname` — ROS parameter name

string

ROS parameter name, specified as a string. This string must match the parameter name exactly.

Output Arguments

`exists` — Flag indicating whether the parameter exists

true | false

Flag indicating whether the parameter exists, returned as `true` or `false`.

See Also

`get` | `rosparam` | `search` | `set`

Introduced in R2015a

hom2cart

Convert homogeneous coordinates to Cartesian coordinates

Syntax

```
cart = hom2cart(hom)
```

Description

`cart = hom2cart(hom)` converts a set of homogeneous points to Cartesian coordinates.

Examples

Convert Homogeneous Points to 3-D Cartesian Points

```
h = [0.2785 0.9575 0.1576 0.5; 0.5469 0.9649 0.9706 0.5];
c = hom2cart(h)

c =

    0.5570    1.9150    0.3152
    1.0938    1.9298    1.9412
```

Input Arguments

`hom` — Homogeneous points

n-by-*k* matrix

Homogeneous points, specified as an *n*-by-*k* matrix, containing *n* points. *k* must be greater than or equal to 2.

Example: `[0.2785 0.9575 0.1576 0.5; 0.5469 0.9649 0.9706 0.5]`

Output Arguments

`cart` — Cartesian coordinates

n-by-(*k*–1) matrix

Cartesian coordinates, returned as an *n*-by-(*k*–1) matrix, containing *n* points. Each row of cart represents a point in (*k*–1)-dimensional space. *k* must be greater than or equal to 2.

Example: `[0.8147 0.1270 0.6324; 0.9058 0.9134 0.0975]`

See Also

`cart2hom`

Introduced in R2015a

plot

Display ROS laser scan messages on custom plot

Syntax

```
plot(scan)
plot(scan,Name,Value)
linehandle = plot( ___ )
```

Description

`plot(scan)` creates a line plot of the laser scan in *xy*-coordinates that is based on the input `LaserScan` object message. Axes are automatically scaled to the maximum range that the laser scanner supports.

`plot(scan,Name,Value)` provides additional options specified by one or more `Name,Value` pair arguments. Name must appear inside single quotes (`''`). You can specify several name-value pair arguments in any order as `Name1,Value1,...,NameN,ValueN`.

`linehandle = plot( ___ )` returns a column vector of line series handles, using any of the arguments from previous syntaxes. Use linehandle to modify properties of the line series after it is created.

When plotting ROS laser scan messages, MATLAB follows the standard ROS convention for axis orientation. This convention states that **positive *x* is forward, positive *y* is left, and positive *z* is up**. For more information, see Axis Orientation on the ROS Wiki.

Examples

Plot Laser Scan

```
plot(scan);
```

Plot Laser Scan with Maximum Range Specified

```
plot(scan,'MaximumRange',10);
```

Save Line Handle for Laser Scan Plot

```
linehandle = plot(scan);
```

Input Arguments

`scan` — Laser scan message

`LaserScan` object handle

`'sensor_msgs/LaserScan'` ROS message, specified as a `LaserScan` object handle.

Name-Value Pair Arguments

Specify optional comma-separated pairs of Name,Value arguments. `Name` is the argument name and `Value` is the corresponding value. `Name` must appear inside single quotes (`' '`). You can specify several name and value pair arguments in any order as `Name1,Value1,...,NameN,ValueN`.

Example: `'MaximumRange',5`

`'Parent'` — Parent of axes

axes object

Parent of axes, specified as the comma-separated pair consisting of `'Parent'` and an axes object in which the laser scan is drawn. By default, the laser scan is plotted in the currently active axes.

`'MaximumRange'` — Range of laser scan

`scan.RangeMax` (default) | scalar

Range of laser scan, specified as the comma-sepearated pair consisting of `'MaximumRange'` and a scalar. When you specify this name-value pair argument, the

minimum and maximum *x*-axis limits and the maximum *y*-axis limit are set based on specified value. The minimum *y*-axis limit is automatically determined by the opening angle of the laser scanner.

Outputs

`linehandle` — One or more chart line objects

scalar | vector

One or more chart line objects, returned as a scalar or a vector. These are unique identifiers, which you can use to query and modify properties of a specific chart line.

See Also

`readCartesian`

Introduced in R2015a

quat2axang

Convert quaternion to axis-angle rotation

Syntax

```
axang = quat2axang(quat)
```

Description

`axang = quat2axang(quat)` converts a quaternion, quat, to the equivalent axis-angle rotation, axang.

Examples

Convert Quaternion to Axis-Angle Rotation

```
quat = [0.7071 0.7071 0 0];
axang = quat2axang(quat)
```

```
axang =

    1.0000         0         0    1.5708
```

Input Arguments

`quat` — Unit quaternion

n-by-4 matrix

Unit quaternion, specified as an *n*-by-4 matrix containing *n* quaternions. Each quaternion, one per row, is of the form $q = [w\ x\ y\ z]$, with w as the scalar number.

Example: `[0.7071 0.7071 0 0]`

Output Arguments

axang — Rotation given in axis-angle form

n-by-4 matrix

Rotation given in axis-angle form, returned as an *n*-by-4 matrix of *n* axis-angle rotations. The first three elements of every row specify the rotation axis, and the last element defines the rotation angle (in radians).

Example: `[1 0 0 pi/2]`

See Also

`axang2quat`

Introduced in R2015a

quat2eul

Convert quaternion to Euler angles

Syntax

```
eul = quat2eul(quat)
eul = quat2eul(quat,sequence)
```

Description

`eul = quat2eul(quat)` converts a quaternion rotation, quat, to the corresponding Euler angles, eul. The default order for Euler angle rotations is `'ZYX'`.

`eul = quat2eul(quat,sequence)` converts a quaternion into Euler angles. The Euler angles are specified in the axis rotation sequence, sequence. The default order for Euler angle rotations is `'ZYX'`.

Examples

Convert Quaternion to Euler Angles

```
quat = [0.7071 0.7071 0 0];
eulZYX = quat2eul(quat)
```

```
eulZYX =

         0         0    1.5708
```

Convert Euler Angles to Quaternion Using ZYZ Axis Order

```
quat = [0.7071 0.7071 0 0];
eulZYZ = quat2eul(quat,'ZYZ')
```

```
eulZYZ =
```

```
   -1.5708    1.5708    1.5708
```

Input Arguments

`quat` — Unit quaternion

n-by-4 matrix

Unit quaternion, specified as an *n*-by-4 matrix containing *n* quaternions. Each quaternion, one per row, is of the form $q = [w\ x\ y\ z]$, with w as the scalar number.

Example: `[0.7071 0.7071 0 0]`

`sequence` — Axis rotation sequence

`'ZYX'` (default) | `'ZYZ'`

Axis rotation sequence for the Euler angles, specified as one of these strings:

- `'ZYX'` (default) – The order of rotation angles is *z*-axis, *y*-axis, *x*-axis.
- `'ZYZ'` – The order of rotation angles is *z*-axis, *y*-axis, *z*-axis.

Output Arguments

`eul` — Euler rotation angles

n-by-3 matrix

Euler rotation angles in radians, returned as an *n*-by-3 array of Euler rotation angles. Each row represents one Euler angle set.

Example: `[0 0 1.5708]`

See Also

`eul2quat`

Introduced in R2015a

quat2rotm

Convert quaternion to rotation matrix

Syntax

```
rotm = quat2rotm(quat)
```

Description

`rotm = quat2rotm(quat)` converts a quaternion quat to an orthonormal rotation matrix, rotm. When using the rotation matrix, premultiply it with the coordinates to be rotated (as opposed to postmultiplying).

Examples

Convert Quaternion to Rotation Matrix

```
quat = [0.7071 0.7071 0 0];
rotm = quat2rotm(quat)
```

```
rotm =

    1.0000         0         0
         0   -0.0000   -1.0000
         0    1.0000   -0.0000
```

Input Arguments

`quat` — Unit quaternion

n-by-4 matrix

Unit quaternion, specified as an *n*-by-4 matrix containing *n* quaternions. Each quaternion, one per row, is of the form $q = [w\ x\ y\ z]$, with w as the scalar number.

Example: `[0.7071 0.7071 0 0]`

Output Arguments

`rotm` — Rotation matrix

3-by-3-by-n matrix

Rotation matrix, returned as a 3-by-3-by-n matrix containing n rotation matrices. Each rotation matrix has a size of 3-by-3 and is orthonormal. When using the rotation matrix, premultiply it with the coordinates to be rotated (as opposed to postmultiplying).

Example: `[0 0 1; 0 1 0; -1 0 0]`

See Also

`rotm2quat`

Introduced in R2015a

quat2tform

Convert quaternion to homogeneous transformation

Syntax

```
tform = quat2tform(quat)
```

Description

`tform = quat2tform(quat)` converts a quaternion, quat, to a homogeneous transformation matrix, tform. When using the transformation matrix, premultiply it with the coordinates to be transformed (as opposed to postmultiplying).

Examples

Convert Quaternion to Homogeneous Transformation

```
quat = [0.7071 0.7071 0 0];
tform = quat2tform(quat)
```

```
tform =

    1.0000         0         0         0
         0   -0.0000   -1.0000         0
         0    1.0000   -0.0000         0
         0         0         0    1.0000
```

Input Arguments

`quat` — Unit quaternion

n-by-4 matrix

Unit quaternion, specified as an *n*-by-4 matrix containing *n* quaternions. Each quaternion, one per row, is of the form $q = [w\ x\ y\ z]$, with w as the scalar number.

Example: `[0.7071 0.7071 0 0]`

Output Arguments

`tform` — Homogeneous transformation

4-by-4-by-n matrix

Homogeneous transformation matrix, returned as a 4-by-4-by-n matrix of n homogeneous transformations. When using the rotation matrix, premultiply it with the coordinates to be rotated (as opposed to postmultiplying).

Example: `[0 0 1 0; 0 1 0 0; -1 0 0 0; 0 0 0 1]`

See Also

`tform2quat`

Introduced in R2015a

rad2deg

Convert angles from radians to degrees

Syntax

```
angleInDegrees = rad2deg(angleInRadians)
```

Description

`angleInDegrees = rad2deg(angleInRadians)` converts angle units from radians to degrees for each element of angleInRadians. This is both an angle conversion function and a distance conversion function, because arc length can be a measure of distance in either radians or degrees, provided that the radius is known.

Examples

Convert great-circle distance to a spherical distance in degrees.

Specify the mean radius of Earth in kilometers.

```
Re = 6371;
```

Calculate the spherical distance in degrees.

```
sphericalDistance = rad2deg(2500 / Re)
```

```
sphericalDistance =

   22.4830
```

Input Arguments

`angleInRadians` — Angles in radians

numeric scalar or array

Angles in radians, specified as a numeric scalar or array. In the case of complex input, `rad2deg` converts the real and imaginary parts separately.

Example: `rad2deg(45)`

Data Types: `single | double`
Complex Number Support: Yes

Output Arguments

`angleInDegrees` — Angle in degrees

numeric scalar or array

Angle in degrees, returned as a numeric scalar or array, the same size and class as the input value.

See Also

`deg2rad`

readAllFieldNames

Get all available field names from ROS point cloud

Syntax

```
fieldnames = readAllFieldNames(pcloud)
```

Description

`fieldnames = readAllFieldNames(pcloud)` gets the names of all point fields that are stored in the `PointCloud2` object message, pcloud, and returns them in fieldnames.

Examples

Read All Fields from Point Cloud Message

```
fieldnames = readAllFieldNames(pcloud);
```

Input Arguments

`pcloud` — Point cloud

`PointCloud2` object handle

Point cloud, specified as a `PointCloud2` object handle for a `'sensor_msgs/PointCloud2'` ROS message.

Output Arguments

`fieldnames` — List of field names in `PointCloud2` object

cell array of strings

List of field names in `PointCloud2` object, returned as a cell array of strings. If no fields exist in the object, `fieldname` returns an empty cell array.

See Also

`readField`

Introduced in R2015a

readBinaryOccupancyGrid

Read binary occupancy grid

Syntax

```
map = readBinaryOccupancyGrid(msg)
map = readBinaryOccupancyGrid(msg,thresh)
map = readBinaryOccupancyGrid(msg,thresh,val)
```

Description

`map = readBinaryOccupancyGrid(msg)` returns a `robotics.BinaryOccupancyGrid` object by reading the data inside a ROS message, msg, which must be a `'nav_msgs/OccupancyGrid'` message. All message data values greater than or equal to the occupancy threshold are set to occupied, `1`, in the map. All other values, including unknown values (`-1`) are set to unoccupied, `0`, in the map.

`map = readBinaryOccupancyGrid(msg,thresh)` specifies a threshold, thresh, for occupied values. All values greater than or equal to the threshold are set to occupied, `1`. All other values are set to unoccupied, `0`.

`map = readBinaryOccupancyGrid(msg,thresh,val)` specifies a value to set for unknown values (`-1`). By default, all unknown values are set to unoccupied, `0`.

Examples

Read Data from Message

Create a occupancy grid message and populate it with data.

```
msg = rosmessage('nav_msgs/OccupancyGrid');
msg.Info.Height = 10;
msg.Info.Width = 10;
msg.Info.Resolution = 0.1;
msg.Data = 100*rand(100,1);
```

Read data from message

```
map = readBinaryOccupancyGrid(msg);
```

Read Message Data with Threshold

Threshold for occupied values is set to 65 and greater.

```
map = readBinaryOccupancyGrid(msg,65);
```

Read Message Data with Threshold and Unknown Value Replacement

```
map = readBinaryOccupancyGrid(msg,65,1);
```

Input Arguments

`msg` — `'nav_msgs/OccupancyGrid'` ROS message

`OccupancyGrid` object handle

`'nav_msgs/OccupancyGrid'` ROS message, specified as a `OccupancyGrid` object handle.

`thresh` — Threshold for occupied values

50 (default) | scalar

Threshold for occupied values, specified as a scalar. Any value greater than or equal to the threshold is set to occupied, `1`. All other values are set to unoccupied, `0`.

Data Types: `double`

`val` — Value to replace unknown values

0 (default) | 1

Value to replace unknown values, specified as either `0` or `1`. Unknown message values (`-1`) are set to the given value.

Data Types: `double | logical`

Output Arguments

`map` — Binary occupancy grid

`BinaryOccupancyGrid` object handle

Binary occupancy grid, returned as a `BinaryOccupancyGrid` object handle. map is converted from a `'nav_msgs/OccupancyGrid'` message on the ROS network. It is an object with a grid of binary values, where `1` indicates an occupied location and `0` indications an unoccupied location.

See Also

`robotics.BinaryOccupancyGrid` | `writeBinaryOccupancyGrid`

Introduced in R2015a

readCartesian

Read laser scan ranges in Cartesian coordinates

Syntax

```
cart = readCartesian(scan)
cart = readCartesian( ___ ,Name,Value)
[angles,cart] = readCartesian( ___ )
```

Description

`cart = readCartesian(scan)` converts the polar measurements of the laser scan object, scan, into Cartesian coordinates, cart. This function uses the metadata in the message, such as angular resolution and opening angle of the laser scanner, to perform the conversion. Invalid range readings, usually represented as `NaN`, are ignored in this conversion.

`cart = readCartesian( ___ ,Name,Value)` provides additional options specified by one or more `Name,Value` pair arguments. Name must appear inside single quotes (`''`). You can specify several name-value pair arguments in any order as `Name1,Value1,...,NameN,ValueN`.

`[angles,cart] = readCartesian( ___ )` returns the scan angles, angles that are associated with each Cartesian coordinate. Angles are measured counter-clockerwise around the positive *z*-axis, with the zero angle along the *x*-axis. angles is returned in radians and wrapped to the [–`pi`, `pi`] interval.

Examples

Read Laser Scan and Convert to Cartesian Coordinates

```
cart = readCartesian(scan);
```

Read Laser Scan and Specify Scan Range

```
cart = readCartesian(scan,'RangeLimit',[0 10]);
```

Input Arguments

`scan` — Laser scan message

`LaserScan` object handle

`'sensor_msgs/LaserScan'` ROS message, specified as a `LaserScan` object handle.

Name-Value Pair Arguments

Specify optional comma-separated pairs of Name,Value arguments. `Name` is the argument name and `Value` is the corresponding value. `Name` must appear inside single quotes (`' '`). You can specify several name and value pair arguments in any order as `Name1,Value1,...,NameN,ValueN`.

Example: `'RangeLimits',[-2 2]`

`'RangeLimits'` — Minimum and maximum range for scan in meters

`[scan.RangeMin scan.RangeMax]` (default) | 2-element `[min max]` vector

Minimum and maximum range for scan in meters, specified as a 2-element `[min max]` vector. All ranges smaller than `min` or larger than `max` are ignored during the conversion to Cartesian coordinates.

Output Arguments

`cart` — Cartesian coordinates of laser scan

n–by–2 matrix in meters

Cortesian coordinates of laser scan, returned as an *n*-by-2 matrix in meters.

`angles` — Scan angles for laser scan data

n–by–1 matrix in radians

Scan angles for laser scan data, returned as an *n*-by-1 matrix in radians. Angles are measured counter-clockerwise around the positive *z*-axis, with the zero angle along the *x*-axis. angles is returned in radians and wrapped to the [–`pi`, `pi`] interval.

See Also

`plot` | `readScanAngles`

Introduced in R2015a

readField

Read point cloud data based on field name

Syntax

```
fielddata = readField(pcloud,fieldname)
```

Description

`fielddata = readField(pcloud,fieldname)` reads the point field from the point cloud, pcloud, specified by fieldname and returns it in fielddata. If fieldname does not exist, the function displays an error.

Examples

Read *x* Coordinates for All Points

```
x = readField(pcloud,'x');
```

Input Arguments

`pcloud` — Point cloud

`PointCloud2` object handle

Point cloud, specified as a `PointCloud2` object handle for a `'sensor_msgs/PointCloud2'` ROS message.

`fieldname` — Field name of point cloud data

string

Field name of point cloud data, specified as a string. This string must match the field name exactly. If fieldname does not exist, the function displays an error.

Output Arguments

`fielddata` — List of field values from point cloud

matrix

List of field values from point cloud, returned as a matrix. Each row of is a point cloud reading, where n is the number of points and c is the number of values for each point. If the point cloud object being read has the `PreserveStructureOnRead` property set to true, the points are returned as an h-by-w-by-c matrix. For more information, see "Preserving Point Cloud Structure" on page 2-61.

More About

Tips

Point cloud data can be organized in either 1-D lists or in 2-D image styles. 2-D image styles usually come from depth sensors or stereo cameras. The input `PointCloud2` object contains a `PreserveStructureOnRead` property that is either `true` or `false` (default). Suppose you set the property to `true`.

```
pcloud.PreserveStructureOnRead = true;
```

Now calling any read functions (`readXYZ`,`readRGB`, or `readField`) preserves the organizational structure of the point cloud. When you preserve the structure, the output matrices are of size m-by-n-by-d, where m is the height, n is the width, and d is the number of return values for each point. Otherwise, all points are returned as a x-by-d list. This structure can only be preserved if the point cloud is organized.

See Also

`readAllFieldNames`

Introduced in R2015a

readImage

Convert ROS image data into MATLAB image

Syntax

```
img = readImage(msg)
[img,alpha] = readImage(msg)
```

Description

`img = readImage(msg)` converts the raw image data in the message object, msg, into an image matrix, img. You can call `readImage` using either `'sensor_msgs/Image'` or `'sensor_msgs/CompressedImage'` messages.

ROS image message data is stored in a format that is not compatible with further image processing in MATLAB. Based on the specified encoding, this function converts the data into an appropriate MATLAB image and returns it in img.

`[img,alpha] = readImage(msg)` returns the alpha channel of the image in alpha. If the image does not have an alpha channel, then alpha is empty.

Examples

Read ROS Image Data

```
[img,alpha] = readImage(obj);
```

Input Arguments

`msg` — ROS image message

`Image` object handle | `CompressedImage` object handle

`'sensor_msgs/Image'` or `'sensor_msgs/CompressedImage'` ROS image message, specified as an `Image` or `Compressed Image` object handle.

Output Arguments

`img` — Image

grayscale image matrix | RBG image matrix | *m*-by-*n*-by-3 array

Image, returned as a matrix representing a grayscale or RGB image or as a*m*-by-*n*-by-3 array, depending on the sensor image.

`alpha` — Alpha channel

`uint8` grayscale image

Alpha channel, returned as a `uint8` grayscale image. If no alpha channel exists, alpha is empty.

More About

Tips

ROS image messages can have different encodings. The encodings supported for images are different for `'sensor_msgs/Image'` and `'sensor_msgs/CompressedImage'` message types. Less compressed images are supported. The following encodings for raw images of size *M*x*N* are supported using the `'sensor_msgs/Image'` message type (**`'sensor_msgs/CompressedImage'` support is in bold**):

- **`rgb8, rgba8, bgr8, bgra8`**: `img` is an `rgb` image of size *M*x*N*x3. The alpha channel is returned in `alpha`. Each value in the outputs is represented as a `uint8`.
- `rgb16, rgba16, bgr16, bgra16`: `img` is an RGB image of size *M*x*N*x3. The alpha channel is returned in `alpha`. Each value in the outputs is represented as a `uint16`.
- **`mono8`** images are returned as grayscale images of size *M*x*N*x1. Each pixel value is represented as a `uint8`.
- `mono16` images are returned as grayscale images of size *M*x*N*x1. Each pixel value is represented as a `uint16`.
- `32fcX` images are returned as floating-point images of size *M*x*N*x*D*, where *D* is 1, 2, 3, or 4. Each pixel value is represented as a `single`.
- `64fcX` images are returned as floating-point images of size *M*x*N*x*D*, where *D* is 1, 2, 3, or 4. Each pixel value is represented as a `double`.
- `8ucX` images are returned as matrices of size *M*x*N*x*D*, where *D* is 1, 2, 3, or 4. Each pixel value is represented as a `uint8`.

- `8scX` images are returned as matrices of size *M*x*N*x*D*, where *D* is 1, 2, 3, or 4. Each pixel value is represented as a `int8`.
- `16ucX` images are returned as matrices of size *M*x*N*x*D*, where *D* is 1, 2, 3, or 4. Each pixel value is represented as a `int16`.
- `16scX` images are returned as matrices of size *M*x*N*x*D*, where *D* is 1, 2, 3, or 4. Each pixel value is represented as a `int16`.
- `32scX` images are returned as matrices of size *M*x*N*x*D*, where *D* is 1, 2, 3, or 4. Each pixel value is represented as a `int32`.
- `bayer_X` images are returned as either Bayer matrices of size *M*x*N*x1, or as a converted image of size *M*x*N*x3 (Image Processing Toolbox™ is required).

The following encoding for raw images of size *M*x*N* is supported using the **`'sensor_msgs/CompressedImage'`** message type:

- `rgb8, rgba8, bgr8, bgra8`: `img` is an `rgb` image of size *M*x*N*x3. The alpha channel is returned in `alpha`. Each output value is represented as a `uint8`.

See Also

`writeImage`

Introduced in R2015a

readMessages

Read messages from rosbag

Syntax

```
msgs = readMessages(bag)
msgs = readMessages(bag,rows)
```

Description

`msgs = readMessages(bag)` returns data from all of the messages in the `BagSelection` object, `bag`. The messages are returned in a cell array of messages.

`msgs = readMessages(bag,rows)` returns data from messages in the rows specified by `rows`. The maximum range of the rows is `[1,bag.NumMessages]`.

Examples

Return All Messages as a Cell Array

```
allMsgs = readMessages(bagMsgs);
```

Return First Ten Messages

```
firstMsgs = readMessages(bagMsgs,1:10);
```

Input Arguments

`bag` — Message of a rosbag

`BagSelection` object

All the messages contained within a rosbag, specified as a `BagSelection` object.

`rows` — Rows of `BagSelection` object

n-by-2 matrix

Rows of `BagSelection` object, specified as an *n*-by-2 matrix, where *n* is the number of rows to retrieve messages from. The maximum range of the rows is [1, `bag.NumMessage`].

Output Arguments

`msgs` — ROS message object handle

handle | cell array

ROS message object handle, returned as a handle or cell array. ROS messages are retrieved from the `BagSelection` object.

See Also

`rosbag` | `select` | `timeseries`

Introduced in R2015a

readRGB

Extract RGB values from point cloud data

Syntax

```
rgb = readXYZ(pcloud)
```

Description

`rgb = readXYZ(pcloud)` extracts the `[r g b]` values from all points in the point cloud object, pcloud and returns them as an n-by-3 of n 3-D point coordinates. If the point cloud does not contain the RGB field, this function will display an error.

Examples

Read RGB Values from Point Cloud Object

```
rgb = readRGB(pcloud);
```

Input Arguments

`pcloud` — Point cloud

`PointCloud2` object handle

Point cloud, specified as a `PointCloud2` object handle for a `'sensor_msgs/PointCloud2'` ROS message.

Output Arguments

`rgb` — List of RGBv alues from point cloud

matrix

List of RGB values from point cloud, returned as a matrix. By default, this is a n-by-3 matrix. If the point cloud object being read has the `PreserveStructureOnRead`

property set to true, the points are returned as an h-by-w-by-3 matrix. For more information, see “Preserving Point Cloud Structure” on page 2-68.

More About

Tips

Point cloud data can be organized in either 1-D lists or in 2-D image styles. 2-D image styles usually come from depth sensors or stereo cameras. The input `PointCloud2` object contains a `PreserveStructureOnRead` property that is either `true` or `false` (default). Suppose you set the property to `true`.

```
pcloud.PreserveStructureOnRead = true;
```

Now calling any read functions (`readXYZ`,`readRGB`, or `readField`) preserves the organizational structure of the point cloud. When you preserve the structure, the output matrices are of size m-by-n-by-d, where m is the height, n is the width, and d is the number of return values for each point. Otherwise, all points are returned as a x-by-d list. This structure can only be preserved if the point cloud is organized.

See Also

`readField` | `readXYZ`

Introduced in R2015a

readScanAngles

Return scan angles for laser scan range readings

Syntax

```
angles = readScanAngles(scan)
```

Description

`angles = readScanAngles(scan)` calculates the scan angles, angles, corresponding to the range readings in the laser scan message, scan. Angles are measured counter-clockerwise around the positive *z*-axis, with the zero angle along the *x*-axis. angles is returned in radians and wrapped to the [–`pi`, `pi`] interval.

Examples

Return Laser Scan Angles from Range Data

```
angles = readScanAngles(scan);
```

Input Arguments

`scan` — Laser scan message

`LaserScan` object handle

`'sensor_msgs/LaserScan'` ROS message, specified as a `LaserScan` object handle.

Output Arguments

`angles` — Scan angles for laser scan data

n–by–1 matrix in radians

Scan angles for laser scan data, returned as an *n*-by-1 matrix in radians. Angles are measured counter-clockerwise around the positive *z*-axis, with the zero angle along the *x*-axis. angles is returned in radians and wrapped to the [–`pi`, `pi`] interval.

See Also

`plot` | `readCartesian`

Introduced in R2015a

readXYZ

Extract XYZ coordinates from point cloud data

Syntax

```
xyz = readXYZ(pcloud)
```

Description

`xyz = readXYZ(pcloud)` extracts the `[x y z]` coordinates from all points in the point cloud object, pcloud, and returns them as an n-by-3 matrix of n 3-D point coordinates. If the point cloud does not contain the x, y, and z fields, this function returns an error. Points that contain `NaN` are preserved in the output.

Examples

Read XYZ Coordinates from Point Cloud

```
xyz = readXYZ(pcloud);
```

Input Arguments

`pcloud` — Point cloud

`PointCloud2` object handle

Point cloud, specified as a `PointCloud2` object handle for a `'sensor_msgs/PointCloud2'` ROS message.

Output Arguments

`xyz` — List of XYZ values from point cloud

matrix

List of XYZ values from point cloud, returned as a matrix. By default, this is a n-by-3 matrix. If the point cloud object being read has the `PreserveStructureOnRead` property set to true, the points are returned as an h-by-w-by-3 matrix. For more information, see "Preserving Point Cloud Structure" on page 2-72.

More About

Tips

Point cloud data can be organized in either 1-D lists or in 2-D image styles. 2-D image styles usually come from depth sensors or stereo cameras. The input `PointCloud2` object contains a `PreserveStructureOnRead` property that is either `true` or `false` (default). Suppose you set the property to `true`.

```
pcloud.PreserveStructureOnRead = true;
```

Now calling any read functions (`readXYZ`,`readRGB`, or `readField`) preserves the organizational structure of the point cloud. When you preserve the structure, the output matrices are of size m-by-n-by-d, where m is the height, n is the width, and d is the number of return values for each point. Otherwise, all points are returned as a x-by-d list. This structure can only be preserved if the point cloud is organized.

See Also

`readField` | `readRGB`

Introduced in R2015a

receive

Wait for new ROS message

Syntax

```
msg = receive(sub)
msg = receive(sub,timeout)
```

Description

`msg = receive(sub)` waits for MATLAB to receive a topic message from the specified subscriber, sub, and returns it as msg.

`msg = receive(sub,timeout)` specifies in timeoutthe number of seconds to wait for a message. If a message is not received within the timeout limit, the software throws an error.

Examples

Create Subscriber and Receive Data

```
laser = rossubscriber('/scan', rostype.sensor_msgs_LaserScan);
scan = receive(laser);
```

Receive Data with a Two Second Timeout

```
scan = receive(sub,2);
```

Input Arguments

sub — ROS subscriber

`Subscriber` object handle

ROS subscriber, specified as a `Subscriber` object handle. You can create the subscriber using `rossubscriber`.

`timeout` — Timeout for receiving a message
scalar in seconds

Timeout for receiving a message, specified as a scalar in seconds.

Output Arguments

`msg` — ROS message
`Message` object handle

ROS message, returned as a `Message` object handle.

See Also

`rosmessage` | `rossubscriber` | `rostopic`

Introduced in R2015a

roboticsSupportPackages

Download and install support packages for Robotics System Toolbox

Syntax

```
roboticsSupportPackages
```

Description

`roboticsSupportPackages` allows you to download and install support packages for Robotics System Toolbox™.

Examples

Start Robotics Support Package Installer

```
roboticsSupportPackages
```

Introduced in R2015a

rosbag

Open and parse rosbag log file

Syntax

```
bag = rosbag(filename)
```

Description

`bag = rosbag(filename)` creates an indexable `BagSelection` object, bag, that contains all the message indexes from the rosbag located at path filename. To access the data, you can call `readMessages` or `timeseries` to extract relevant data.

A rosbag, or bag, is a file format for storing ROS message data. They are used primarily to log messages within the ROS network. You can use these bags for offline analysis, visualization, and storage.

This function supports version 2.0 of the rosbag file format. It also supports only uncompressed rosbags. See the ROS Wiki page for more information about rosbags and Bag version 2.0.

Examples

Retrieve Information from rosbag

Set the path to a rosbag file.

```
filePath = 'path/to/logfile.bag';
```

Retrieve information from the rosbag.

```
bagselect = rosbag(filePath)
```

Select a subset of the messages, filtered by time and topic

```
bagselect2 = select(bagselect, 'Time', ...
```

```
[bagselect.StartTime bagselect.StartTime + 1], 'Topic', '/odom')
```

Input Arguments

`filename` — Name of rosbag file and its path

string

Name of file and its path, for the rosbag you want to access, specified as a string. This path can be relative or absolute.

Output Arguments

`bag` — Selection of rosbag messages

`BagSelection` object handle

Selection of rosbag messages, returned as a `BagSelection` object handle.

See Also

`readMessages` | `select` | `timeseries`

Introduced in R2015a

rosinit

Connect to ROS network

Syntax

```
rosinit
rosinit(hostname)
rosinit(hostname,port)
rosinit(URI)
rosinit(___,Name,Value)
```

Description

`rosinit` starts the global ROS node with a default MATLAB name and tries to connect to a ROS master running on `localhost` and port `11311`. If the global ROS node cannot connect to the ROS master, `rosinit` also starts a ROS core in MATLAB, which consists of a ROS master, a ROS parameter server, and a rosout logging node.

`rosinit(hostname)` tries to connect to the ROS master at the host name or IP address specified by hostname. This syntax uses `11311` as the default port number.

`rosinit(hostname,port)` tries to connect to the host name or IP address specified by hostname and the port number specified by port.

`rosinit(URI)` tries to connect to the ROS master at the given resource identifier, URI, for example, `'http://192.168.1.1:11311'`.

`rosinit(___,Name,Value)` provides additional options specified by one or more `Name,Value` pair arguments. `Name` must appear inside single quotes (`' '`). You can specify several name-value pair arguments in any order as `Name1,Value1,...,NameN,ValueN`.

Using `rosinit` is a prerequisite for most ROS-related tasks in MATLAB because:

- Communicating with a ROS network requires a ROS node connected to a ROS master.

- By default, ROS functions in MATLAB operate on the global ROS node, or they operate on objects that depend on the global ROS node.

For example, after creating a global ROS node with `rosinit`, you can subscribe to a topic on the global ROS node. When another node on the ROS network publishes messages on that topic, the global ROS node receives the messages.

If a global ROS node already exists, then `rosinit` restarts the global ROS node based on the new set of arguments.

Examples

Start ROS Core and Global Node

```
rosinit
```

```
Initializing ROS master on http://hostname.mathworks.com:11311/.
Initializing global node /matlab_global_node_9152 with NodeURI http://hostname:54194/
```

Start Node and Connect to ROS Master at Specified IP Address

```
rosinit('192.168.1.10')
```

```
Initializing global node /matlab_tped50a5c2_4448_4d11_a523_9829a6b3b5af with NodeURI ht
```

Start Global Node at Given IP and Node Name

```
rosinit('192.168.1.10', 'NodeHost','192.168.1.1','NodeName','/test_node')
```

```
Initializing global node /test_node with NodeURI http://192.168.1.1:64053/
```

Input Arguments

`hostname` — Host name or IP address

string

Host name or IP address, specified as a string.

`port` — Port number

scalar

Port number used to connect to the ROS master, specified as a scalar.

`URI` — URI for ROS master

string

URI for ROS master, specified as a string. Standard format for URIs is either `http://ipaddress:port` or `http://hostname:port`

Name-Value Pair Arguments

Specify optional comma-separated pairs of Name,Value arguments. `Name` is the argument name and `Value` is the corresponding value. `Name` must appear inside single quotes (`' '`). You can specify several name and value pair arguments in any order as `Name1,Value1,...,NameN,ValueN`.

Example: `'NodeHost','192.168.1.1'`

`'NodeHost'` — Host name or IP address

string

Host name or IP address under which the node advertises itself to the ROS network, specified as the comma-separated pair consisting of' 'NodeHost' and a string.

Example: 'comp-home'

`'NodeName'` — Global node name

string

Global node name, specified as the comma-separated pair consisting of 'NodeName' and a string. The node that is created through `rosinit` is registered on the ROS network with this name.

Example: 'NodeName','/test_node'

See Also

`rosshutdown`

Introduced in R2015a

rosmessage

Create ROS messages

Syntax

```
msg = rosmessage(messagetype)

msg = rosmessage(pub)
msg = rosmessage(sub)
msg = rosmessage(client)
msg = rosmessage(server)
```

Description

`msg = rosmessage(messagetype)` creates an empty ROS message object with message type. The messagetype string is case-sensitive and no partial matches are allowed. It must match a message on the list given by calling `rosmsg('list')`. To avoid errors in entering the message type, you can use `rostype` with tab completion to browse the list of all available types.

`msg = rosmessage(pub)` creates an empty message determined by the topic published by pub.

`msg = rosmessage(sub)` creates an empty message determined by the subscribed topic of sub.

`msg = rosmessage(client)` creates an empty message determined by the service associated with client.

`msg = rosmessage(server)` creates an empty message determined by the service type of server.

Examples

Create Empty String Message

```
strMsg = rosmessage('std_msgs/String');
```

Create Laser Scan Message using `rostype`

```
scan = rosmessage(rostype.sensor_msgs_LaserScan);
```

Create Message to Publish using ROS Publisher

```
chatpub = rospublisher('/chatter','std_msgs/String');
chatmsg = rosmessage(chatpub);
```

Input Arguments

`messagetype` — Message type

string

Message type, specified as a string. The string is case-sensitive and no partial matches are allowed. It must match a message on the list given by calling `rosmsg('list')`. To avoid errors in entering the message type, you can use `rostype` with tab completion to browse the list of all available types.

`pub` — ROS publisher

`Publisher` object handle

ROS publisher, specified as a `Publisher` object handle. You can create the object using `rospublisher`.

`sub` — ROS subscriber

`Subscriber` object handle

ROS subscriber, specified as a `Subscriber` object handle. You can create the object using `rossubscriber`.

`client` — ROS service client

`ServiceClient` object handle

ROS service client, specified as a `ServiceClient` object handle. You can create the object using `rossvcclient`.

`server` — ROS service server
`ServiceServer` object handle

ROS service server, specified as a `ServiceServer` object handle. You can create the object using `rossvcserver`.

Output Arguments

`msg` — ROS message
`Message` object handle

ROS message, returned as a `Message` object handle.

More About

- "Built-In Message Support"

See Also

`roboticsSupportPackages` | `rosmsg` | `rostype`

Introduced in R2015a

rosmsg

Retrieve information about ROS messages and message types

Syntax

```
rosmsg show msgtype
rosmsg md5 msgtype
rosmsg list
```

```
msginfo = rosmsg('show', msgtype)
msgmd5 = rosmsg('md5', msgtype)
msglist = rosmsg('list')
```

Description

`rosmsg show msgtype` returns the definition of the msgtype message.

`rosmsg md5 msgtype` returns the MD5 checksum of the msgtype message.

`rosmsg list` returns all available message types that you can use in MATLAB.

`msginfo = rosmsg('show', msgtype)` returns the definition of the msgtype message as a string.

`msgmd5 = rosmsg('md5', msgtype)` returns the 'MD5' checksum of the msgtype message as a string.

`msglist = rosmsg('list')` returns a cell array containing all available message types that you can use in MATLAB.

Examples

Retrieve Message Type Definition

```
msgInfo = rosmsg('show','geometry_msgs/Point')
```

```
msgInfo =
```

```
% This contains the position of a point in free space
double X
double Y
double Z
```

Get the MD5 Checksum of Message Type

```
msgMd5 = rosmsg('md5','geometry_msgs/Point')
```

```
msgMd5 =

4a842b65f413084dc2b10fb484ea7f17
```

Input Arguments

`msgtype` — ROS message type

string

ROS message type, specified as a string. `msgType` must be a valid ROS message type from ROS that MATLAB supports.

Example: 'std_msgs/Int8'

Output Arguments

`msginfo` — Details of message definition

string

Details of the information inside the ROS message definition, returned as a string.

`msgmd5` — MD5 checksum hash value

string

MD5 checksum hash value, returned as a string. The MD5 output is a string representation of the 16-byte hash value that follows the MD5 standard.

`msglist` — List of all message types available in MATLAB

cell array of strings

List of all message types available in MATLAB, returned as a cell array of strings.

Introduced in R2015a

rosnode

Retrieve information about ROS network nodes

Syntax

```
rosnode list
rosnode info nodename
rosnode ping nodename
```

```
nodelist = rosnode('list')
nodeinfo = rosnode('info',nodename)
rosnode('ping',nodename)
```

Description

`rosnode list` returns a list of all nodes registered on the ROS network. Use these nodes to exchange data between MATLAB and the ROS network.

`rosnode info nodename` returns a structure containing the name, URI, publications, subscriptions, and services of a specific ROS node,nodename.

`rosnode ping nodename` pings a specific node, nodename, and displays the response time.

`nodelist = rosnode('list')` returns a cell array of strings containing the nodes registered on the ROS network.

`nodeinfo = rosnode('info',nodename)` returns a structure containing the name, URI, publications, subscriptions, and services of a specific ROS node, nodename.

`rosnode('ping',nodename)` pings a specific node, nodename and displays the response time.

Examples

Retrieve List of ROS Nodes

```
rosnode list
```

```
/bumper2pointcloud
/cmd_vel_mux
/depthimage_to_laserscan
/gazebo
/laserscan_nodelet_manager
/matlab_tp8cc35a0e_35fd_4f70_9886_9e489b95b611
/mobile_base_nodelet_manager
/robot_state_publisher
/rosout
```

Retrieve ROS Node Info

```
nodeinfo = rosnode('info','/robot_state_publisher')
```

```
nodeinfo =

         NodeName: '/robot_state_publisher'
              URI: 'http://192.168.154.132:58140/'
     Publications: [2x1 struct]
    Subscriptions: [2x1 struct]
         Services: [2x1 struct]
```

Ping ROS Node

```
rosnode('ping','/robot_state_publisher')
```

```
Pinging the /robot_state_publisher node with a timeout of 3 seconds.
Ping reply from http://192.168.154.132:58140/, response time = 2.920 ms.
Ping reply from http://192.168.154.132:58140/, response time = 2.138 ms.
Ping reply from http://192.168.154.132:58140/, response time = 2.194 ms.
Ping reply from http://192.168.154.132:58140/, response time = 4.607 ms.
Ping average time: 2.965 ms
```

Input Arguments

`nodename` — Name of node

string

Name of node, specified as a string. The name of the node must match the name given in ROS.

Output Arguments

`nodeinfo` — Information about ROS node

structure

Information about ROS node, returned as a structure containing these properties: `'NodeName'`, `'URI'`, `'Publications'`, `'Subscriptions'`, and `'Services'`. Access these properties using dot syntax, for example, `nodeinfo.NodeName`.

`nodelist` — List of node names available

cell array of strings

List of node names available, returned as a cell array of strings.

See Also

`rosinit` | `rostopic`

Introduced in R2015a

rosparam

Access ROS parameter server values

Syntax

```
ptree = rosparam
```

Description

`ptree = rosparam` creates a parameter tree object, ptree. Once ptree is created, the connection to the parameter server remains persistent until the object is deleted or the ROS master becomes unavailable.

A ROS parameter tree communicates with the ROS parameter server. The ROS parameter server can store strings, integers, doubles, booleans and cell arrays. The parameters are accessible by every node in the ROS network. Use the parameters to store static data such as configuration parameters. Use the `get`, `set`, `has`, `search`, and `del` functions to manipulate and view parameter values.

Examples

Create Parameter Tree Object and View Parameters

```
ptree = rosparam
```

```
ptree =

  ParameterTree with properties:

    AvailableParameters: {40x1 cell}
```

```
ptree.AvailableParameters
```

```
ans =

    '/bumper2pointcloud/pointcloud_radius'
    '/camera/imager_rate'
```

```
    '/camera/rgb/image_raw/compressed/format'
    ...
```

Output Arguments

`ptree` — Parameter tree

`ParameterTree` object handle

Parameter tree, returned as a `ParameterTree` object handle. Use this object to reference parameter information, for example, `ptree.AvailableFrames`.

See Also

`del` | `get` | `has` | `search` | `set`

Introduced in R2015a

rospublisher

Publish messages on a topic

Syntax

```
pub = rospublisher(topicname)
pub = rospublisher(topicname,msgtype)
pub = rospublisher( ___ ,Name,Value)
[pub,msg] = rospublisher( ___ )

rospublisher(topicname,msg)
```

Description

`pub = rospublisher(topicname)` creates a publisher, pub, for a topic, topicname, that already exists on the ROS master topic list. The publisher gets the topic message type from the topic list on the ROS master. When the MATLAB global node publishes messages on that topic, ROS nodes that subscribe to that topic receive those messages. If the topic is not on the ROS master topic list, this function displays an error message. To see a list of available topic names, at the MATLAB command prompt, type `rostopic list`/

`pub = rospublisher(topicname,msgtype)` creates a publisher for a topic and adds that topic to the ROS master topic list. If the ROS master topic list already contains a matching topic, the ROS master adds the MATLAB global node to the list of publishers for that topic. If msgtype differs from the topic type on the ROS master topic list, the function displays an error message.

`pub = rospublisher( ___ ,Name,Value)` provides additional options specified by one or more `Name,Value` pair arguments using any of the argument from previous syntaxes. `Name` is the property name and `Value` is the corresponding value. `Name` must appear inside single quotes (`''`). You can specify several name-value pair arguments in any order as `Name1,Value1,...,NameN,ValueN`). Properties not specified retain their default values.

`[pub,msg] = rospublisher( ___ )` returns a message, msg, that you can send with the publisher, pub. The message is initialized with default values.

`rospublisher(topicname,msg)` publishes a message, msg, to the specified topic without creating a publisher.

Properties: When you call `rospublisher`, pub is returned as a `Publisher` object with the following properties:

- `TopicName` (read-only): Name of the published topic
- `MessageType` (read-only): Message type of published messages
- `IsLatching`: Indicates if publisher is latching
- `NumSubscribers` (read-only): Number of current subscribers for the published topic

To access these properties, use `pub.TopicName`, `pub.MessageType`, `pub.IsLatching`, or `pub.NumSubscribers`.

Examples

Create a Publisher with Specified Message Type and Send String Data

```
chatpub = rospublisher('/chatter','std_msgs/String');
msg = rosmessage(chatpub);
msg.Data = 'Some test string';
send(chatpub,msg);
```

Send Single Message Without Creating a Publisher

```
rospublisher('/chatter',msg)
```

Input Arguments

`topicname` — ROS topic name

string

ROS topic name, specified as a string.

`msgtype` — Message type for ROS topic

string

ROS message type, specified as a string.

Name-Value Pair Arguments

Specify optional comma-separated pairs of Name,Value arguments. `Name` is the argument name and `Value` is the corresponding value. `Name` must appear inside single quotes (`' '`). You can specify several name and value pair arguments in any order as `Name1,Value1,...,NameN,ValueN`.

Example: `'IsLatching',false`

`'IsLatching'` — Latch property

`true` (default) | logical

Latch property, specified as the comma-seperated pair consisting of `'isLatching` and a logical. If enabled, latch mode saves the last message sent by the publisher and resends it to new subscribers. By default, latch mode is disabled (`false`). To enable latch mode, set `'IsLatching'` to `true`.

Output Arguments

`pub` — ROS publisher

`Publisher` object handle

ROS publisher, returned as a `Publisher` object handle.

`msg` — ROS message

`Message` object handle

ROS message, returned as a `Message` object handle.

See Also

`rosmessage` | `rossubscriber`

Introduced in R2015a

rosservice

Retrieve information about services in ROS network

Syntax

```
rosservice list
rosservice info svcname
rosservice type svcname
rosservice uri svcname

svclist = rosservice('list')
svcinfo = rosservice('info',svcname)
svctype = rosservice('type',svcname)
svcuri = rosservice('uri',svcname)
```

Description

`rosservice list` returns a list of service names for all of the active service servers on the ROS network.

`rosservice info svcname` returns information about the specified service, `svcname`.

`rosservice type svcname` returns the service type.

`rosservice uri svcname` returns the URI of the service.

`svclist = rosservice('list')` returns a list of service names for all of the active service servers on the ROS network. svclist contains a cell array of service names.

`svcinfo = rosservice('info',svcname)` returns a structure of information, svcinfo, about the service, `svcname`.

`svctype = rosservice('type',svcname)` returns the service type of the service as a string.

`svcuri = rosservice('uri',svcname)` returns the URI of the service as a string.

Examples

View List of ROS Services

```
rosservice list
```

```
/bumper2pointcloud/get_loggers
/bumper2pointcloud/set_logger_level
/camera/rgb/image_raw/compressed/set_parameters
...
```

Get Information, Type and URI for ROS Service

Get the service information.

```
svcinfo = rosservice('info','gazebo/pause_physics')
```

```
svcinfo =

    Node: '/gazebo'
     URI: 'rosrpc://192.168.154.132:33953'
    Type: 'std_srvs/Empty'
    Args: {}
```

Get the service type.

```
svctype = rosservice('type','gazebo/pause_physics')
```

```
svctype =

std_srvs/Empty
```

Get the service URI.

```
svcuri = rosservice('uri','gazebo/pause_physics')
```

```
svcuri =

rosrpc://192.168.154.132:33953
```

Input Arguments

`svcname` — Name of service

string

Name of service, specified as a string. The service name must match its name in the ROS network.

Output Arguments

`svcinfo` — Information about a ROS service

string

Information about a ROS service, returned as a string.

`svclist` — List of available ROS services

cell array of strings

List of available ROS services, returned as a cell array of strings.

`svctype` — Type of ROS service

string

Type of ROS service, returned as a string.

`svcuri` — URI for accessing service

string

URI for accessing service, returned as a string.

See Also

`rosinit` | `rosparam`

Introduced in R2015a

rosshutdown

Shut down ROS system

Syntax

```
rosshutdown
```

Description

`rosshutdown` shuts down the global node and, if it is running, the ROS master. When you finish working with the ROS network, use `rosshutdown` to shut down the global ROS entities created by `rosinit`. If the global node and ROS master are not running, this function has no effect. After calling `rosshutdown`, any ROS entities that depend on the global node, for example, subscribers created with `rossubscriber`, are deleted and become unstable.

Examples

Shut Down Global ROS Node

```
rosshutdown
```

```
Shutting down global node /matlab_global_node_9220 with NodeURI http://hostname:54335/
Shutting down ROS master on http://hostname.mathworks.com:11311/.
```

See Also

`rosinit`

Introduced in R2015a

rossubscriber

Subscribe to messages on a topic

Syntax

```
sub = rossubscriber(topicname)
sub = rossubscriber(topicname,msgtype)

sub = rossubscriber(topicname,callback)
sub = rossubscriber(topicname, msgtype,callback)

sub = rossubscriber(___,Name,Value)
```

Description

`sub = rossubscriber(topicname)` subscribes to a topic with name topicname. If the ROS master topic list includes topicname, this syntax returns a subscriber object handle, sub. If the ROS master topic list does not include the topic, this syntax displays an error. `rossubscriber` enables you to transfer data by subscribing to messages. When ROS nodes publish messages on that topic, MATLAB receives those messages through this subscriber.

`sub = rossubscriber(topicname,msgtype)` subscribes to a topic that has the specified name, topicname, and type, msgtype. If the topic list on the ROS master does not include a topic with that specified name and type, a topic with the specific name and type is added to the topic list. Use this syntax to avoid errors when it is possible for the subscriber to subscribe to a topic before a publisher has added the topic to the topic list on the ROS master.

`sub = rossubscriber(topicname,callback)` specifies a callback function, callback that runs when the subscriber object handle receives a topic message. Use this syntax to avoid the blocking receive function. callback can be a single function handle or a cell array. The first element of the cell array must be be a function handle or a string containing the name of a function. The remaining elements of the cell array can be arbitrary user data that is passed to the callback function.

`sub = rossubscriber(topicname, msgtype,callback)` specifies a callback function and subscribes to a topic that has the specified name, topicname, and type, msgtype.

`sub = rossubscriber(___,Name,Value)` provides additional options specified by one or more `Name,Value` pair arguments using any of the argument from previous syntaxes. `Name` is the property name and `Value` is the corresponding value. `Name` must appear inside single quotes (`''`). You can specify several name-value pair arguments in any order as `Name1,Value1,...,NameN,ValueN`). Properties not specified retain their default values.

Properties: When you call `rossubscriber`, sub is returned as a `Subscriber` object with the following properties:

- `TopicName` (read-only): Name of the published topic
- `MessageType` (read-only): Message type of published messages
- `LatestMessage` (read-only): Latest message received
- `BufferSize` (read-only): Buffer size of the incoming queue
- `NewMessageFcn`: Callback property for subscriber callbacks

To access these properties, use `sub.TopicName`, `sub.MessageType`, `sub.LatestMessage`, `sub.BufferSize`, or `sub.NewMessageFcn`..

Examples

Create Subscriber

```
sub = rossubscriber('/scan');
```

Create Subscriber Using `rostype` for Message Type

Create the subscriber.

```
sub = rossubscriber('/scan', rostype.sensor_msgs_LaserScan);
```

Get the last message from the topic.

```
scan = sub.LatestMessage;
```

Wait to receive the next message and store in `scan`.

```
scan = receive(sub);
```

Create Subscriber Using Callback Function

Create the publisher and subscriber.

```
chatpub = rospublisher('/chatter', rostype.std_msgs_String);
chatsub = rossubscriber('/chatter', @testCallback);
```

Change the Callback Function of Existing Subscriber

```
chatsub = rossubscriber('/chatter', @testCallback);
userData = [5 1; 1 5];
chatsub.NewMessageFcn = {@func1, userData};
```

Create Subscriber with Specified Buffer Size

```
chatbuf = rossubscriber('/chatter', 'BufferSize', 5);
```

Input Arguments

`topicname` — ROS topic name

string

ROS topic name, specified as a string.

`msgtype` — Message type for ROS topic

string

Message type for ROS topic, specified as a string.

`callback` — Callback function

function handle | cell array

Callback function, specified as a function handle or cell array. In the first element of the cell array, specify either a function handle or a string representing a function name. In subsequent elements, specify user data.

The subscriber callback function requires at least two input arguments. The first argument, `src`, is the associated subscriber object. The second argument, `msg`, is the received message object. The function header for the callback is:

```
function subCallback(src,msg)
```

When setting the callback, you pass additional parameters to the callback function by including both the callback function and the parameters as elements of a cell array.

Name-Value Pair Arguments

Specify optional comma-separated pairs of Name,Value arguments. `Name` is the argument name and `Value` is the corresponding value. `Name` must appear inside single quotes (`' '`). You can specify several name and value pair arguments in any order as `Name1,Value1,...,NameN,ValueN`.

Example: `'Buffersize',25`

`'BufferSize'` — Buffer size
1 (default) | scalar

Buffer size, specified as the comma-separated pair consisting of `'BufferSize'` and a scalar. If messages arrive faster and than your callback can process them, they will be deleted once the incoming queue is full.

`'NewMessageFcn'` — Callback property
function handle | cell array

Callback property, specified as a function handle or cell array. In the first element of the cell array, specify either a function handle or a string representing a function name. In subsequent elements, specify user data.

The subscriber callback function requires at least two input arguments. The first argument, `src`, is the associated subscriber object. The second argument, `msg`, is the received message object. The function header for the callback is:

```
function subCallback(src,msg)
```

When setting the callback, you pass additional parameters to the callback function by including both the callback function and the parameters as elements of a cell array.

Output Arguments

`sub` — ROS subscriber
`Subscriber` object handle

ROS subscriber, returned as a `Subscriber` object handle. You can create the object using `rossubscriber`.

See Also

`rosmessage` | `rospublisher`

Introduced in R2015a

rossvcclient

Create ROS service client

Syntax

```
client = rossvcclient(servicename)
client = rossvcclient(servicename,Name,Value)

[client,reqmsg] = rossvcclient( ___ )
```

Description

`client = rossvcclient(servicename)` creates a service client that connects to, and gets its service type from, a service server. This command syntax blocks the current MATLAB program from running until it can connect to the service server.

Use `rossvcclient` to create a ROS service client. This service client uses a persistent connection to send requests to, and receive responses from, a ROS service server. The connection persists until the service client is deleted or the service server becomes unavailable.

`client = rossvcclient(servicename,Name,Value)` provides additional options specified by one or more `Name,Value` pair arguments. Name must appear inside single quotes (`''`). You can specify several name-value pair arguments in any order as `Name1,Value1,...,NameN,ValueN`.

`[client,reqmsg] = rossvcclient( ___ )` returns a new service request message in reqmsg, using any of the arguments from previous syntaxes. The message type of reqmsg is determined by the service that client is connected to. The message is initialized with default values.

Properties: When you call `rossubscriber`, client is returned as a `ServiceClient` object with the following properties:

- `ServerName` (read-only): Name of the service
- `ServiceType` (read-only): Type of the service

To access these properties, use `client.ServerName` or `client.ServerType`.

Examples

Create Service Client and Wait to Connect to Service

```
client = rossvcclient('/gazebo/get_model_state');
```

Connect to Service Server with Timeout

```
client = rossvcclient('/gazebo/get_model_state', 'Timeout', 3);
```

Create Service Request Message and Call for Response

Create the service request message.

```
request = rosmessage(client);
```

Send the service request and wait for a response.

```
request.ModelName = 'SomeModel';
response = call(client, request);
```

Create a Service Client and Get a Request Message

```
[client,reqmsg] = rossvcclient('/gazebo/get_model_state');
```

Input Arguments

`servicename` — Service name

string

Service name, specified as a string. To access information about active services, such as the service name, use the `rosservice` function.

Name-Value Pair Arguments

Specify optional comma-separated pairs of Name,Value arguments. `Name` is the argument name and `Value` is the corresponding value. `Name` must appear inside single

quotes (' '). You can specify several name and value pair arguments in any order as `Name1,Value1,...,NameN,ValueN`.

Example: `'Timeout',10`

`'Timeout'` — Timeout period in seconds

`inf` (default) | scalar

Timeout period in seconds, specified as a scalar. If the service client does not connect to the service server by the end of the timeout period, `rossvcclient` displays an error message, and MATLAB keeps running the current program. The default value of `inf` blocks MATLAB from running the current program until the service client is connected to the service server.

Output Arguments

`client` — ROS service client

`ServiceClient` object handle

ROS service client, returned as a `ServiceClient` object handle. This service client uses a persistent connection to send requests to, and receive responses from, a ROS service server.

`reqmsg` — ROS message

`Message` object handle

ROS message, returned as a `Message` object handle that matches the request type of the service.

See Also

`call` | `rosservice` | `rossvcserver`

Introduced in R2015a

rossvcserver

Create ROS service server

Syntax

```
server = rossvcserver(servicename,svctype)
server = rossvcserver(servicename,svctype,callback)

servicename = rossvcserver(servicename,svctype,Name,Value)
```

Description

`server = rossvcserver(servicename,svctype)` creates a service server object of type svctype available in the ROS network under the name servicename. The service object cannot respond to service requests until you specify a function handle callback.

Use `rossvcserver` to create a ROS service server that can receive requests from, and send responses to, a ROS service client. The service server must exist before creating the service client. When you create the client, it establishes a connection to the server. The connection persists while both client and server exist and can reach each other.

`server = rossvcserver(servicename,svctype,callback)` specifies the function handle callback, callback, that constructs a response when the server receives a request. callback can be a single function handle or a cell array. The first element of the cell array must be a function handle or a string containing the name of a function. The remaining elements of the cell array can be arbitrary user data that is passed to the callback function.

`servicename = rossvcserver(servicename,svctype,Name,Value)` provides additional options specified by one or more `Name,Value` pair arguments using any of the argument from previous syntaxes. `Name` is the property name and `Value` is the corresponding value. `Name` must appear inside single quotes (`''`). You can specify several name-value pair arguments in any order as `Name1,Value1,...,NameN,ValueN`). Properties not specified retain their default values.

Properties: When you call `rossubscriber`, server is returned as a `ServiceServer` object with the following properties:

- `ServerName` (read-only): Name of the service
- `ServiceType` (read-only): Type of the service
- `NewRequestFcn`: Callback property for service request callbacks

To access these properties, use `client.ServerName`, `client.ServerType`, or `client.NewRequestFcn`.

Examples

Create Service Server

```
server = rossvcserver('/gazebo/get_model_state', rostype.gazebo_msgs_GetModelState);
```

Create Service Server with Callback Function and User Data

Create user data.

```
userData = randi(20);
```

Create a service server.

```
server = rossvcserver('/gazebo/get_model_state2', rostype.gazebo_msgs_GetModelState
   {@func1, userData});
```

Change the callback for a incoming service calls.

```
server.NewRequestFcn = @func2;
```

Input Arguments

`servicename` — Service name

string

Service name, specified as a string. You can access information about active services, such as the service name, using `rosservice`.

`svctype` — Service message type

string

Service message type, specified as a string. You can access information about service message types using `rostype`. Use tab completion to select the message.

`callback` — Callback function and inputs

function handle | cell array

Callback function and inputs, specified as a function handle or a cell array. The first element of the cell array must be a function handle or a string containing the name of a function. The remaining elements of the cell array can be arbitrary user data that is passed to the callback function. The service server callback function requires at least three input arguments and one output. The first argument, `server`, is the associated service server object. The second argument, `reqmsg`, is the request message object sent by the service client. The third argument is the default response message object, `defaultrespmsg`. Use `defaultrespmsg` as a starting point for constructing the function output `response`, which is sent back to the service client.

```
function response = serviceCallback(server,reqmsg,defaultrespmsg)
  response = defaultrespmsg;
  % Build the response message here
end
```

While setting the callback, to construct a callback that accepts additional parameters, use a cell array that includes the function handle callback and the parameters.

Name-Value Pair Arguments

Specify optional comma-separated pairs of Name,Value arguments. `Name` is the argument name and `Value` is the corresponding value. `Name` must appear inside single quotes (`' '`). You can specify several name and value pair arguments in any order as `Name1,Value1,...,NameN,ValueN`.

Example: `'NewMessageFcn',{@func1,userDate}`

`'NewMessageFcn'` — Callback property

function handle | cell array

Callback property, specified as a function handle or a cell array. The first element of the cell array must be a function handle or a string containing the name of a function. The remaining elements of the cell array can be arbitrary user data that is passed to the callback function. The service server callback function requires at least three input arguments and one output. The first argument, `server`, is the associated service server object. The second argument, `reqmsg`, is the request message object sent by the service client. The third argument is the default response message object, `defaultrespmsg`. Use `defaultrespmsg` as a starting point for constructing the function output `response`, which is sent back to the service client.

```
function response = serviceCallback(server,reqmsg,defaultrespmsg)
  response = defaultrespmsg;
  % Build the response message here
end
```

While setting the callback, to construct a callback that accepts additional parameters, use a cell array that includes the function handle callback and the parameters.

Output Arguments

`server` — Service server

`ServiceServer` object handle

Service server, returned as a `ServiceServer` object handle. This service server registers with the ROS master, which enables service clients to send it requests.

See Also

`rossvcclient`

Introduced in R2015a

rostf

Access ROS transformations

Syntax

```
tfTree = rostf
```

Description

`tfTree = rostf` creates a ROS transformation tree object. The object allows you to access the tf coordinate transformations that are shared on the ROS network. You can receive transformations and apply them to different entities. You can also send transformations and share them with the rest of the ROS network.

ROS uses the tf transform library to keep track of the relationship between multiple coordinate frames. The relative transformations between these coordinate frames is maintained in a tree structure. Querying this tree lets you transform entities like poses and points between any two coordinate frames. To access available frames use the syntax:

```
tfTree.AvailableFrames
```

MATLAB can only keep track of the most current information between different frames. ROS tf allows for "time-traveling" or retrieving transformations from specific time instances.

Examples

Create Transformation Tree

```
tree = rostf;
```

Output Arguments

`tfTree` — ROS transformation tree

`TransformationTree` object handle

ROS transformation tree, returned as a `TransformationTree` object handle.

See Also

`getTransform` | `transform`

Introduced in R2015a

rostime

Access ROS time functionality

Syntax

```
time = rostime('now')
[time,issimtime] = rostime('now')
time = rostime('now','system')
```

Description

`time = rostime('now')` returns the current ROS time. If the `use_sim_time` ROS parameter is set to `true`, the `rostime` returns the simulation time published on the `clock` topic. Otherwise, the function returns your machine's system time. time is a ROS `Time` object. If no output argument is given, the current time (in seconds) is printed to the screen.

`rostime` can be used to timestamp messages or to measure time in the ROS network.

`[time,issimtime] = rostime('now')` also returns a Boolean that indicates if time is in simulation time (`true`) or system time (`false`).

`time = rostime('now','system')` always returns your machine's system time, even if ROS publishes simulation time on the `clock` topic. If no output argument is given, the system time (in seconds) is printed to the screen.

The system time in ROS follows the Unix or POSIX time standard. POSIX time is defined as the time that has elapsed since 00:00:00 Coordinated Universal Time (UTC), 1 January 1970, not counting leap seconds.

Examples

Show Current ROS Time

```
t = rostime('now')
```

```
t =

  ROS Time with properties:

     Sec: 1417812065
    Nsec: 368000000
```

Indicate Whether Time is System Time

```
[t,issim] = rostime('now');
```

```
t =

  ROS Time with properties:

     Sec: 1417812173
    Nsec: 171000000


issim =

     0
```

Timestamp Message Data

```
point = rosmessage('geometry_msgs/PointStamped');
point.Header.Stamp = rostime('now','system');
```

Output Arguments

`time` — Current ROS or system time

`Time` object handle

Current ROS or system time, returned as a `Time` object handle. By default, `time` is the ROS simulation time published on the `clock` topic. If the system time if the `use_sim_time` ROS parameter is set to `true`, `time` returns the system time..

`issimtime` — System time indicator

boolean

System time indicator, returned as a boolean. This indicates whether the time argument is in simulation time (`true`) or system time (`false`), returned as a Boolean.

See Also

`rosmessage`

Introduced in R2015a

rostopic

Retrieve information about ROS topics

Syntax

```
rostopic list
rostopic echo topicname
rostopic info topicname
rostopic type topicname
```

```
topiclist = rostopic('list')
msg = rostopic('echo', topicname)
topicinfo = rostopic('info', topicname)
msgtype = rostopic('type', topicname)
```

Description

`rostopic list` returns a list of ROS topics from the ROS master.

`rostopic echo topicname` returns the messages being sent from the ROS master about a specific topic, topicname. To stop returning messages, press **Ctrl+C**.

`rostopic info topicname` returns the message type, publishers, and subscribers for a specific topic, topicname.

`rostopic type topicname` returns the message type for a specific topic.

`topiclist = rostopic('list')` returns a cell array containing the ROS topics from the ROS master. If you do not define the output argument, the list is returned in the MATLAB Command Window.

`msg = rostopic('echo', topicname)` returns the messages being sent from the ROS master about a specific topic, topicname. To stop returning messages, press **Ctrl+C**. If the output argument is defined, then `rostopic` returns the first message that arrives on that topic.

`topicinfo = rostopic('info', topicname)` returns a structure containing the message type, publishers, and subscribers for a specific topic, topicname.

`msgtype = rostopic('type', topicname)` returns a string containing the message type for the specified topic, topicname.

Examples

Get LIist of Topics Available on ROS Master

```
  rostopic list
```

```
/camera/depth/camera_info
/camera/depth/image_raw
/camera/depth/points
/camera/parameter_descriptions
...
```

Get Topic Info for Specified ROS Topic

```
 topicinfo = rostopic('info','camera/depth/points')
```

```
topicinfo =

    MessageType: 'sensor_msgs/PointCloud2'
     Publishers: [1x1 struct]
    Subscribers: [0x0 struct]
```

Get Message Type for Specified ROS Topic

```
 msgtype = rostopic('type','camera/depth/points')
```

```
msgtype =

sensor_msgs/PointCloud2
```

Input Arguments

`topicname` — ROS topic name

string

ROS topic name, specified as a string. The topic name must match one of the topics that`rostopic('list')` outputs.

Output Arguments

`topiclist` — List of topics from the ROS master

cell array of strings

List of topics from ROS master, returned as a cell array of strings.

`msg` — ROS message for a given topic

object handle

ROS message for a given topic, returned as an object handle.

`topicinfo` — Information about a given ROS topic

structure

Information about a ROS topic, returned as a structure. `topicinfo` included the message type, publishers, and subscribers associated with that topic.

`msgtype` — Message type for a ROS topic

string

Message type for a ROS topic, returned as a string.

Introduced in R2015a

rostype

Access available ROS message types

Syntax

```
rostype
```

Description

`rostype` creates a blank message of a certain type by browsing the list of available message types. You can use tab completion and do not have to rely on typing error-free message type strings. By typing `rostype.partialstring` , and pressing **Tab**, a list of matching message types appears in a list. By setting the message type equal to a variable, you can create a string of that message type. Alternatively, you can create the message by supplying the message type directly into `rosmessage` as an input argument.

Examples

Create ROS Message Type and ROS Message

```
t = rostype.std_msgs_String
msg = rosmessage(rostype.sensor_msgs_PointCloud2);
```

Introduced in R2015a

rotm2axang

Convert rotation matrix to axis-angle rotation

Syntax

```
axang = rotm2axang(rotm)
```

Description

`axang = rotm2axang(rotm)` converts a rotation given as an orthonormal rotation matrix, rotm, to the corresponding axis-angle representation, axang. The input rotation matrix must be in the premultiply form for rotations.

Examples

Convert Rotation Matrix to Axis-Angle Rotation

```
rotm = [1 0 0 ; 0 -1 0; 0 0 -1];
axang = rotm2axang(rotm)
```

```
axang =

    1.0000         0         0    3.1416
```

Input Arguments

`rotm` — Rotation matrix

3-by-3-by-n matrix

Rotation matrix, specified as a 3-by-3-by-n matrix containing n rotation matrices. Each rotation matrix has a size of 3-by-3 and is orthonormal. The input rotation matrix must be in the premultiply form for rotations.

Example: `[0 0 1; 0 1 0; -1 0 0]`

Output Arguments

axang — Rotation given in axis-angle form

n-by-4 matrix

Rotation given in axis-angle form, returned as an *n*-by-4 matrix of *n* axis-angle rotations. The first three elements of every row specify the rotation axis, and the last element defines the rotation angle (in radians).

Example: `[1 0 0 pi/2]`

See Also

`axang2rotm`

Introduced in R2015a

rotm2eul

Convert rotation matrix to Euler angles

Syntax

```
eul = rotm2eul(rotm)
eul = rotm2eul(rotm,sequence)
```

Description

`eul = rotm2eul(rotm)` converts a rotation matrix, rotm, to the corresponding Euler angles, eul. The input rotation matrix must be in the premultiply form for rotations. The default order for Euler angle rotations is `'ZYX'`.

`eul = rotm2eul(rotm,sequence)` converts a rotation matrix to Euler angles. The Euler angles are specified in the axis rotation sequence, sequence. The default order for Euler angle rotations is `'ZYX'`.

Examples

Convert Rotation Matrix to Euler Angles

```
rotm = [0 0 1; 0 1 0; -1 0 0];
eulZYX = rotm2eul(rotm)
```

```
eulZYX =

         0    1.5708         0
```

Convert Euler Angles to Quaternion Using ZYZ Axis Order

```
rotm = [0 0 1; 0 -1 0; -1 0 0];
eulZYZ = rotm2eul(rotm,'ZYZ')
```

```
eulZYZ =
```

```
         0    1.5708    3.1416
```

Input Arguments

`rotm` — Rotation matrix

3-by-3-by-*n* matrix

Rotation matrix, specified as a 3-by-3-by-*n* matrix containing *n* rotation matrices. Each rotation matrix has a size of 3-by-3 and is orthonormal. The input rotation matrix must be in the premultiply form for rotations.

Example: `[0 0 1; 0 1 0; -1 0 0]`

`sequence` — Axis rotation sequence

`'ZYX'` (default) | `'ZYZ'`

Axis rotation sequence for the Euler angles, specified as one of these strings:

- `'ZYX'` (default) – The order of rotation angles is *z*-axis, *y*-axis, *x*-axis.
- `'ZYZ'` – The order of rotation angles is *z*-axis, *y*-axis, *z*-axis.

Output Arguments

`eul` — Euler rotation angles

n-by-3 matrix

Euler rotation angles in radians, returned as an *n*-by-3 array of Euler rotation angles. Each row represents one Euler angle set.

Example: `[0 0 1.5708]`

See Also

`eul2rotm`

Introduced in R2015a

rotm2quat

Convert rotation matrix to quaternion

Syntax

```
quat = rotm2quat(rotm)
```

Description

`quat = rotm2quat(rotm)` converts a rotation matrix, rotm, to the corresponding unit quaternion representation, quat. The input rotation matrix must be in the premultiply form for rotations.

Examples

Convert Rotation Matrix to Quaternion

```
rotm = [0 0 1; 0 1 0; -1 0 0];
quat = rotm2quat(rotm)
```

```
quat =

    0.7071         0    0.7071         0
```

Input Arguments

`rotm` — Rotation matrix

3-by-3-by-n matrix

Rotation matrix, specified as a 3-by-3-by-n matrix containing n rotation matrices. Each rotation matrix has a size of 3-by-3 and is orthonormal. The input rotation matrix must be in the premultiply form for rotations.

Example: `[0 0 1; 0 1 0; -1 0 0]`

Output Arguments

`quat` — Unit quaternion

n-by-4 matrix

Unit quaternion, returned as an *n*-by-4 matrix containing *n* quaternions. Each quaternion, one per row, is of the form $q = [w\ x\ y\ z]$, with w as the scalar number.

Example: `[0.7071 0.7071 0 0]`

See Also

`quat2rotm`

Introduced in R2015a

rotm2tform

Convert rotation matrix to homogeneous transformation

Syntax

```
tform = rotm2tform(rotm)
```

Description

`tform = rotm2tform(rotm)` converts the rotation matrix, rotm, into a homogeneous transformation matrix, tform. The input rotation matrix must be in the premultiply form for rotations. When using the transformation matrix, premultiply it with the coordinates to be transformed (as opposed to postmultiplying).

Examples

Convert Rotation Matrix to Homogeneous Transformation

```
rotm = [1 0 0 ; 0 -1 0; 0 0 -1];
tform = rotm2tform(rotm)
```

```
tform =

     1     0     0     0
     0    -1     0     0
     0     0    -1     0
     0     0     0     1
```

Input Arguments

`rotm` — Rotation matrix

3-by-3-by-n matrix

Rotation matrix, specified as a 3-by-3-by-n matrix containing n rotation matrices. Each rotation matrix has a size of 3-by-3 and is orthonormal. The input rotation matrix must be in the premultiply form for rotations.

Example: `[0 0 1; 0 1 0; -1 0 0]`

Output Arguments

`tform` — Homogeneous transformation

4-by-4-by-*n* matrix

Homogeneous transformation matrix, specified by a 4-by-4-by-*n* matrix of *n* homogeneous transformations. When using the rotation matrix, premultiply it with the coordinates to be rotated (as opposed to postmultiplying).

Example: `[0 0 1 0; 0 1 0 0; -1 0 0 0; 0 0 0 1]`

See Also

`tform2rotm`

Introduced in R2015a

scatter3

Display point cloud in scatter plot

Syntax

```
scatter3(pcloud)
scatter3(pcloud,Name,Value)
h = scatter3( ___ )
```

Description

`scatter3(pcloud)` plots the input pcloud point cloud as a 3-D scatter plot in the current axes handle. If the data contains RGB information for each point, the scatter plot is colored accordingly.

`scatter3(pcloud,Name,Value)` provides additional options specified by one or more `Name,Value` pair arguments. Name must appear inside single quotes (`''`). You can specify several name-value pair arguments in any order as `Name1,Value1,...,NameN,ValueN`)

`h = scatter3( ___ )` returns the scatter series object, using any of the arguments from previous syntaxes. Use h to modify properties of the scatter series after it is created.

When plotting ROS point cloud messages, MATLAB follows the standard ROS convention for axis orientation. This convention states that **positive *x* is forward, positive *y* is left, and positive *z* is up**. However, if cameras are used, a second frame is defined with an "_optical" suffix which changes the orientation of the axis. In this case, positive *z* is forward, positive *x* is right, and positive *y* is down. MATLAB looks for the "_optical" suffix and will adjust the axis orientation of the scatter plot accordingly. For more information, see Axis Orientation on the ROS Wiki.

Examples

Show 3-D Point Cloud

```
scatter3(pcloud);
```

Show 3-D Ppoint Cloud with Uniform Red Points

```
scatter3(pcloud,'MarkerEdgeColor',[1 0 0]);
```

Input Arguments

`pcloud` — Point cloud

`PointCloud2` object handle

Point cloud, specified as a `PointCloud2` object handle for a `'sensor_msgs/PointCloud2'` ROS message.

Name-Value Pair Arguments

Specify optional comma-separated pairs of Name,Value arguments. `Name` is the argument name and `Value` is the corresponding value. `Name` must appear inside single quotes (`' '`). You can specify several name and value pair arguments in any order as `Name1,Value1,...,NameN,ValueN`.

Example: `'MarkerEdgeColor',[1 0 0]`

`'MarkerEdgeColor'` — Marker outline color

`'flat'` (default) | `'none'` | RGB triplet | color string

Marker outline color, specified as one of these values:

- `'flat'` — Colors defined by the CData property.
- `'none'` — No color, which makes unfilled markers invisible.
- RGB triplet or color string — Specify a custom color.

An RGB triplet is a three-element row vector whose elements specify the intensities of the red, green, and blue components of the color. The intensities must be in the range `[0,1]`, for example, `[0.4 0.6 0.7]`. This table lists RGB triplet values that have equivalent color strings.

Long Name	Short Name	RGB Triplet
'yellow'	'y'	[1 1 0]
'magenta'	'm'	[1 0 1]
'cyan'	'c'	[0 1 1]
'red'	'r'	[1 0 0]
'green'	'g'	[0 1 0]
'blue'	'b'	[0 0 1]
'white'	'w'	[1 1 1]
'black	'k'	[0 0 0]

Example: `[0.5 0.5 0.5]`

Example: `'blue'`

`'Parent'` — Parent of axes
axes object

Parent of axes, specified as the comma-separated pair consisting of `'Parent` and an axes object in which to draw the point cloud. By default, the point cloud is plotted in the active axes.

Outputs

h — Scatter series object
scalar

Scatter series object, returned as a scalar. This value is a unique identifier, which you can use to query and modify the properties of the scatter object after it is created.

See Also
`readRGB` | `readXYZ`

Introduced in R2015a

search

Search ROS network for parameter names

Syntax

```
pnames = search(ptree,searchstr)
[pnames,pvalues] = search(ptree,searchstr)
```

Description

`pnames = search(ptree,searchstr)` searches within the parameter tree ptree and returns the parameter names that contain the string searchstr.

`[pnames,pvalues] = search(ptree,searchstr)` also returns the parameter values.

Examples

Search for Parameter Names and Values Using Partial String

```
[pnames,pvalues] = search(ptree,'gravity')
```

```
pnames =

    '/gazebo/gravity_x'    '/gazebo/gravity_y'    '/gazebo/gravity_z'


pvalues =

    [      0]
    [      0]
    [-9.8000]
```

Input Arguments

`ptree` — Parameter tree

`ParameterTree` object handle

Parameter tree, specified as a `ParameterTree` object handle. Create this object using the `rosparam` function.

`searchstr` — ROS parameter search string
string

ROS parameter search string. `search` returns all parameters that contain this string.

Output Arguments

`pnames` — Parameter values
cell array of strings

Parameter names, returned as a cell array of strings. These strings match the parameter names in the ROS master that contain the search string.

`pvalues` — Parameter values
cell array

Parameter values, returned as a cell array. These values vary, but it should match the value expected for each parameter name in the array. Supported values are

- `int32`
- `logical`
- `double`
- string
- cell array

Currently, Base64–encoded binary data and iso8601 data from ROS are not supported.

See Also

`get` | `rosparam`

Introduced in R2015a

select

Select subset of messages in rosbag

Syntax

```
bagsel = select(bag)
bagsel = select(bag,Name,Value)
```

Description

`bagsel = select(bag)` returns an object, bagsel, that contains all of the messages in the `BagSelection` object, bag

This function does not change the contents of the original `BagSelection` object. It returns a new object that contains the specified message selection.

`bagsel = select(bag,Name,Value)` provides additional options specified by one or more `Name,Value` pair arguments. `Name`must appear inside single quotes (`''`). You can specify several name-value pair arguments in any order as `Name1,Value1,...,NameN,ValueN`.

Examples

Create Copy of rosbag

Retrieve a rosbag file.

```
bag = rosbag(filepath);
```

Copy the bag using the `select` function.

```
bagCopy = select(bag);
```

Select Message Based on Time

Get the messages from the first full second of the rosbag.

```
bagMsgs = select(bagMsgs, 'Time', [bagMsgs.StartTime, ...
          bagMsgs.StartTime + 1])
```

Input Arguments

`bag` — Message of a rosbag

`BagSelection` object

All the messages contained within a rosbag, specified as a `BagSelection` object.

Name-Value Pair Arguments

Specify optional comma-separated pairs of Name,Value arguments. `Name` is the argument name and `Value` is the corresponding value. `Name` must appear inside single quotes (`' '`). You can specify several name and value pair arguments in any order as `Name1,Value1,...,NameN,ValueN`.

Example: `'MessageType','/geometry_msgs/Point'`

`'MessageType'` — ROS message type

string | cell array

ROS message type, specified as a string or cell array. Multiple message types can be specified with a cell array of strings.

`'Time'` — Start and end times

n-by-2 matrix

Start and end times of the rosbag selection, specified as an *n*-by-2 vector.

`'Topic'` — ROS topic name

string | cell array

ROS topic name, specified as a string or cell array. Multiple topic names can be specified with a cell array of strings.

Output Arguments

`bagsel` — Copy or subset of rosbag messages

`BagSelection` object

Copy or subset of rosbag messages, returned as a `BagSelection` object

See Also

`readMessages` | `rosbag` | `timeseries`

Introduced in R2015a

send

Publish ROS message to topic

Syntax

```
send(pub,msg)
```

Description

`send(pub,msg)` publishes a message to the topic specified by the publisher, pub. This message can be received by all subscribers in the ROS network that are subscribed to the topic specified by pub

Examples

Publish Message Using `send`

```
send(pub,msg);
```

Create, Send and Receive Message

Set up a topic, publisher, and subscriber to share and receive a message.

Create a topic and publisher.

```
msgtype = rostype.geometry_msgs_Point;
pub = rospublisher('position', msgtype);
```

Create a message.

```
msg = rosmessage(msgtype);
msg.Y = 2
```

```
msg =

  ROS Point message with properties:

    MessageType: 'geometry_msgs/Point'
```

```
              X: 0
              Y: 2
              Z: 0

  Use showdetails to show the contents of the message
```

Send the message.

```
send(pub,msg)
```

Subscribe to the publisher.

```
sub = rossubscriber('position',msgtype)
```

```
sub =

  Subscriber with properties:

       TopicName: '/position'
     MessageType: 'geometry_msgs/Point'
   LatestMessage: [1x1 Point]
      BufferSize: 25
   NewMessageFcn: []
```

Verify that the latest message received is correct.

```
sub.LatestMessage
```

```
ans =

  ROS Point message with properties:

    MessageType: 'geometry_msgs/Point'
              X: 0
              Y: 2
              Z: 0

  Use showdetails to show the contents of the message
```

Input Arguments

pub — ROS publisher

`Publisher` object handle

ROS publisher, specified as a `Publisher` object handle. You can create the object using `rospublisher`.

`msg` — ROS message
`Message` object handle

ROS message, specified as a `Message` object handle.

See Also

`rospublisher` | `rostopic`

Introduced in R2015a

sendTransform

Send transformation to ROS network

Syntax

```
sendTransform(tftree,tf)
```

Description

`sendTransform(tftree,tf)` broadcasts a transform or array of transforms, tf, to the ROS network as a `TransformationStamped` ROS message.

Examples

Send Transformation to ROS Network

```
tftree = rostf
tf = gettransform(tftree,'/camera_depth_frame','/base_link');
sendTransform(tftree,tf)
```

Input Arguments

`tftree` — ROS transformation tree

`TransformationTree` object handle

ROS transformation tree, specified as a `TransformationTree` object handle. You can create a transformation tree by calling the `rostf` function.

`tf` — Transformations between coordinate frames

`TransformStamped` object handle | array of object handles

Transformations between coordinate frames, returned as a `TransformStamped` object handle or as an array of object handles. Transformations are structured as a 3-D translation (3-element vector) and a 3-D rotation (quaternion).

See Also

`getTransform` | `transform`

Introduced in R2015a

set

Set value of ROS parameter; add new parameter

Syntax

```
set(ptree,paramname,pvalue)
```

Description

`set(ptree,paramname,pvalue)` assigns the value pvalue to the parameter with the name paramname, which is contained in the parameter tree ptree.

Examples

Set and Get Parameter Value

```
ptree = rosparam;
set(ptree,'DoubleParam',1.0)
get(ptree,'DoubleParam')
```

```
ans =

     1
```

Input Arguments

`ptree` — Parameter tree

`ParameterTree` object handle

Parameter tree, specified as a `ParameterTree` object handle. Create this object using the `rosparam` function.

`paramname` — ROS parameter name

string

ROS parameter name, specified as a string. This string must match the parameter name exactly.

`pvalue` — Parameter value

int32 | logical | char | double | cell array

Parameter value, returned as either a `int32`, `logical`, `double`, `char`, or `cell array`. `pvalue` matches the value of the specified`paramname` and the supported data type in `ParameterTree`. Currently, Base64–encoded binary data and iso8601 data from ROS are not supported.

See Also

`get` | `rosparam`

Introduced in R2015a

showdetails

Display all ROS message contents

Syntax

```
details = showdetails(msg)
```

Description

`details = showdetails(msg)` gets all data contents of message object msg. The details are stored in details or displayed on the command line.

Examples

Create Message and View Details

Create a message.

```
msg = rosmessage(rostype.geometry_msgs_Point);
msg.X = 1;
msg.Y = 2;
msg.Z = 3;
```

View the message details.

```
showdetails(msg)
```

```
  X :  1
  Y :  2
  Z :  3
```

Input Arguments

`msg` — ROS message

`Message` object handle

ROS message, specified as a `Message` object handle.

Output Arguments

`details` — Details of ROS message

string

Details of ROS message, returned as a string.

See Also

`rosmessage`

Introduced in R2015a

tform2axang

Convert homogeneous transformation to axis-angle rotation

Syntax

```
axang = tform2axang(tform)
```

Description

`axang = tform2axang(tform)` converts the rotational component of a homogeneous transformation, tform, to an axis-angle rotation, axang. The translational components of tform are ignored. The input homogeneous transformation must be in the premultiply form for transformations.

Examples

Convert Homogeneous Transformation to Axis-Angle Rotation

```
tform = [1 0 0 0; 0 0 -1 0; 0 1 0 0; 0 0 0 1]
axang = tform2axang(tform)
```

```
axang =

    1.0000         0         0    1.5708
```

Input Arguments

`tform` — Homogeneous transformation

4-by-4-by-n matrix

Homogeneous transformation, specified by a 4-by-4-by-n matrix of n homogeneous transformations. The input homogeneous transformation must be in the premultiply form for transformations.

Example: `[0 0 1 0; 0 1 0 0; -1 0 0 0; 0 0 0 1]`

Output Arguments

axang — Rotation given in axis-angle form

n-by-4 matrix

Rotation given in axis-angle form, specified as an *n*-by-4 matrix of *n* axis-angle rotations. The first three elements of every row specify the rotation axes, and the last element defines the rotation angle (in radians).

Example: `[1 0 0 pi/2]`

See Also

`axang2tform`

Introduced in R2015a

tform2eul

Extract Euler angles from homogeneous transformation

Syntax

```
eul = tform2eul(tform)
eul = tform2eul(tform, sequence)
```

Description

`eul = tform2eul(tform)` extracts the rotational component from a homogeneous transformation, tform, and returns it as Euler angles, eul. The translational components of tform are ignored. The input homogeneous transformation must be in the premultiply form for transformations. The default order for Euler angle rotations is `'ZYX'`.

`eul = tform2eul(tform, sequence)` extracts the Euler angles, eul, from a homogeneous transformation, tform, using the specified rotation sequence, sequence. The default order for Euler angle rotations is `'ZYX'`.

Examples

Extract Euler Angles from Homogeneous Transformation Matrix

```
tform = [1 0 0 0.5; 0 -1 0 5; 0 0 -1 -1.2; 0 0 0 1];
eulZYX = tform2eul(tform)
```

```
eulZYX =

         0         0    3.1416
```

Extract Euler Angles from Homogeneous Transformation Matrix Using ZYZ Rotation

```
tform = [1 0 0 0.5; 0 -1 0 5; 0 0 -1 -1.2; 0 0 0 1];
eulZYZ = tform2eul(tform,'ZYZ')
```

```
eulZYZ =
```

```
         0    3.1416    3.1416
```

Input Arguments

`tform` — Homogeneous transformation

4-by-4-by-*n* matrix

Homogeneous transformation, specified by a 4-by-4-by-*n* matrix of *n* homogeneous transformations. The input homogeneous transformation must be in the premultiply form for transformations.

Example: `[0 0 1 0; 0 1 0 0; -1 0 0 0; 0 0 0 1]`

`sequence` — Axis rotation sequence

`'ZYX'` (default) | `'ZYZ'`

Axis rotation sequence for the Euler angles, specified as one of these strings:

- `'ZYX'` (default) – The order of rotation angles is *z*-axis, *y*-axis, *x*-axis.
- `'ZYZ'` – The order of rotation angles is *z*-axis, *y*-axis, *z*-axis.

Output Arguments

`eul` — Euler rotation angles

n-by-3 matrix

Euler rotation angles in radians, returned as an *n*-by-3 array of Euler rotation angles. Each row represents one Euler angle set.

Example: `[0 0 1.5708]`

See Also

`eul2tform`

Introduced in R2015a

tform2quat

Extract quaternion from homogeneous transformation

Syntax

```
quat = tform2quat(tform)
```

Description

`quat = tform2quat(tform)` extracts the rotational component from a homogeneous transformation, tform, and returns it as a quaternion, quat. The translational components of tform are ignored. The input homogeneous transformation must be in the premultiply form for transformations.

Examples

Extract Quaternion from Homogeneous Transformation

```
tform = [1 0 0 0; 0 -1 0 0; 0 0 -1 0; 0 0 0 1];
quat = tform2quat(tform)
```

```
quat =

     0     1     0     0
```

Input Arguments

`tform` — Homogeneous transformation

4-by-4-by-*n* matrix

Homogeneous transformation, specified by a 4-by-4-by-*n* matrix of *n* homogeneous transformations. The input homogeneous transformation must be in the premultiply form for transformations.

Example: `[0 0 1 0; 0 1 0 0; -1 0 0 0; 0 0 0 1]`

Output Arguments

`quat` — Unit quaternion

n-by-4 matrix

Unit quaternion, returned as an *n*-by-4 matrix containing *n* quaternions. Each quaternion, one per row, is of the form $q = [w\ x\ y\ z]$, with w as the scalar number.

Example: `[0.7071 0.7071 0 0]`

See Also

`quat2tform`

Introduced in R2015a

tform2rotm

Extract rotation matrix from homogeneous transformation

Syntax

```
rotm = tform2rotm(tform)
```

Description

`rotm = tform2rotm(tform)` extracts the rotational component from a homogeneous transformation, tform, and returns it as an orthonormal rotation matrix, rotm. The translational components of tform are ignored. The input homogeneous transformation must be in the pre-multiply form for transformations. When using the rotation matrix, premultiply it with the coordinates to be rotated (as opposed to postmultiplying).

Examples

Convert Homogeneous Transformation to Rotation Matrix

```
tform = [1 0 0 0; 0 -1 0 0; 0 0 -1 0; 0 0 0 1];
rotm = tform2rotm(tform)
```

```
rotm =

     1     0     0
     0    -1     0
     0     0    -1
```

Input Arguments

`tform` — Homogeneous transformation

4-by-4-by-n matrix

Homogeneous transformation matrix, specified by a 4-by-4-by-n matrix of n homogeneous transformations. The input homogeneous transformation must be in the pre-multiply form for transformations.

Example: `[0 0 1 0; 0 1 0 0; -1 0 0 0; 0 0 0 1]`

Output Arguments

`rotm` — Rotation matrix

3-by-3-by-*n* matrix

Rotation matrix, returned as a 3-by-3-by-*n* matrix containing *n* rotation matrices. Each rotation matrix has a size of 3-by-3 and is orthonormal. When using the rotation matrix, premultiply it with the coordinates to be rotated (as opposed to postmultiplying).

Example: `[0 0 1; 0 1 0; -1 0 0]`

See Also

`rotm2tform`

Introduced in R2015a

tform2trvec

Extract translation vector from homogeneous transformation

Syntax

```
trvec = tform2trvec(tform)
```

Description

`trvec = tform2trvec(tform)` extracts the Cartesian representation of translation vector, trvec , from a homogeneous transformation, tform. The rotational components of tform are ignored. The input homogeneous transformation must be in the premultiply form for transformations.

Examples

Extract Translation Vector from Homogeneous Transformation

```
tform = [1 0 0 0.5; 0 -1 0 5; 0 0 -1 -1.2; 0 0 0 1];
trvec = tform2trvec(tform)
```

```
trvec =

    0.5000    5.0000   -1.2000
```

Input Arguments

`tform` — Homogeneous transformation

4-by-4-by-*n* matrix

Homogeneous transformation, specified by a 4-by-4-by-*n* matrix of *n* homogeneous transformations. The input homogeneous transformation must be in the premultiply form for transformations.

Example: `[0 0 1 0; 0 1 0 0; -1 0 0 0; 0 0 0 1]`

Output Arguments

`trvec` — Cartesian representation of a translation vector
n-by-3 matrix

Cartesian representation of a translation vector, returned as an *n*-by-3 matrix containing *n* translation vectors. Each vector is of the form $t = [x\ y\ z]$.

Example: `[0.5 6 100]`

See Also

`trvec2tform`

Introduced in R2015a

timeseries

Creates a time series object for selected message properties

Syntax

```
[ts,cols] = timeseries(bag)
[ts,cols] = timeseries(bag,property)
[ts,cols] = timeseries(bag,property,...,propertyN)
```

Description

`[ts,cols] = timeseries(bag)` creates a time series for all numeric and scalar message properties. The function evaluates each message in the current `BagSelection` object, bag, as ts. The cols output argument stores property names as a cell array of strings.

The returned time series object is memory-efficient because it stores only particular message properties instead of whole messages.

`[ts,cols] = timeseries(bag,property)` creates a time series for a specific message property, property. Property names can also be nested, for example, `'Pose.Pose.Position.X'` for the *x*-axis position of a robot.

`[ts,cols] = timeseries(bag,property,...,propertyN)` creates a time series for a range specific message properties. Each property is a different column in the time series object.

Examples

Create Time Series from Entire Bag Selection

```
ts = timeseries(bagMsgs);
```

Create Time Series with Single Property

```
ts = timeseries(bagMsgs, 'Pose.Pose.Position.X');
```

Create Time Series with Multiple Properties

```
ts = timeseries(bagMsgs, 'Twist.Twist.Angular.X', ...
          'Twist.Twist.Angular.Y', 'Twist.Twist.Angular.Z')
```

Input Arguments

`bag` — Bag selection

`BagSelection` object handle

Bag selection, specified as a `BagSelection` object handle. You can get a bag selection by calling `rosbag`.

`property` — Property names

string

Property names, specified as a string. Multiple properties can be specified. Each property name is a separate input and represents a different column in the time series object.

Output Arguments

`ts` — Time series

`Time` object handle

Time series, returned as a `Time` object handle.

`cols` — List of property names

cell array of strings

List of property names, returned as a cell array of strings.

More About

- "Time Series Basics"

See Also

`readMessages` | `rosbag` | `select`

Introduced in R2015a

transform

Transform message entities into target coordinate frame

Syntax

```
tfentity = transform(tftree,targetframe,entity)
```

Description

`tfentity = transform(tftree,targetframe,entity)` retrieves the transformation between targetframe and entity and applies it to entity, a ROS message of a specific type. tftree is the full transformation tree containing known transformations between entities. If the transformation from entity to targetframe does not exist, MATLAB thows an error.

Examples

Transform `PointStamped` Message

Define a point in the coordinate frame of a camera.

```
pt = rosmessage('geometry_msgs/PointStamped');
       pt.Header.FrameId = '/camera_depth_frame';
       pt.Point.X = 3;
       pt.Point.Y = 1.5;
       pt.Point.Z = 0.2;
```

Transform the point to the `base_link` frame.

```
tfpt = transform(tftree, '/base_link', pt)
```

Input Arguments

`tftree` — ROS transformation tree

`TransformationTree` object handle

ROS transformation tree, specified as a `TransformationTree` object handle. You can create a transformation tree by calling the `rostf` function.

`targetframe` — Target coordinate frame

string

Target coordinate frame that entity transforms into, specified as a string. You can view the available frames for transformation calling `tftree.AvailableFrames`.

`entity` — Initial message entity

`Message` object handle

Initial message entity, specified as a `Message` object handle.

Supported messages are:

- `geometry_msgs/PointStamped`
- `geometry_msgs/PoseStamped`
- `geometry_msgs/PointCloud2Stamped`
- `geometry_msgs/QuaternionStamped`
- `geometry_msgs/Vector3Stamped`

Output Arguments

`tfentity` — Transformed entity

`Message` object handle

Transformed entity, returned as a `Message` object handle.

See Also

`getTransform` | `waitforTransform`

Introduced in R2015a

trvec2tform

Convert translation vector to homogeneous transformation

Syntax

```
tform = trvec2tform(trvec)
```

Description

`tform = trvec2tform(trvec)` converts the Cartesian representation of a translation vector, trvec, to the corresponding homogeneous transformation, tform. When using the transformation matrix, premultiply it with the coordinates to be transformed (as opposed to postmultiplying).

Examples

Convert Translation Vector to Homogeneous Transformation

```
trvec = [0.5 6 100];
tform = trvec2tform(trvec)
```

```
tform =

    1.0000         0         0    0.5000
         0    1.0000         0    6.0000
         0         0    1.0000  100.0000
         0         0         0    1.0000
```

Input Arguments

`trvec` — Cartesian representation of a translation vector

n-by-3 matrix

Cartesian representation of a translation vector, specified as an *n*-by-3 matrix containing *n* translation vectors. Each vector is of the form $t = [x\ y\ z]$.

Example: `[0.5 6 100]`

Output Arguments

`tform` — Homogeneous transformation

4-by-4-by-*n* matrix

Homogeneous transformation matrix, returned as a 4-by-4-by-*n* matrix of *n* homogeneous transformations. When using the rotation matrix, premultiply it with the coordinates to be rotated (as opposed to postmultiplying).

Example: `[0 0 1 0; 0 1 0 0; -1 0 0 0; 0 0 0 1]`

See Also

`tform2trvec`

Introduced in R2015a

waitforTransform

Wait until a transformation is available

Syntax

```
waitforTransform(tftree,targetframe,sourceframe)
waitforTransform(tftree,targetframe,sourceframe,timeout)
```

Description

`waitforTransform(tftree,targetframe,sourceframe)` waits until the transformation between targetframe and sourceframe is available in the transformation tree, tftree. This functions disables the command prompt until a transformation becomes available on the ROS network.

`waitforTransform(tftree,targetframe,sourceframe,timeout)` specifies a timeout period in seconds. If the transformation does not become available, MATLAB displays an error, but continues running the current program.

Examples

Wait for Transform

```
waitforTransform(tftree,'/camera_depth_frame','/base_link');
```

Specify Timeout of Five Seconds to Wait for Transform

```
waitforTransform(tftree,'/camera_depth_frame','/base_link',5);
```

Input Arguments

`tftree` — ROS transformation tree

`TransformationTree` object handle

ROS transformation tree, specified as a `TransformationTree` object handle. You can create a transformation tree by calling the `rostf` function.

`targetframe` — Target coordinate frame

string

Target coordinate frame, specified as a string. You can view the available frames for transformation by calling `tftree.AvailableFrames`.

`sourceframe` — Initial coordinate frame

string

Initial coordinate frame, specified as a string. You can view the available frames for transformation using `tftree.AvailableFrames`.

`timeout` — Timeout period

scalar in seconds

Timeout period, specified as a scalar in seconds. If the transformation does not become available, MATLAB displays an error, but continues running the current program.

See Also

`getTransform` | `receive` | `transform`

Introduced in R2015a

writeBinaryOccupancyGrid

Write values from grid to ROS message

Syntax

```
writeBinaryOccupancyGrid(msg,map)
```

Description

`writeBinaryOccupancyGrid(msg,map)` writes occupancy values and other information to the ROS message, msg, from the binary occupancy grid, map.

Examples

Write Binary occupancy Grid Information to ROS Message

```
map = robotics.BinaryOccupancyGrid(randi([0,1], 10));
msg = rosmessage('nav_msgs/OccupancyGrid');
writeBinaryOccupancyGrid(msg, map);
```

Input Arguments

`map` — Binary occupancy grid

`BinaryOccupancyGrid` object handle

Binary occupancy grid, specified as a `BinaryOccupancyGrid` object handle. map is converted to a `'nav_msgs/OccupancyGrid'` message on the ROS network. `map` is an object with a grid of binary values, where `1` indicates an occupied location and `0` indications an unoccupied location.

`msg` — `'nav_msgs/OccupancyGrid'` ROS message

`OccupancyGrid` object handle

`'nav_msgs/OccupancyGrid'` ROS message, specified as a `OccupancyGrid` object handle.

See Also

`robotics.BinaryOccupancyGrid` | `readBinaryOccupancyGrid`

Introduced in R2015a

writeImage

Write MATLAB image to ROS image message

Syntax

```
writeImage(msg,img)
writeImage(msg,img,alpha)
```

Description

`writeImage(msg,img)` converts the MATLAB image, img, to a message object and stores the ROS compatible image data in the message object, msg. The message must be a `'sensor_msgs/Image'` message. `'sensor_msgs/CompressedImage'` messages are not supported.

`writeImage(msg,img,alpha)` converts the MATLAB image, img to a message object. If the image encoding supports an alpha channel (`rgba` or `bgra` family), specify this alpha channel in alpha. Alternatively, the input image can store the alpha channel as its fourth channel.

Examples

Write Image to Message

```
msg = rosmessage('sensor_msgs/Image')
writeImage(msg,img);
```

Write Message Using Alpha Channel

```
writeImage(msg,img,alpha);
```

Input Arguments

`msg` — ROS image message

`Image` object handle

`'sensor_msgs/Image'` ROS image message, specified as an `Image` object handle. `'sensor_msgs/Image'` image messages are not supported.

`img` — Image

grayscale image matrix | RBG image matrix | *m*-by-*n*-by-3 array

Image, specified as a matrix representing a grayscale or RGB image or as a*m*-by-*n*-by-3 array, depending on the sensor image.

`alpha` — Alpha channel

`uint8` grayscale image

Alpha channel, specified as a `uint8` grayscale image. Alpha must be the same size and data type as img.

More About

Tips

You must specify encoding of the input image in the `'Encoding'` property of the image message. If you do not specify the image encoding before calling the function, the default encoding, `rgb8`, is used (3-channel RGB image with uint8 values).

All encoding types supported for the `readImage` are also supported in this function. For more information on supported encoding types and their representations in MATLAB, see `readImage`.

Bayer-encoded images (`bayer_rggb8`, `bayer_bggr8`, `bayer_gbrg8`, `bayer_grbg8` and their 16-bit equivalents) must be given as 8-bit or 16-bit single-channel images or they do not encode.

See Also

`readImage`

Introduced in R2015a

Methods — Alphabetical List

copy

Class: robotics.BinaryOccupancyGrid
Package: robotics

Copy array of handle objects

Syntax

```
b = copy(a)
```

Description

`b = copy(a)` copies each element in the array of handles, a, to the new array of handles, b.

The `copy` method does not copy dependent properties. MATLAB does not call `copy` recursively on any handles contained in property values. MATLAB does not call the class constructor or property set methods during the copy operation.

b has the same number of elements and is the same size and class ofa. b is the same class as a. If a is empty, b is also empty. If a is heterogeneous, b is also heterogeneous. If a contains deleted handles, then `copy` creates deleted handles of the same class in b. Dynamic properties and listeners associated with objects in a are not copied to objects in a.

`copy` is a sealed and public method in class `matlab.mixin.Copyable`.

Input Arguments

a — Oject array

handle

Object array, specified as a handle.

Output Arguments

b — Object array containing copies of the objects in a

handle

Object array containing copies of the object in `a`, specified as a handle.

See Also

`robotics.BinaryOccupancyGrid`

Introduced in R2015a

getOccupancy

Class: robotics.BinaryOccupancyGrid
Package: robotics

Get occupancy value for one or more positions

Syntax

```
occval = getOccupancy(map,xy)
occval = getOccupancy(map,ij,'grid')
```

Description

`occval = getOccupancy(map,xy)` returns an array of occupancy values for an input array of world coordinates, xy. Each row of xy is a point in the world, represented as an [x y] coordinate pair. occval is the same length as xy and a single column array. An occupied location is represented as `true` (1), and a free location is represented as `false` (0).

`occval = getOccupancy(map,ij,'grid')` returns an array of occupancy values based on a `[rows cols]`input array of grid positions, ij.

Input Arguments

`map` — Map representation

`BinaryOccupancyGrid` object

Map representation, specified as a `robotics.BinaryOccupancyGrid` object. This object represents the environment of the robot. The object contains a matrix grid with binary values indicating obstacles as `true` (1) and free locations as `false` (0).

`xy` — World coordinates

n-by-2 vertical array

World coordiantes, specified as an *n*-by-2 vertical array of `[x y]` pairs, where *n* is the number of world coordinates.

Data Types: `double`

`ij` — Grid positions

n-by-2 vertical array

Grid positions, specified as an *n*-by-2 vertical array of `[i j]` pairs in `[rows cols]` format, where *n* is the number of grid positions.

Data Types: `double`

Output Arguments

`occval` — Occupancy values

n-by-1 vertical array

Occupancy values of the same length as either xy or ij, returned as an *n*-by-1 vertical array, where *n* is the same *n* in either xy or ij.

See Also

`robotics.BinaryOccupancyGrid` |
`robotics.BinaryOccupancyGrid.setOccupancy`

Introduced in R2015a

grid2world

Class: robotics.BinaryOccupancyGrid
Package: robotics

Convert grid indices to world coordinates

Syntax

```
xy = grid2world(map,ij)
```

Description

`xy = grid2world(map,ij)` converts a `[row col]` array of grid indices, ij, to an array of world coordinates, xy.

Input Arguments

`map` — Map representation

`BinaryOccupancyGrid` object

Map representation, specified as a `robotics.BinaryOccupancyGrid` object. This object represents the environment of the robot. The object contains a matrix grid with binary values indicating obstacles as `true` (1) and free locations as `false` (0).

`ij` — Grid positions

n-by-2 vertical array

Grid positions, specified as an *n*-by-2 vertical array of `[i j]` pairs in `[rows cols]` format, where *n* is the number of grid positions.

Output Arguments

`xy` — World coordinates

n-by-2 vertical array

World coordiantes, specified as an n-by-2 vertical array of `[x y]` pairs, where n is the number of world coordinates.

See Also

`robotics.BinaryOccupancyGrid` |
`robotics.BinaryOccupancyGrid.world2grid`

Introduced in R2015a

inflate

Class: robotics.BinaryOccupancyGrid
Package: robotics

Inflate each occupied grid location

Syntax

```
inflate(map,radius)
inflate(map,gridradius,'grid')
```

Description

`inflate(map,radius)` inflates each occupied position of the map by the radius given in meters. radius is rounded up to the nearest cell equivalent based on the resolution of the map. Every cell within the radius is set to `true` (`1`).

`inflate(map,gridradius,'grid')` inflates each occupied position by the radius given in number of cells.

Input Arguments

`map` — Map representation

`BinaryOccupancyGrid` object

Map representation, specified as a `robotics.BinaryOccupancyGrid` object. This object represents the environment of the robot. The object contains a matrix grid with binary values indicating obstacles as `true` (`1`) and free locations as `false` (`0`).

`radius` — Dimension the defines how much to inflate occupied locations

scalar

Dimension that defines how much to inflate occupied locations, specified as a scalar. `radius` is rounded up to the nearest cell value.

Data Types: `double`

`gridradius` — Dimension the defines how much to inflate occupied locations

positive scalar

Dimension that defines how much to inflate occupied locations, specified as a positive scalar. `gridradius` is the number of cells to inflate the occupied locations.

Data Types: `double`

See Also

`robotics.BinaryOccupancyGrid` |
`robotics.BinaryOccupancyGrid.setOccupancy`

Introduced in R2015a

setOccupancy

Class: robotics.BinaryOccupancyGrid
Package: robotics

Set occupancy value for one or more positions

Syntax

```
setOccupancy(map,xy,occval)
setOccupancy(map,ij,occval,'grid')
```

Description

`setOccupancy(map,xy,occval)` assigns occupancy values, occval, to the input array of world coordinates, xy in the occupancy grid, map. Each row of the array, xy, is a point in the world and is represented as an [x y] coordinate pair. occval is either a scalar or a single column array of the same length as xy . An occupied location is represented as `true` (1), and a free location is represented as `false` (0).

`setOccupancy(map,ij,occval,'grid')` assigns occupancy values, occval, to the input array of grid indices, ij, as `[rows cols]`.

Input Arguments

`map` — Map representation

`BinaryOccupancyGrid` object

Map representation, specified as a `robotics.BinaryOccupancyGrid` object. This object represents the environment of the robot. The object contains a matrix grid with binary values indicating obstacles as `true` (1) and free locations as `false` (0).

`xy` — World coordinates

n-by-2 vertical array

World coordiantes, specified as an *n*-by-2 vertical array of `[x y]` pairs, where *n* is the number of world coordinates.

Data Types: `double`

`ij` — Grid positions

n-by-2 vertical array

Grid positions, specified as an *n*-by-2 vertical array of `[i j]` pairs in `[rows cols]` format, where *n* is the number of grid positions.

Data Types: `double`

`occval` — Occupancy values

n-by-1 vertical array

Occupancy values of the same length as either xy or ij, returned as an *n*-by-1 vertical array, where *n* is the same *n* in either xy or ij.

Examples

Set Occupancy Values

Set the occupancy of grid locations using `setOccupancy`.

Initialize an occupancy grid object using `BinaryOccupancyGrid`.

```
map = robotics.BinaryOccupancyGrid(10,10);
```

Set the occupancy of a specific location using `setOccupancy`.

```
setOccupancy(map, [8 8], 1);
```

Set the occupancy of an array of locations.

```
[x,y] = meshgrid(2:5);
setOccupancy(map, [x(:) y(:)],1);
```

See Also

`robotics.BinaryOccupancyGrid` | `robotics.BinaryOccupancyGrid.getOccupancy`

Introduced in R2015a

show

Class: robotics.BinaryOccupancyGrid
Package: robotics

Show occupancy grid values

Syntax

```
show(map)
show(map, 'grid')

show(___,'Parent',parent)

h = show(map,___)
```

Description

`show(map)` displays the binary occupancy grid map in the current axes, with the axes labels representing the world coordinates.

`show(map, 'grid')` displays the binary occupancy grid map in the current axes, with the axes labels representing the grid coordinates.

`show(___,'Parent',parent)` sets the specified axes handle parent to the axes, using any of the arguments from previous syntaxes.

`h = show(map,___)` returns the figure object handle created by `show`.

Input Arguments

`map` — Map representation

`BinaryOccupancyGrid` object

Map representation, specified as a `robotics.BinaryOccupancyGrid` object. This object represents the environment of the robot. The object contains a matrix grid with binary values indicating obstacles as `true` (1) and free locations as `false` (0).

`parent` — Axes properties
handle

Axes properties, specified as a handle.

See Also
`robotics.BinaryOccupancyGrid`

Introduced in R2015a

world2grid

Class: robotics.BinaryOccupancyGrid
Package: robotics

Convert world coordinates to grid indices

Syntax

```
ij = world2grid(map,xy)
```

Description

`ij = world2grid(map,xy)` converts an array of world coordinates, xy, to a `[rows cols]` array of grid indices, ij.

Input Arguments

`map` — Map representation

`BinaryOccupancyGrid` object

Map representation, specified as a `robotics.BinaryOccupancyGrid` object. This object represents the environment of the robot. The object contains a matrix grid with binary values indicating obstacles as `true` (1) and free locations as `false` (0).

`xy` — World coordinates

n-by-2 vertical array

World coordiantes, specified as an *n*-by-2 vertical array of `[x y]` pairs, where *n* is the number of world coordinates.

Output Arguments

`ij` — Grid positions

n-by-2 vertical array

Grid positions, specified as an *n*-by-2 vertical array of `[i j]` pairs in `[rows cols]` format, where *n* is the number of grid positions.

See Also

`robotics.BinaryOccupancyGrid` |
`robotics.BinaryOccupancyGrid.grid2world`

Introduced in R2015a

findpath

Class: robotics.PRM
Package: robotics

Find path between start and goal points on roadmap

Syntax

```
xy = findpath(prm,start,goal)
```

Description

`xy = findpath(prm,start,goal)` finds an obstacle-free path between start and goal locations within prm, a roadmap object that contains a network of connected points.

If any properties of prm change, or if the roadmap is not created, `update` is called.

Input Arguments

`prm` — Roadmap path planner

PRM object

Roadmap path planner, specified as a `robotics.PRM` object.

`start` — Start location of path

2-by-1 vector

Start location of path, specified as a 2-by-1 vector representing an `[x y]` pair.

Example: [0 0]

`goal` — Final location of path

2-by-1 vector

Final location of path, specified as a 2-by-1 vector representing an `[x y]` pair.

Example: [10 10]

Output Arguments

`xy` — Waypoints for a path between `start` and `goal`

2-by-n column vector

Waypoints for a path between start and goal, specified as a 2-by-n column vector of `[x y]` pairs, where n is the number of waypoints. These pairs represent the solved path from the `start` and `goal` locations, given the roadmap from the `prm` input object.

See Also

`robotics.PRM` | `robotics.PRM.show` | `robotics.PRM.update`

Introduced in R2015a

show

Class: robotics.PRM
Package: robotics

Show map, roadmap, and path

Syntax

```
show(prm)
show(prm,Name,Value)
```

Description

`show(prm)` shows the map and the roadmap, specified as prm in a figure window. If no roadmap exists, `update` is called. If a path is computed before calling `show`, the path is also plotted on the figure.

`show(prm,Name,Value)` sets the specified `Value` to the property `Name`.

Input Arguments

`prm` — Roadmap path planner

PRM object

Roadmap path planner, specified as a `robotics.PRM` object.

Name-Value Pair Arguments

Specify optional comma-separated pairs of Name,Value arguments. `Name` is the argument name and `Value` is the corresponding value. `Name` must appear inside single quotes (`' '`). You can specify several name and value pair arguments in any order as `Name1,Value1,...,NameN,ValueN`.

`'Parent'` — Axes handle

handle

Axes handle that specifies the parent of the figure object created by show, specified as the comma-separated pair consisting of 'Parent' and a handle.

`'Map'` — Map display option

'on' (default) | 'off'

Map display option, specified as the comma-separated pair consisting of `'Map'` and either 'on' or 'off'.

`'Roadmap'` — Roadmap display option

'on' (default) | 'off'

Roadmap display option, specified as the comma-separated pair consisting of `'Roadmap'` and either 'on' or 'off'.

`'Path'` — Path display option

'on' (default) | 'off'

A string to turn on or off the display of the path, whose value is 'on' or 'off'.

See Also

| |

Related Examples

- "Path Following for a Differential Drive Robot"

Introduced in R2015a

update

Class: robotics.PRM
Package: robotics

Create or update roadmap

Syntax

```
update(prm)
```

Description

`update(prm)` creates a roadmap if called for the first time after creating the `PRM` object, prm. Subsequent calls of `update` recreate the roadmap by resampling the map. `update` creates the new roadmap using the `Map`, `NumNodes`, and `ConnectionDistance` property values specified in prm.

Input Arguments

`prm` — Roadmap path planner

PRM object

Roadmap path planner, specified as a `robotics.PRM` object.

See Also

`robotics.PRM` | `robotics.PRM.findpath` | `robotics.PRM.show`

Introduced in R2015a

clone

Class: robotics.PurePursuit
Package: robotics

Create PurePursuit object with same property values

Syntax

```
copy = clone(controller)
```

Description

`copy = clone(controller)` creates another instance of the System object, controller, with the same property values. The clone method creates a new unlocked object without initialized states.

Input Arguments

`controller` — Pure pursuit controller

`PurePursuit` object

Pure pursuit controller, specified as a `PurePursuit` object.

Output Arguments

`copy` — Pure pursuit controller

`PurePursuit` object

Copy of pure pursuit controller, returned as a `PurePursuit` object.

See Also

`robotics.PurePursuit`

Introduced in R2015a

isLocked

Class: robotics.PurePursuit
Package: robotics

Check locked states (logical)

Syntax

```
status = isLocked(controller)
```

Description

`status = isLocked(controller)` returns a logical value, status, which indicates whether input attributes and nontunable properties are locked for the object, controller. For the PurePursuit class, the only nontunable property is `Waypoints`.

Input Arguments

`controller` — Pure pursuit controller

`PurePursuit` object

Pure pursuit controller, specified as a `PurePursuit` object.

Output Arguments

`status` — Locked status of object

`Boolean`

Locked status of the object input attributes and nontunable properties, returned as a Boolean.

See Also

`robotics.PurePursuit` | `robotics.PurePursuit.release` | `robotics.PurePursuit.step`

Introduced in R2015a

release

Class: robotics.PurePursuit
Package: robotics

Allow property value changes

Syntax

```
release(controller)
```

Description

`release(controller)` resets the internal properties of the `controller` object and unlocks the object so that you can modify nontunable properties. For the PurePursuit class, the only nontunable property is `Waypoints`. After `release` is called, you can change the properties and input characteristics of controller.

Input Arguments

`controller` — Pure pursuit controller

`PurePursuit` object

Pure pursuit controller, specified as a `PurePursuit` object.

See Also

`robotics.PurePursuit` | `robotics.PurePursuit.isLocked` | `robotics.PurePursuit.step`

Introduced in R2015a

reset

Class: robotics.PurePursuit
Package: robotics

Reset internal states to default

Syntax

```
reset(controller)
```

Description

`reset(controller)` resets the internal system properties of the controller object. All properties specific to the PurePursuit object are kept the same and the locked status of the object does not change.

Input Arguments

`controller` — Pure pursuit controller

`PurePursuit` object

Pure pursuit controller, specified as a `PurePursuit` object.

See Also

`robotics.PurePursuit` | `robotics.PurePursuit.release`

Introduced in R2015a

step

Class: robotics.PurePursuit
Package: robotics

Compute linear and angular velocity control commands

Syntax

```
[vel, angvel] = step(controller,pose)
```

Description

`[vel, angvel] = step(controller,pose)` processes the robot's position and orientation, pose, as `[x y theta]`, and outputs the linear velocity, vel, and angular velocity, angvel, based on the specified controller .

Input Arguments

`controller` — Pure pursuit controller

`PurePursuit` object

Pure pursuit controller, specified as a `PurePursuit` object.

`pose` — Position and orientation of robot

3-by-1 vector in the form `[x y theta]`

Position and orientation of robot, specified as a 3-by-1 vector in the form `[x y theta]`. The robot's pose is an x and y position with angular orientation (in radians) measured from the x-axis.

Output Arguments

`vel` — Linear velocity

scalar in meters per second

Linear velocity, specifed as a scalar in meters per second.

Data Types: `double`

`angvel` — Angular velocity

scalar in radians per second

Angular velocity, specified as a scalar in radians per second.

Data Types: `double`

See Also

`robotics.PurePursuit`

Introduced in R2015a

Blocks — Alphabetical List

Blank Message
Publish
Subscribe

Blank Message

Create blank message using specified message type

Library

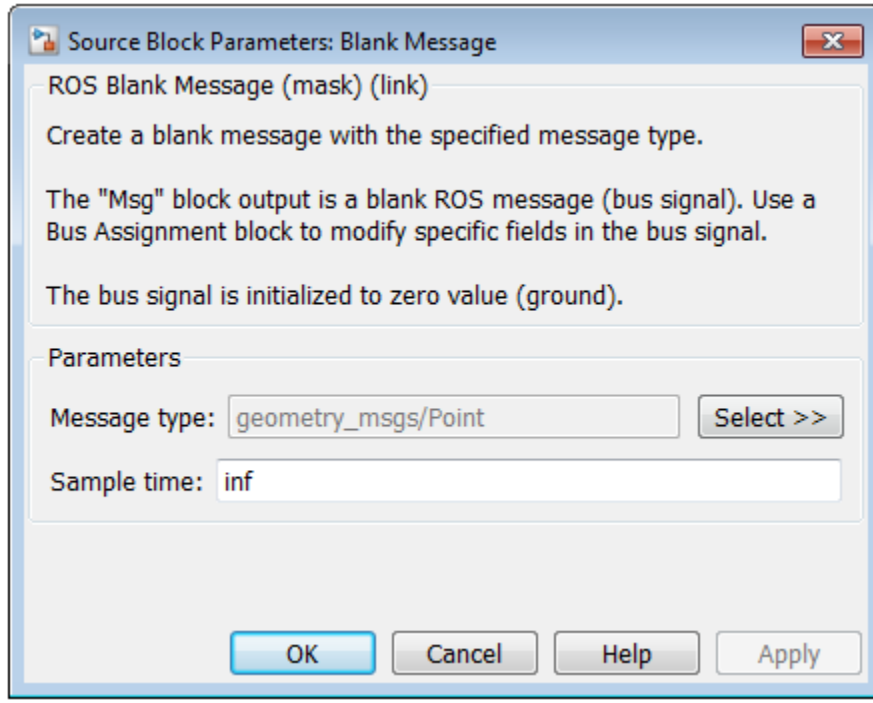
Robotics System Toolbox

`robotlib`

Description

The Blank Message block creates a Simulink® nonvirtual bus corresponding to the selected ROS message type. On each sample hit, the block emits a blank or “zero” signal for the designated message type. All elements of the bus are initialized to 0, and the length of the variable-length arrays are initialized to 0 as well.

Dialog Box



Message type

Message type for the blank message. Use the **Select** button to select from a full list of supported ROS messages. You can also use the `rostype` function in MATLAB to view the list of supported ROS messages.

Sample time

Interval between times that the Blank Message block output can change during simulation.

Default: `inf`

This default value indicates that the block output can never change. Using this value speeds simulation and code generation by eliminating the need to recompute the block output.

For more information, see “ Specify Sample Time”.

See Also

Publish | Subscribe

Related Examples

- “Virtual and Nonvirtual Buses”

Introduced in R2015a

Publish

Send messages to ROS network

Library

Robotics System Toolbox

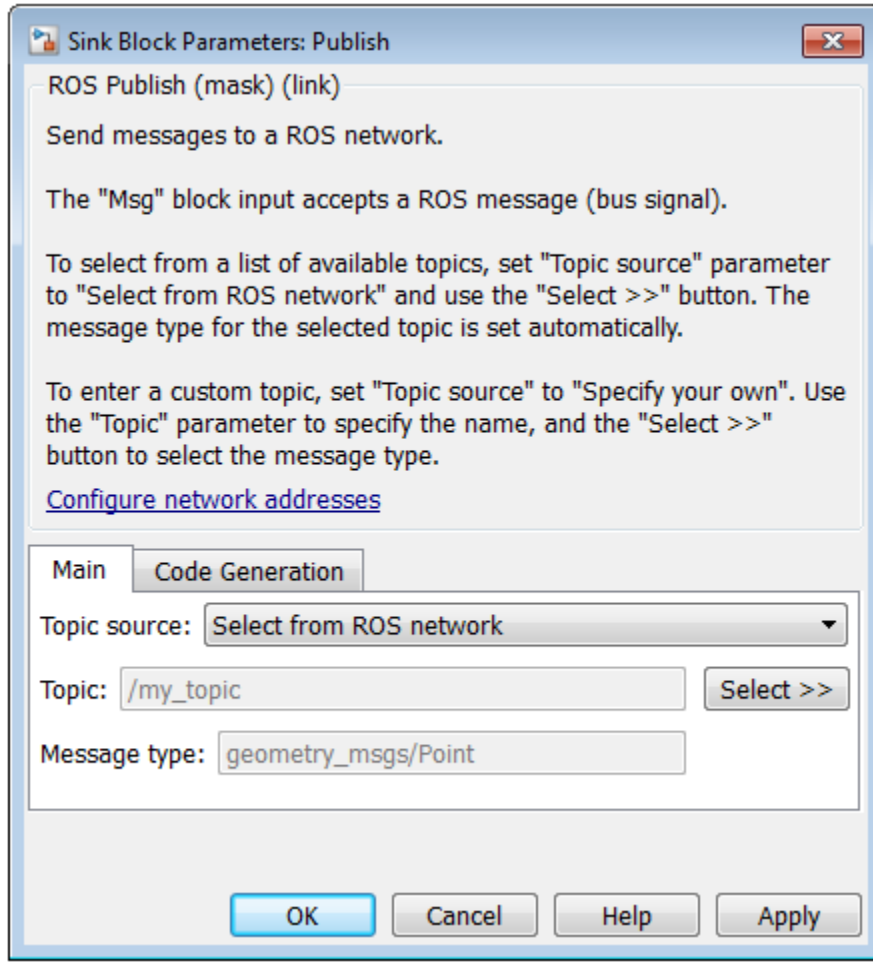
`robotlib`

Description

The Publish block takes in as its input a Simulink nonvirtual bus that corresponds to the specified ROS message type and publishes it to the ROS network. It uses the node of the Simulink model to create a ROS publisher for a specific topic. This node is created when the model runs and is deleted when the model terminates. If the model does not have a node, the block creates one.

On each sample hit, the block converts the `Msg` input from a Simulink bus signal to a ROS message and publishes it. The block does not distinguish whether the input is a new message but merely publishes it on every sample hit. For simulation, this input is a MATLAB ROS message and in code generation, it is a C++ ROS message.

Dialog Box



Topic source

This selector determines where you get the topic name that you want to subscribe to.

- `Select from ROS network` — Use the **Select** button to select a topic. You must be connected to a ROS network.

- `Specify your own` — Enter a topic name in **Topic**. You must match a topic name exactly.

Topic

The ROS topic to publish to, specified as a string. When **Topic source** is set to `Select from ROS network`, use the**Select** button to select from the ROS network. You must be connected to a ROS network to get a list of topics. Otherwise, specify the topic you want.

Topic name strings must follow the rules of ROS topic names. Valid names have the following characteristics:

- The first character is an alpha character ([a-z|A-Z]), tilde (~), or forward slash (/).
- Subsequent characters are alphanumeric ([a-z|A-Z]), underscores(_), or forward slashes (/).

Message type

Message type for the **Topic** specified. If you select a topic from the ROS network, the message type is selected for you. Otherwise, use **Select** button to select from a full list of supported ROS messages. You can also use the `rostype` function in MATLAB to view the list of messages.

Tips

You can also set the addresses for the ROS master and node host by clicking the **Configure network addresses** link in the dialog box.

See Also

Blank Message | Subscribe

Related Examples

- "Virtual and Nonvirtual Buses"

Introduced in R2015a

Subscribe

Receive messages from ROS network

Library

Robotics System Toolbox

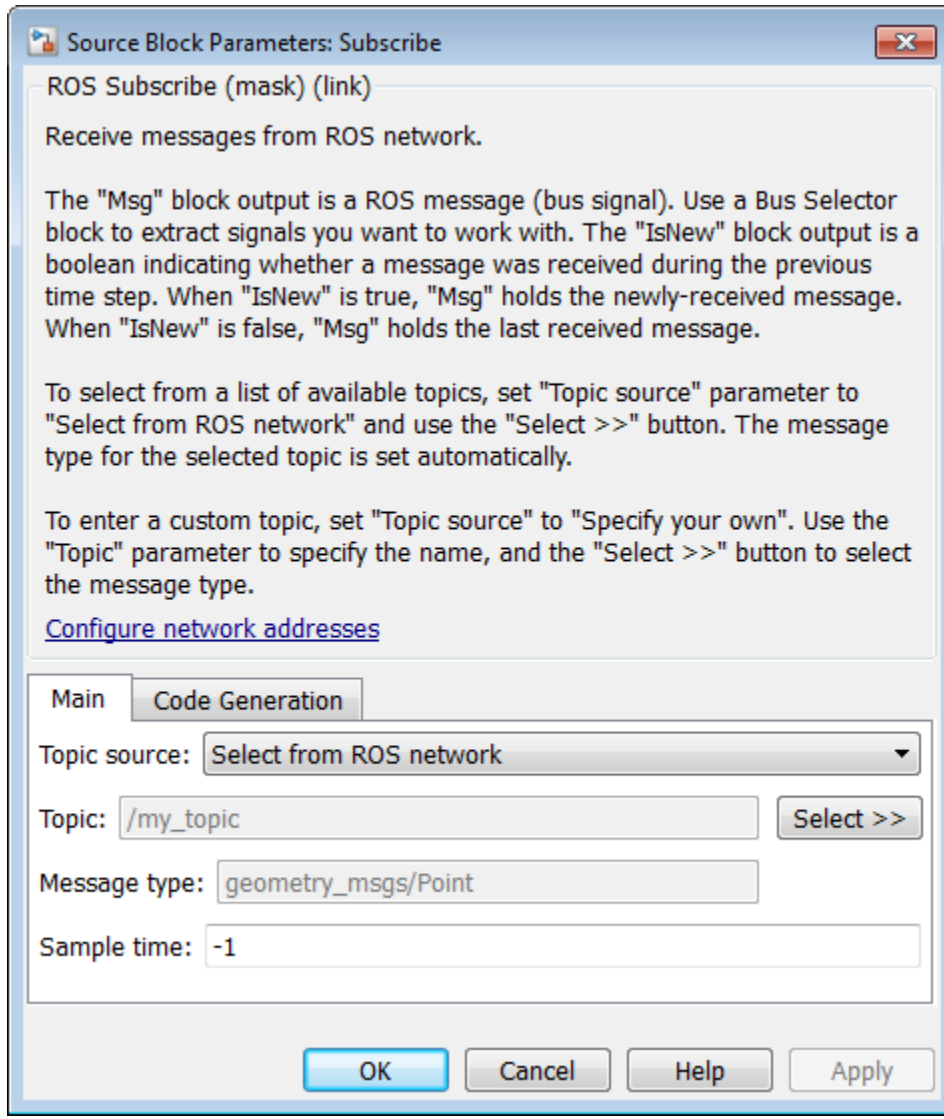
`robotlib`

Description

Subscribe creates a Simulink nonvirtual bus that corresponds to the specified ROS message type. The block uses the node of the Simulink model to create a ROS subscriber for a specific topic. This node is created when the model runs and is deleted when the model terminates. If the model does not have a node, the block creates one.

On each sample hit, the block checks if a new message available on the specific topic. If a new message is available, the block retrieves the message and converts it to a Simulink bus signal. The `Msg` outputs this new message. If a new message is not available, `Msg` outputs the last received ROS message. If there has not been a received message since the start of the simulation, `Msg` outputs a blank message.

Dialog Box



Topic source

This selector determines where you get the topic name that you want to subscribe to.

- `Select from ROS network` — Use the **Select** button to select a topic. You must be connected to a ROS network.
- `Specify your own` — Enter a topic name in **Topic**. You must match a topic name exactly.

Topic

The ROS topic to publish to, specified as a string. When **Topic source** is set to `Select from ROS network`, use the**Select** button to select from the ROS network. You must be connected to a ROS network to get a list of topics. Otherwise, specify the topic you want.

Topic name strings must follow the rules of ROS topic names. Valid names have the following characteristics:

- The first character is an alpha character ([a-z|A-Z]), tilde (~), or forward slash (/).
- Subsequent characters are alphanumeric ([a-z|A-Z]), underscores(_), or forward slashes (/).

Message type

Message type for the **Topic** specified. If you select a topic from the ROS network, the message type is selected for you. Otherwise, use **Select** button to select from a full list of supported ROS messages. You can also use the `rostype` function in MATLAB to view the list of messages.

Sample time

Interval between times that the Subscribe block output can change during simulation. In simulation, the sample time follows simulation time and not actual wall-block time.

Default: `-1`

This default value indicates that the block sample time is *inherited*.

For more information about the *inherited* sample time type, see " Specify Sample Time".

Tips

You can also *Configure Network Addresses* by clicking the link in the dialog box. This allows you to set the addresses for the 'ROS Master' and 'Node Host'.

See Also

Blank Message | Publish

Related Examples

- "Virtual and Nonvirtual Buses"

Introduced in R2015a