Sensor Fusion and Tracking Toolbox™ Release Notes

MATLAB®

MathWorks®

How to Contact MathWorks

Latest news: www.mathworks.com

Sales and services: www.mathworks.com/sales_and_services

User community: www.mathworks.com/matlabcentral

Technical support: www.mathworks.com/support/contact_us

Phone: 508-647-7000

The MathWorks, Inc.
3 Apple Hill Drive
Natick, MA 01760-2098

Sensor Fusion and Tracking Toolbox™ Release Notes

Contents

R2018b

R2018b

Version: 1.0

New Features

Single-Hypothesis and Multi-Hypothesis Multi-Object Trackers

Sensor Fusion and Tracking Toolbox provides multi-object trackers that fuse information from various sensors. Use `trackerGNN` to maintain a single hypothesis about the objects it tracks. Use `trackerTOMHT` to maintain multiple hypotheses about the objects it tracks.

Estimation Filters for Tracking

Sensor Fusion and Tracking Toolbox provides estimation filters that are optimized for specific scenarios, such as linear or nonlinear motion models, linear or nonlinear measurement models, or incomplete observability.

Estimation filters include:

Estimate Filters	Description
`trackingABF`	Alpha-beta filter
`trackingKF`	Linear Kalman filter
`trackingEKF`	Extended Kalman filter
`trackingUKF`	Unscented Kalman filter
`trackingCKF`	Cubature Kalman filter
`trackingPF`	Particle filter
`trackingMSCEKF`	Extended Kalman filter in modified spherical coordinates
`trackingGSF`	Gaussian-sum filter
`trackingIMM`	Interacting multiple model filter

Inertial Sensor Fusion to Estimate Pose

Sensor Fusion and Tracking Toolbox provides algorithms to estimate orientation and position from IMU and GPS data. The algorithms are optimized for different sensor configurations, output requirements, and motion constraints.

Inertial sensor fusion algorithms include:

Inertial Sensor Fusion Algorithm	Description
ecompass	Estimate orientation using magnetometer and accelerometer readings.
imufilter	Estimate orientation using accelerometer and gyroscope readings
ahrsfilter	Estimate orientation using accelerometer, gyroscope, and magnetometer readings
insfilter	Estimate position and orientation (pose) using IMU and GPS readings.

Active and Passive Sensor Models

Sensor Fusion and Tracking Toolbox provides active and passive sensor models. You can mimic environmental, channel, and sensor configurations by modifying parameters of the sensor models. For active sensors, you can model the corresponding emitters and channels as separate models.

Sensor models include:

Sensor Model	Description
imuSensor	IMU measurements of accelerometer, gyroscope, and magnetometer
gpsSensor	GPS position, velocity, groundspeed, and course measurements
insSensor	INS/GPS position, velocity, and orientation emulator
monostaticRadarSensor	Radar detection generator
sonarSensor	Active or passive sonar detection generator
irSensor	Infrared (IR) detection generator
radarSensor	Radio frequency detection generator

Trajectory and Scenario Generation

Generate ground-truth trajectories to drive sensor models using the `kinematicTrajectory` and `waypointTrajectory` System objects. Simulate tracking of multiple platforms in a 3-D arena using `trackingScenario`.

Visualization and Analytics

Use `theaterPlot` with `trackingScenario` to plot the ground-truth pose, detections, and estimated pose tracks for multi-object scenarios. Get error metrics for tracks using `trackErrorMetrics`. Analyze and compare the performance of multi-object tracking systems using `trackAssignmentMetrics`.

Orientation, Rotations, and Representation Conversions

The `quaternion` data type enables efficient representation of orientation and rotations. Sensor Fusion and Tracking Toolbox provides the following functions for use with the `quaternion` data type:

Rotations	
`rotateframe`	Quaternion frame rotation
`rotatepoint`	Quaternion point rotation

Representation Conversion	
`rotmat`	Convert quaternion to rotation matrix
`rotvec`	Convert quaternion to rotation vector (radians)
`rotvecd`	Convert quaternion to rotation vector (degrees)
`parts`	Extract quaternion parts
`euler`	Convert quaternion to Euler angles (radians)
`eulerd`	Convert quaternion to Euler angles (degrees)
`compact`	Convert quaternion array to N-by-4 matrix

Metrics and Interpolation	
`dist`	Angular distance in radians
`norm`	Quaternion norm
`meanrot`	Quaternion mean rotation
`slerp`	Spherical linear interpolation

Initialization and Convenience Functions	
`ones`	Create quaternion array with real parts set to one and imaginary parts set to zero
`zeros`	Create quaternion array with all parts set to zero
`classUnderlying`	Class of parts within quaternion
`normalize`	Quaternion normalization

Mathematics	
`times, .*`	Element-wise quaternion multiplication
`mtimes, *`	Quaternion multiplication
`prod`	Product of a quaternion array
`minus, -`	Quaternion subtraction
`uminus, -`	Quaternion unary minus
`conj`	Complex conjugate of quaternion
`ldivide, .\`	Element-wise quaternion left division
`rdivide, ./`	Element-wise quaternion right division
`exp`	Exponential of quaternion array
`log`	Natural logarithm of quaternion array
`power, .^`	Element-wise quaternion power

Array Manipulation	
`ctranspose, '`	Complex conjugate transpose of quaternion array
`transpose, .'`	Transpose of quaternion array

Sensor Fusion and Tracking Examples

The release of Sensor Fusion and Tracking Toolbox includes the following examples.

Applications
"Air Traffic Control"
"Multiplatform Radar Detection Fusion"
"Passive Ranging Using a Single Maneuvering Sensor"
"Tracking Using Distributed Synchronous Passive Sensors"
"Search and Track Scheduling for Multifunction Phased Array Radar"
"Extended Object Tracking"
"Visual-Inertial Odometry Using Synthetic Data"
"IMU and GPS Fusion for Inertial Navigation"

Multi-Object Trackers
"Multiplatform Radar Detection Fusion"
"Tracking Closely Spaced Targets Under Ambiguity"
"Tracking Using Distributed Synchronous Passive Sensors"
"Extended Object Tracking"
"Introduction to Using the Global Nearest Neighbor Tracker"
"Introduction to Track Logic"

Estimation Filters
"Tracking Maneuvering Targets"
"Tracking with Range-Only Measurements"
"Passive Ranging Using a Single Maneuvering Sensor"

Inertial Sensor Fusion
"Estimate Orientation Through Inertial Sensor Fusion"
"IMU and GPS Fusion for Inertial Navigation"
"Estimate Position and Orientation of a Ground Vehicle"

Inertial Sensor Fusion
“Estimate Orientation and Height Using IMU, Magnetometer, and Altimeter”

Sensor Models
“Inertial Sensor Noise Analysis Using Allan Variance”
“Simulating Passive Radar Sensors and Radar Interferences”
“Introduction to Simulating IMU Measurements”
“Introduction to Tracking Scenario and Simulating Radar Detections”
“Scanning Radar Mode Configuration”

Trajectory and Scenario Generation
“Introduction to Tracking Scenario and Simulating Radar Detections”
“Benchmark Trajectories for Multi-Object Tracking”
“Multiplatform Radar Detection Generation”

Quaternion Representation
“Rotations, Orientation and Quaternions”
“Lowpass Filter Orientation Using Quaternion SLERP”