RTG for efficient high-quality motion planning - Reference manual

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This inheritance list is sorted roughly, but not completely, alphabetically:

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Here are the classes, structs, unions and interfaces with brief descriptions:

Chapter 3

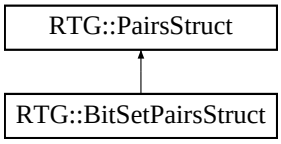
Class Documentation

3.1 RTG::BitSetPairsStruct Class Reference

A class for storing the already reported pairs, which uses a bitset of the pairs.

`#include <bitset_pairs_struct.h>`

Inheritance diagram for RTG::BitSetPairsStruct:



Public Types

- typedef boost::dynamic_bitset **Pairs**

Public Member Functions

- BitSetPairsStruct (unsigned int n, bool add_once=true)
  Constructor.
- virtual bool pair_exists (int i, int j) const
  Check whether a pair exists in the structure.
- virtual void add_pair (int i, int j)
  Add pair to the structure.
- virtual void clear (void)
  Clear the datastructure.
- virtual void neighbors_of_i (int i, std::vector< int > &neighborsVec) const
  places the indices of the neighbors of index i in the given vector

- virtual void all_pairs (std::vector< std::pair< int, int >> &pairsVec) const

  places the reported pairs of indices in the given vector

3.1.1 Detailed Description

A class for storing the already reported pairs, which uses a bitset of the pairs.

The data structure is a bitset, where pair (i,j) is mapped to an index k.

The documentation for this class was generated from the following file:

- bitset_pairs_struct.h

3.2 RTG::SingleGrid< _PointDT, _SqrdDistanceFuncT >::Cell_ind_hash Struct Reference

hash function for cell indices

`#include <single_grid.h>`

Public Member Functions

- std::size_t **operator()** (Cell_index const &cell) const

3.2.1 Detailed Description

template<typename _PointDT = Point_d_, typename _SqrdDistanceFuncT = EuclideanSqrdDistanceFunc<_PointDT>>struct RTG::SingleGrid< _PointDT, _SqrdDistanceFuncT >::Cell_ind_hash

hash function for cell indices

The documentation for this struct was generated from the following file:

- single_grid.h

3.3 RTG::EuclideanSqrdDistanceFunc< _T > Class Template Reference

A functor for computing the Euclidean squared distance of two given points.

`#include <distance_functors.h>`

Public Member Functions

- **EuclideanSqrdDistanceFunc** (unsigned int dim)
- double **operator()** (const _T &data1, const _T &data2) const

3.3.1 Detailed Description

template<typename _T>class RTG::EuclideanSqrdDistanceFunc< _T >

A functor for computing the Euclidean squared distance of two given points.

The documentation for this class was generated from the following file:

- distance_functors.h

3.4 RTG::MultiRobotSqrdDistanceFunc< _T > Class Template Reference

A functor for computing the Multi Robot squared distance of two given points, representing two configurations.

`#include <distance_functors.h>`

Public Member Functions

- **MultiRobotSqrdDistanceFunc** (unsigned int num_of_robots, unsigned int dim=3)
- double **operator()** (const _T &data1, const _T &data2) const

3.4.1 Detailed Description

template<typename _T>class RTG::MultiRobotSqrdDistanceFunc< _T >

A functor for computing the Multi Robot squared distance of two given points, representing two configurations.

Each configuration represents the position of a set of robots. The distance according to multi-robot metric is the sum of distances traveled by each robot. This functor computes the squared distance of two configurations.

The documentation for this class was generated from the following file:

- distance_functors.h

3.5 RTG::NearestNeighborsRTG< _PointDT, _SqrdDistanceFuncT > Class Template Reference

Randomly Translated Grids, a data structure for nearest neighbor search. Especially for all r-nearest neighbors.

`#include <nearest_neighbors_RTG.h>`

Public Types

- typedef _PointDT **PointD**
- typedef _SqrdDistanceFuncT **SqrdDistanceFunc**
- typedef SingleGrid< PointD, SqrdDistanceFunc > **RTGSingleGrid**

Public Member Functions

- NearestNeighborsRTG (double r, double cell_size, unsigned int grid_num, unsigned int num_samples, unsigned int dim, SqrdDistanceFunc *pDistFunc=NULL, PairsStruct *pairs=NULL, bool all_nn_only=true, int seed=1)

  Constructor.
- ~NearestNeighborsRTG (void)

  Distructor.
- void **set_pairs_struct** (PairsStruct *pairs)
- void add (const PointD &data)

  Adds a data point into the existing array of points.
- void add (const std::vector< PointD > &data)

  Adds a vector of points into the existing array of points.
- void nearestR (int data_index, std::vector< PointD > &nbh)

  A method retrieving the r-nearest-neighbors of the point whose index in the data points array is data_index. The neighbors are inserted into the nbh vector of data points. This method is not supported when all_nn_only is set to true.
- void nearestR (int data_index, std::vector< int > &nbh_ind)

  A method retrieving the indices of r-nearest-neighbors of the point whose index in the data points array is data_index. The indices of neighbors are inserted into the nbh_ind vector of integers. This method is not supported when all_nn_only is set to true.
- void all_nearestR (std::vector< std::pair< PointD, PointD > > &nbh_pairs)

  A method retrieving all pairs r-nearest-neighbors. The pairs of data points are inserted into the nbh_pairs vector of pairs of points.
- void all_nearestR (std::vector< std::pair< int, int > > &nbh_ind_pairs)

  A method retrieving all pairs of indices of r-nearest-neighbors points. The pairs of indices are inserted into the nbh_ind_pairs vector of pairs of points indices.
- std::size_t size (void) const

  A method retrieving the number of data points in the structure.

3.5.1 Detailed Description

template<typename _PointDT = Point_d_, typename _SqrdDistanceFuncT = EuclideanSqrdDistanceFunc<_PointDT>>class RTG::NearestNeighborsRTG< _PointDT, _SqrdDistanceFuncT >

Randomly Translated Grids, a data structure for nearest neighbor search. Especially for all r-nearest neighbors.

Based on:

D. Aiger, H. Kaplan, and M. Sharir, Reporting Neighbors in High-Dimensional Euclidean Space, *SIAM J. Comput.*, vol. 43(4), pp. 1363-1395, 2014. DOI: 10.1137/12089867X

The documentation for this class was generated from the following file:

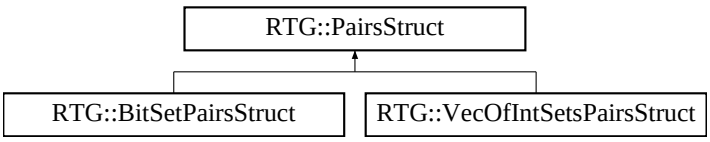
- nearest_neighbors_RTG.h

3.6 RTG::PairsStruct Class Reference

An absract class for the Pairs data structure.

`#include <pairs.h>`

Inheritance diagram for RTG::PairsStruct:



Public Member Functions

- PairsStruct (unsigned int n, bool add_once=true)
  Constructor.
- virtual ~PairsStruct (void)
  Destructor.
- virtual bool pair_exists (int i, int j) const =0
  Check whether a pair exists in the structure.
- virtual void add_pair (int i, int j)=0
  Add pair to the structure.
- virtual void neighbors_of_i (int i, std::vector< int > &neighborsVec) const =0
  Output the neighbors of the i-th data point.
- virtual void all_pairs (std::vector< std::pair< int, int >> &pairsVec) const =0
  Output all neighboring pairs.
- virtual void clear (void)
  Clear the datastructure.

Protected Attributes

- unsigned int num_of_points_

  number of data points
- bool add_once_

  A flag indicating whether to a pair (i,j) once or twice (add (i,j) and (j,i))

3.6.1 Detailed Description

An absract class for the Pairs data structure.

The documentation for this class was generated from the following file:

- pairs.h

3.7 RTG::Point_d_ Class Reference

A class used for defining a d-dimensional point.

`#include <Point_d.h>`

Public Member Functions

- template<class InputIterator >
  Point_d_ (unsigned int dim, InputIterator first, InputIterator last)

  Constructor given an input iterator.
- Point_d_ (const Point_d_ &p)

  Copy constructor.
- ~Point_d_ ()

  Destructor.
- double & operator[] (unsigned int idx)

  retrieves the i-th coordinate of the d-dimensional point This method must be implmeneted
- const double & operator[] (unsigned int idx) const

  retrieves the i-th coordinate of the d-dimensional point This method must be implmeneted
- unsigned int dimension () const

  returns the dimension of the point

Friends

- std::ostream & operator<< (std::ostream &output, const Point_d_ &p)

  operator<< for outputing the point

3.7.1 Detailed Description

A class used for defining a d-dimensional point.

A single transformed grid that defines a partition of the data into cells of a given size. Nearby points that lie in the same cell are reported.

It is possible to use different classes for d-dimensional points.

However, these classes must implement the following methods:

- double& operator[](unsigned int idx)
- const double& operator[](unsigned int idx) const

The documentation for this class was generated from the following file:

- Point_d.h

3.8 RTG::Random_utils< Point_d > Class Template Reference

A class used for generating random d dimensional points.

`#include <Random_utils.h>`

Public Types

- typedef boost::random::mt19937 **MTEng**
- typedef boost::random::uniform_real_distribution< double > **UniformDist**

Public Member Functions

- Random_utils (int seed=1, double min=-1, double max=1)

  Constructor.
- double get_random_num () const

  returning a random real number according to a uniform distribution
- Point_d get_random_point (int dim) const

  returning a random point in dim dimensions.
- void get_random_vec (int dim, std::vector< double > &vec) const

  updating the given vec with dim random elements

3.8.1 Detailed Description

template<typename Point_d>class RTG::Random_utils< Point_d >

A class used for generating random d dimensional points.

The documentation for this class was generated from the following file:

- Random_utils.h

3.9 RTG::RandomMatrixGen Class Reference

A class used for generating a random d x d rotation matrix.

`#include <Random_matrix_gen.h>`

Public Types

- typedef Eigen::MatrixXd **MatrixXd**
- typedef Eigen::VectorXd **VectorXd**

Public Member Functions

- boost::shared_ptr< MatrixXd > get_random_rotation_matrix (int d) const

  returns a shared pointer of a d x d random rotation matrix

3.9.1 Detailed Description

A class used for generating a random d x d rotation matrix.

The documentation for this class was generated from the following file:

- Random_matrix_gen.h

3.10 RTG::RTG_utils Class Reference

Class of static methods.

`#include <RTG_utils.h>`

Static Public Member Functions

- static double calculate_radius (int n, double d, double mu=1.0, double vol=1.0)

  returns the radius for r-NN based on the number n of points, the ratio between the free space volume and c-space volume, and the dimension d mu is the free space volume out of the c-space which is 1

- template<typename _T >
  static double get_bbox_volume (std::vector< _T > &points, unsigned int dim)

  computes the volume of the bounding box of a given point-set

3.10.1 Detailed Description

Class of static methods.

3.10.2 Member Function Documentation

3.10.2.1 static double RTG::RTG_utils::calculate_radius (int *n*, double *d*, double *mu* = 1.0, double *vol* = 1.0) [inline, static]

returns the radius for r-NN based on the number n of points, the ratio between the free space volume and c-space volume, and the dimension d mu is the free space volume out of the c-space which is 1

Based on:

L. Janson and M. Pavone, Fast Marching Trees: a Fast Marching Sampling-Based Method for Optimal Motion Planning in Many Dimensions - Extended Version, *CoRR*, abs/1306.3532, 2013.

The documentation for this class was generated from the following file:

- RTG_utils.h

3.11 RTG::SingleGrid< _PointDT, _SqrdDistanceFuncT > Class Template Reference

A class used for defining a single grid.

`#include <single_grid.h>`

Classes

- struct Cell_ind_hash

  hash function for cell indices

Public Types

- typedef _SqrdDistanceFuncT **SqrdDistanceFunc**
- typedef _PointDT **PointD**

Public Member Functions

- SingleGrid (std::vector< double > &shift, double cell_size, double r_sq, const std::vector< PointD > &points, unsigned int dim, boost::shared_ptr< Eigen::MatrixXd > rotation_matrix, SqrdDistanceFunc *pSqrDistFunc)

constructor of a single grid with rotation

- SingleGrid (std::vector< double > shift, double cell_size, double r_sq, const std::vector< PointD > &points, unsigned int dim, SqrdDistanceFunc *pSqrDistFunc)

  constructor of a single grid without rotation

- ~SingleGrid ()

  distructor

- void find_all_pairs_single (PairsStruct *pairs)

  find all r-near pairs and update the auxiliary pairs structure

Protected Types

- typedef std::vector< int > **Cell_index**
- typedef int **Compact_cell_index**
- typedef boost::unordered_map< Cell_index, Compact_cell_index, Cell_ind_hash > Cell_index_to_compact_cell_index

  The type of the map between cell index to compact ones.

- typedef std::vector< std::vector< int > > Compact_cell_index_to_int_vec

  The type of the map between compact cell index to vector of integers (the indices of the data points)

3.11.1 Detailed Description

template<typename _PointDT = Point_d_, typename _SqrdDistanceFuncT = EuclideanSqrdDistanceFunc<_PointDT>>class RTG::SingleGrid< _PointDT, _SqrdDistanceFuncT >

A class used for defining a single grid.

A single transformed grid that defines a partition of the data into cells of a given size. Nearby points that lie in the same cell are reported.

The documentation for this class was generated from the following file:

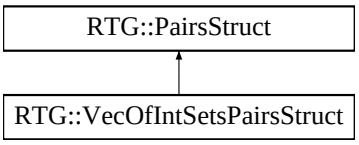
- single_grid.h

3.12 RTG::VecOfIntSetsPairsStruct Class Reference

A class for storing the already reported pairs, which uses a vector of unordered-sets (hash maps).

`#include <vec_of_intsets_pairs_struct.h>`

Inheritance diagram for RTG::VecOfIntSetsPairsStruct:



Public Types

- typedef boost::unordered_set< int > **Int_set**
- typedef std::vector< Int_set > **Pairs**

Public Member Functions

- VecOfIntSetsPairsStruct (unsigned int n, bool add_once=true)

  Constructor.
- virtual bool pair_exists (int i, int j) const

  Check whether a pair exists in the structure.
- virtual void add_pair (int i, int j)

  Add pair to the structure.
- virtual void clear (void)

  Clear the datastructure.
- virtual void neighbors_of_i (int i, std::vector< int > &neighborsVec) const

  places the indices of the neighbors of index i in the given vector
- virtual void all_pairs (std::vector< std::pair< int, int >> &pairsVec) const

  places the reported pairs of indices in the given vector

3.12.1 Detailed Description

A class for storing the already reported pairs, which uses a vector of unordered-sets (hash maps).

The data structure is a vector of unordered-sets. The i-th entry of the vector stores the set of reported neighbors of the i-th data point.

The documentation for this class was generated from the following file:

- vec_of_intsets_pairs_struct.h

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