GTEC

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Contents

1 Class Index **1**

1.1 Class List . . . 1

2 File Index **3**

2.1 File List . . . 3

3 Class Documentation **5**

3.1 inout Class Reference . . . 5

3.2 internalTime Class Reference . . . 5

3.2.1 Detailed Description . . . 6

3.2.2 Constructor & Destructor Documentation . . . 6

3.2.2.1 internalTime(int Y, int M, int D, int h, int m, int s) . . . 6

3.2.2.2 internalTime() . . . 7

3.2.3 Member Function Documentation . . . 7

3.2.3.1 parse(std::string strtime) . . . 7

3.2.3.2 toUNIXTime() . . . 7

3.2.4 Member Data Documentation . . . 7

3.2.4.1 year . . . 7

3.3 navigation Class Reference . . . 8

3.3.1 Detailed Description . . . 8

3.3.2 Constructor & Destructor Documentation . . . 8

3.3.2.1 navigation(std::vector< std::string > fnames) . . . 8

3.3.2.2 navigation() . . . 9

3.3.3 Member Function Documentation . . . 9

3.3.3.1 read() 9
3.4 ObsData Class Reference 9
3.4.1 Detailed Description 12
3.4.2 Constructor & Destructor Documentation 12
3.4.2.1 ObsData(std::vector< std::string > fvec, std::string sysString) 12
3.4.3 Member Function Documentation 12
3.4.3.1 lagrangeInterpolation(float ∗target, float ∗s, float ∗e, int deg) 12
3.4.3.2 pre_process(int minArcLen, int intrpolIntrvl, int deg) 13
3.4.3.3 read() 13
3.4.3.4 setArcStartEnd() 13
3.4.3.5 setSysFlags(std::string sysString) 14
3.4.4 Member Data Documentation 14
3.4.4.1 arcs 14
3.4.4.2 arcs2 14
3.4.4.3 arcs3 14
3.4.4.4 BDU_ucTEC 14
3.4.4.5 GAL_ucTEC 14
3.4.4.6 GLO_ucTEC 15
3.4.4.7 GPS_ucTEC 15
3.4.4.8 hasTOFO 15
3.4.4.9 numArcs 15
3.4.4.10 S 15
3.4.4.11 S_arcnum 15
3.4.4.12 S_prn 15
3.5 ptr_pair Class Reference 16
3.5.1 Detailed Description 16
3.5.2 Constructor & Destructor Documentation 16
3.5.2.1 ptr_pair() 16
3.5.2.2 ptr_pair(float ∗s, float ∗e) 16
3.6 triple Class Reference 17
3.6.1 Detailed Description 17
3.6.2 Member Function Documentation 17
3.6.2.1 dump(std::ostream &s) 17

4 File Documentation 19

4.1 /home/mowais/GTEC/src/internalTime.hpp File Reference 19

4.1.1 Detailed Description 20

4.2 /home/mowais/GTEC/src/navigation.hpp File Reference 20

4.2.1 Detailed Description 20

4.3 /home/mowais/GTEC/src/ObsData.hpp File Reference 21

4.3.1 Detailed Description 21

4.4 /home/mowais/GTEC/src/ptr_pair.hpp File Reference 21

4.4.1 Detailed Description 22

4.5 /home/mowais/GTEC/src/triple.hpp File Reference 22

4.5.1 Detailed Description 23

Index 25

Chapter 1

Class Index

1.1 Class List

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

inout 5
internalTime 5
navigation 8
ObsData 9
ptr_pair 16
triple 17

Chapter 2

File Index

2.1 File List

Here is a list of all documented files with brief descriptions:

/home/mowais/GTEC/src/**constants.hpp** . . . . ??

/home/mowais/GTEC/src/**inout.hpp** . . . . ??

/home/mowais/GTEC/src/internalTime.hpp
Class defining internal time format 19

/home/mowais/GTEC/src/navigation.hpp
This class navigation data 20

/home/mowais/GTEC/src/ObsData.hpp
Class defining observation data 21

/home/mowais/GTEC/src/ptr_pair.hpp
Class defining pointer pairs 21

/home/mowais/GTEC/src/triple.hpp
This class defines a 3-D Coordinate 22

Chapter 3

Class Documentation

3.1 inout Class Reference

Public Member Functions

- void **process_Inputs** (int ac, char ∗args[ ])
- void **dump** (std::ostream &s)

Public Attributes

- int **nobsfiles**
- int **nnavfiles**
- bool **systemGPS**
- bool **systemGlonass**
- bool **systemGalileo**
- bool **systemBeidou**
- bool **systemQZSS**
- std::vector< std::string > **navfiles**
- std::vector< std::string > **obsfiles**

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

- /home/mowais/GTEC/src/inout.hpp
- /home/mowais/GTEC/src/inout.cpp

3.2 internalTime Class Reference

```
#include <internalTime.hpp>
```

Public Member Functions

- internalTime (int Y, int M, int D, int h, int m, int s)

  Constructor with explicit values.
- void parse (std::string strtime)

  Member function parse.
- void **parse** (std::string, std::string &)
- void toUNIXTime ()

  Member Function, providing UNIX time.
- void **toUNIXTime** (int)

Public Attributes

- int year
- int month

  Stores Month as Integer.
- int day

  Stores day as Integer.
- int hour

  Stores hour as Integer.
- int minute

  Stores minute as Integer.
- int second

  Stores second as Integer.
- int UNIX

  Stores Converted UNIX Time as Integer.

Private Member Functions

- internalTime ()

3.2.1 Detailed Description

Author

Muhammad Owais

Date

04/12/16

3.2.2 Constructor & Destructor Documentation

3.2.2.1 internalTime::internalTime (int *Y,* int *M,* int *D,* int *h,* int *m,* int *s*)

Constructor with explicit values.

Constructs internalTime object explicitly taking date/time values as parameters. Requires 6 integers (YYYY,MM,DD,hh,mm,ss).

Parameters

Y	year(YYYY), given as integer
M	Month(MM), given as integer
D	Day(DD), given as integer
h	Hour(hh), given as integer
m	Minute(mm), given as integer
s	Second(ss), given as integer

3.2.2.2 internalTime::internalTime ( ) [private]

Default Constructor. Hidden, cannot be used.

3.2.3 Member Function Documentation

3.2.3.1 void internalTime::parse (std::string *strtime*)

Member function parse.

Member function parse sets internal values by parsing a given string representing date/time values.

Parameters

strtime	string representing time.

3.2.3.2 void internalTime::toUNIXTime ( )

Member Function, providing UNIX time.

Member function, converting stored time to UNIX time.

3.2.4 Member Data Documentation

3.2.4.1 int internalTime::year

Stores Year as Integer

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

- /home/mowais/GTEC/src/internalTime.hpp
- /home/mowais/GTEC/src/internalTime.cpp

3.3 navigation Class Reference

```
#include <navigation.hpp>
```

Public Member Functions

- void read ()

  Member function read.
- navigation (std::vector< std::string > fnames)

  Constructor with Input files.

Public Attributes

- std::vector< std::string > fileNames

  list of file names to read from
- float version

  Stores RINEX version.
- int leapSeconds

  Stores leapSeconds from Navigation files.
- std::vector< std::vector< ephemerisGE > > ephemeris_G

  Vector to store objects of type ephemerisGE for GPS.
- std::vector< std::vector< ephemerisGE > > ephemeris_E

  Vector to store objects of type ephemerisGE for Galileo.
- std::vector< std::vector< ephemerisR > > ephemeris_R

  Vector to store objects of type ephemerisR for GLONASS.
- std::vector< std::vector< ephemerisGE > > ephemeris_C

  Vector to store objects of type ephemerisGE for BeiDou.

Private Member Functions

- navigation ()

3.3.1 Detailed Description

Author

Muhammad Owais

Date

05/12/16

3.3.2 Constructor & Destructor Documentation

3.3.2.1 navigation::navigation (std::vector< std::string > *fnames*)

Constructor with Input files.

Constructs navigation object by reading input navigation files defined by fnames.

Parameters

fnames	Vector of Navigation file names.

3.3.2.2 navigation::navigation ( ) `[private]`

Default Constructor. Hidden, cannot be used.

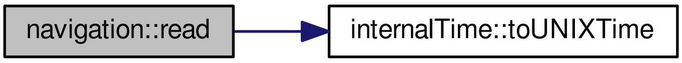
3.3.3 Member Function Documentation

3.3.3.1 void navigation::read ( )

Member function read.

Member function read parses input navigation files and constructs internal navigation structure.

Here is the call graph for this function:



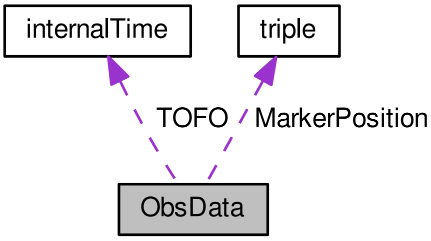
The documentation for this class was generated from the following files:

- /home/mowais/GTEC/src/navigation.hpp
- /home/mowais/GTEC/src/navigation.cpp

3.4 ObsData Class Reference

```
#include <ObsData.hpp>
```

Collaboration diagram for ObsData:



Public Member Functions

- void read ()

  Member function read.
- ObsData (std::vector< std::string > fvec, std::string sysString)

  Constructor with Input files, and system string.
- int **dumpArc** (char, int)
- int **dumpArcByTime** (char, int)
- int **dumpArcBinary** (char, int)
- int **dumpSizes** ()
- void pre_process (int minArcLen, int intrpolIntrvl, int deg)

  Function to perform preprocessing.
- void **dumpNonZeroArcs** ()
- int **dumpArcBinaryPtrsAll** ()
- int **dumpArcValuePtrsAll** ()

Public Attributes

- std::vector< std::string > fnames

  list of file names to read from
- triple MarkerPosition

  triple Object to store receiver-station position
- float version

  Stores RINEX version of observation files.
- int interval

  Interval between observations in data file.
- bool hasGPS

  Flag to indicate whether Data file contains GPS Data.
- bool hasGLO

  Flag to indicate whether Data file contains GLONASS Data.
- bool hasGAL

  Flag to indicate whether Data file contains Galileo Data.
- bool hasBEI

  Flag to indicate whether Data file contains BeiDou Data.
- bool readGPS

  Flag to indicate whether to process GPS Data.
- bool readGLO

  Flag to indicate whether to process GLONASS Data.
- bool readGAL

  Flag to indicate whether to process Galileo Data.
- bool readBEI

  Flag to indicate whether to process BeiDou Data.
- bool hasTOFO

  Time of first observation flag.
- std::string TOFO_system

  Time system of first observation from observation Header.
- internalTime TOFO

  internalTime Object to store Time of first observation
- std::vector< int > timeline_main

  Integer vector to store epochs in UNIX time.
- std::vector< std::vector< float > > GPS_ucTEC

Vectors to store raw non-calibrated TEC for GPS Satellites.

- std::vector< std::vector< float > > GLO_ucTEC

  Vectors to store raw non-calibrated TEC for GLONASS Satellites.
- std::vector< std::vector< float > > GAL_ucTEC

  Vectors to store raw non-calibrated TEC for Galileo Satellites.
- std::vector< std::vector< float > > BDU_ucTEC

  Vectors to store raw non-calibrated TEC for BeiDou Satellites.
- std::vector< float > S

  Stores matrix S (non-calibrated TEC).
- std::vector< int > S_arcnum

  Stores arc numbers for S.
- std::vector< int > S_prn

  Stores Satellite IDs for S.
- int size_of_S

  Indicates size of S.
- std::vector< int_pair > **intse**
- int numArcs

  Indicates total number of arcs.
- std::vector< int > **prnid**
- int **GPS_Mark** [32]
- int **GLO_Mark** [24]
- int **GAL_Mark** [30]
- int **BDU_Mark** [34]
- int **NonZero_Mark** [120]
- int **numNonZeroArcs**
- std::vector< ptr_pair > arcs

  Initial non-zero arc pinters.
- std::vector< ptr_pair > arcs2

  Arc pointers without zeros.
- std::vector< ptr_pair > arcs3

  Arc pointers without gaps.

Private Member Functions

- ObsData ()

  default hidden Constructor
- void setSysFlags (std::string sysString)

  Sets system flags.
- int **pad_zero** (int)
- void **resetMark** ()
- int **pad_zero** ()
- void **markNonZeroArcs** (int, int)
- void **getnumNonZeroArcs** ()
- void setArcStartEnd ()

  Sets Arc pointers using ptr_pair objects.
- int lagrangeInterpolation (float ∗target, float ∗s, float ∗e, int deg)

  Function to perform lagrange interpolation.

3.4.1 Detailed Description

Author

Muhammad Owais

Date

05/12/16

3.4.2 Constructor & Destructor Documentation

3.4.2.1 ObsData::ObsData (std::vector< std::string > *fvec*, std::string *sysString*)

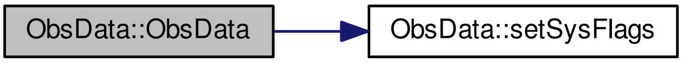
Constructor with Input files, and system string.

Constructs observation object by seting input observation file name vector fnames given file names and setting system flags given system string.

Parameters

fvec	Vector of observation file names.
sysString	string (any combination of 'G','R','E','C') defining constellations being processed.

Here is the call graph for this function:



3.4.3 Member Function Documentation

3.4.3.1 int ObsData::lagrangeInterpolation (float ∗ *target*, float ∗ *s*, float ∗ *e*, int *deg*) [private]

Function to perform lagrange interpolation.

This function performs lagrange Interpolation needed in preprocessing phase, given a required degree for interpolation.

Parameters

target	pointer to the value being interpolated.
s	start pointer of the arc.
e	end pointer of the arc.
deg	degree of Interpolation.

3.4.3.2 void ObsData::pre_process (int *minArcLen*, int *intrpolIntrvl*, int *deg*)

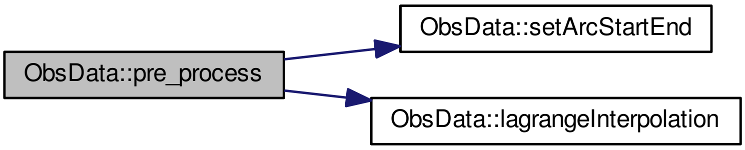
Function to perform preprocessing.

This function performs preprocessing by filling gaps using lagrange interpolation and removing phase jumps using quartiles and Inter Quartile Range.

Parameters

minArcLen	minimum data duration(Seconds) to consider an arc valid.
intrpolIntrvl	Maximum gap duration (Seconds) to interpolate.
deg	Degree of Interpolation, passed to lagrangeInterpolation.

Here is the call graph for this function:

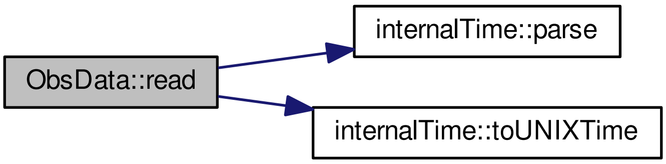


3.4.3.3 void ObsData::read ( )

Member function read.

Member function read parses input observation files and constructs internal observation structure.

Here is the call graph for this function:



3.4.3.4 void ObsData::setArcStartEnd ( ) [private]

Sets Arc pointers using ptr_pair objects.

This function sets Arc pointers to start/end pairs using ptr_pair, which serve as input arcs to preprocessing phase.

3.4.3.5 void ObsData::setSysFlags (std::string *sysString*) [private]

Sets system flags.

This function sets system flags given sysString, to indicate which constellations are processed.

Parameters

sysString	string (any combination of 'G','R','E','C') indicating constellations being processed.

3.4.4 Member Data Documentation

3.4.4.1 std::vector<ptr_pair> ObsData::arcs

Initial non-zero arc pinters.

ptr_pair Object containing Initial non-zero arcs, without preprocessing being applied.

3.4.4.2 std::vector<ptr_pair> ObsData::arcs2

Arc pointers without zeros.

ptr_pair Object containing arcs, without leading and trailing zeros.

3.4.4.3 std::vector<ptr_pair> ObsData::arcs3

Arc pointers without gaps.

ptr_pair Object containing arcs, with gaps removoed by lagrangeInterpolation and phase jumps removed. These are the processed Arcs.

3.4.4.4 std::vector< std::vector<float> > ObsData::BDU_ucTEC

Vectors to store raw non-calibrated TEC for BeiDou Satellites.

This is a Vector of float-vectors, where first index is the Satellite prn-id and the second index is the raw non-calibrated TEC for BeiDou satellites corresponding to the epoch index in timeline_main.

3.4.4.5 std::vector< std::vector<float> > ObsData::GAL_ucTEC

Vectors to store raw non-calibrated TEC for Galileo Satellites.

This is a Vector of float-vectors, where first index is the Satellite prn-id and the second index is the raw non-calibrated TEC for Galileo satellites corresponding to the epoch index in timeline_main.

3.4.4.6 std::vector< std::vector<float> > ObsData::GLO_ucTEC

Vectors to store raw non-calibrated TEC for GLONASS Satellites.

This is a Vector of float-vectors, where first index is the Satellite prn-id and the second index is the raw non-calibrated TEC for GLONASS satellites corresponding to the epoch index in timeline_main.

3.4.4.7 std::vector< std::vector<float> > ObsData::GPS_ucTEC

Vectors to store raw non-calibrated TEC for GPS Satellites.

This is a Vector of float-vectors, where first index is the Satellite prn-id and the second index is the raw non-calibrated TEC for GPS satellites corresponding to the epoch index in timeline_main.

3.4.4.8 bool ObsData::hasTOFO

Time of first observation flag.

Flag to indicate whether Time of first observation was present in observation Header.

3.4.4.9 int ObsData::numArcs

Indicates total number of arcs.

Indicates total number of arcs formed. Arc numbers are defined by pre_processing phase using pre_process.

3.4.4.10 std::vector<float> ObsData::S

Stores matrix S (non-calibrated TEC).

This vector stores all computed non-calibrated TEC values, arranged by epochs. This is the input vector given to the system solver.

3.4.4.11 std::vector<int> ObsData::S_arcnum

Stores arc numbers for S.

This vector stores for each element in S , a corresponding value indicating the its arc number. Arc numbers are defined by pre_processing phase using pre_process.

3.4.4.12 std::vector<int> ObsData::S_prn

Stores Satellite IDs for S.

This vector stores for each element in S , a corresponding value indicating the its Satellite ID.

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

- /home/mowais/GTEC/src/ObsData.hpp
- /home/mowais/GTEC/src/ObsData.cpp

3.5 ptr_pair Class Reference

```
#include <ptr_pair.hpp>
```

Public Member Functions

- ptr_pair ()

  Default constructor.
- ptr_pair (float ∗s, float ∗e)

  Custom constructor.

Public Attributes

- float ∗ start

  Start pointer.
- float ∗ end

  End pointer.

3.5.1 Detailed Description

Author

Muhammad Owais

Date

05/12/16

3.5.2 Constructor & Destructor Documentation

3.5.2.1 ptr_pair::ptr_pair ( )

Default constructor.

Default constructur, creates ptr_pair object with NULLL start and end pointers.

3.5.2.2 ptr_pair::ptr_pair (float ∗ *s*, float ∗ *e*)

Custom constructor.

Constructur, creates ptr_pair object with start and end pointers set to given pointers.

Parameters

s	Input start pointer for new ptr_pair object.
e	Input end pointer for new ptr_pair object.

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

- /home/mowais/GTEC/src/ptr_pair.hpp
- /home/mowais/GTEC/src/ptr_pair.cpp

3.6 triple Class Reference

```
#include <triple.hpp>
```

Public Member Functions

- void dump (std::ostream &s)

  Member function dump.

Public Attributes

- double X

  Stores X Coordinate.
- double Y

  Stores Y Coordinate.
- double Z

  Stores Z Coordinate.

3.6.1 Detailed Description

Author

Muhammad Owais

Date

05/12/16

3.6.2 Member Function Documentation

3.6.2.1 void triple::dump (std::ostream & *s*)

Member function dump.

Member function dump output coordinates into a given output stream.

Parameters

s	output stream

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

- /home/mowais/GTEC/src/triple.hpp
- /home/mowais/GTEC/src/triple.cpp

Chapter 4

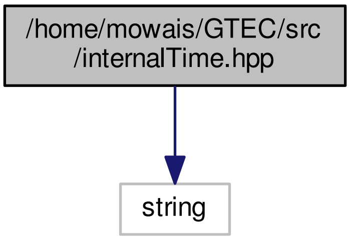
File Documentation

4.1 /home/mowais/GTEC/src/internalTime.hpp File Reference

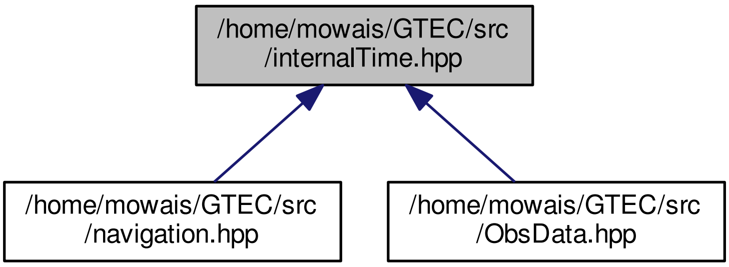
Class defining internal time format.

```
#include <string>
```

Include dependency graph for internalTime.hpp:



This graph shows which files directly or indirectly include this file:



Classes

- class internalTime

4.1.1 Detailed Description

Class defining internal time format.

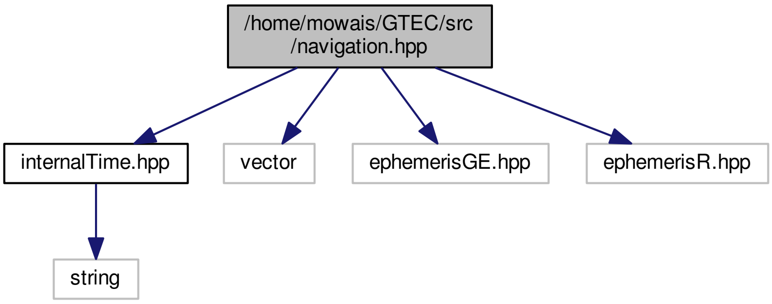
This Class Defines Internal time which is based on Unix Time. It stores the normal Date/Time as (Year,Month,Day,Hour,Minute,Second), while also providing equivalent UNIX Time. An instance of this class could be generated by explicitely providing normal Date/Time values or by providing a string which would be parse to store time in both formats.

4.2 /home/mowais/GTEC/src/navigation.hpp File Reference

This class navigation data.

```
#include "internalTime.hpp"
#include <vector>
#include "ephemerisGE.hpp"
#include "ephemerisR.hpp"
```

Include dependency graph for navigation.hpp:



Classes

- class navigation

4.2.1 Detailed Description

This class navigation data.

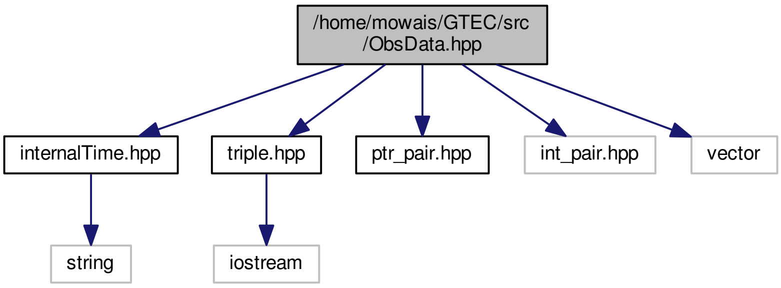
This class defines navigation data, stored after reading RINEX navigation files, for different constellations.

4.3 /home/mowais/GTEC/src/ObsData.hpp File Reference

Class defining observation data.

```
#include "internalTime.hpp"
#include "triple.hpp"
#include "ptr_pair.hpp"
#include "int_pair.hpp"
#include <vector>
```

Include dependency graph for ObsData.hpp:



Classes

- class ObsData

4.3.1 Detailed Description

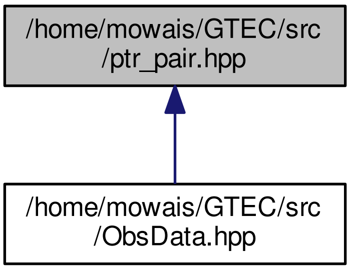
Class defining observation data.

This Class Defines observation data handling, including reading from observation files and storing in internal data structure, the raw non-calibrated TEC from phase observables. This class also includes preprocessing routines being applied to internal data structure, and allot of dump routines for debugging and ploting arc states.

4.4 /home/mowais/GTEC/src/ptr_pair.hpp File Reference

Class defining pointer pairs.

This graph shows which files directly or indirectly include this file:



Classes

- class ptr_pair

4.4.1 Detailed Description

Class defining pointer pairs.

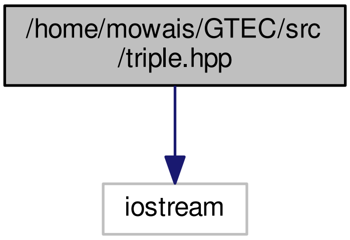
This Class Defines pointer pairs objects used in preprocessing to define arcs. Each arc coud be defined as a ptr_pair object having a start pointer (pointer to first value in arc) and an end pointer (pointer to last value in arc).

4.5 /home/mowais/GTEC/src/triple.hpp File Reference

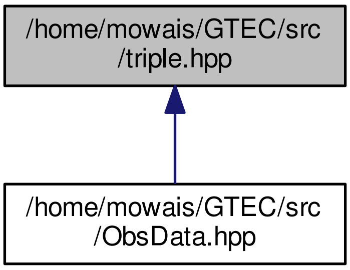
This class defines a 3-D Coordinate.

```
#include <iostream>
```

Include dependency graph for triple.hpp:



This graph shows which files directly or indirectly include this file:



Classes

- class triple

4.5.1 Detailed Description

This class defines a 3-D Coordinate.

Index

/home/mowais/GTEC/src/ObsData.hpp, 21
/home/mowais/GTEC/src/internalTime.hpp, 19
/home/mowais/GTEC/src/navigation.hpp, 20
/home/mowais/GTEC/src/ptr_pair.hpp, 21
/home/mowais/GTEC/src/triple.hpp, 22

arcs
    ObsData, 14
arcs2
    ObsData, 14
arcs3
    ObsData, 14

BDU_ucTEC
    ObsData, 14

dump
    triple, 17

GAL_ucTEC
    ObsData, 14
GLO_ucTEC
    ObsData, 14
GPS_ucTEC
    ObsData, 15

hasTOFO
    ObsData, 15

inout, 5
internalTime, 5
    internalTime, 6, 7
    parse, 7
    toUNIXTime, 7
    year, 7

lagrangeInterpolation
    ObsData, 12

navigation, 8
    navigation, 8, 9
    read, 9
numArcs
    ObsData, 15

ObsData, 9
    arcs, 14
    arcs2, 14
    arcs3, 14
    BDU_ucTEC, 14
    GAL_ucTEC, 14
    GLO_ucTEC, 14
    GPS_ucTEC, 15
    hasTOFO, 15
    lagrangeInterpolation, 12
    numArcs, 15
    ObsData, 12
    pre_process, 13
    read, 13
    S, 15
    S_arcnum, 15
    S_prn, 15
    setArcStartEnd, 13
    setSysFlags, 13

parse
    internalTime, 7
pre_process
    ObsData, 13
ptr_pair, 16
    ptr_pair, 16

read
    navigation, 9
    ObsData, 13

S
    ObsData, 15
S_arcnum
    ObsData, 15
S_prn
    ObsData, 15
setArcStartEnd
    ObsData, 13
setSysFlags
    ObsData, 13

toUNIXTime
    internalTime, 7
triple, 17
    dump, 17

year
    internalTime, 7