# qpp

0.1

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# Contents

# Chapter 1

# Namespace Index

## 1.1 Namespace List

Here is a list of all namespaces with brief descriptions:

# Chapter 2

# Hierarchical Index

## 2.1 Class Hierarchy

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

# Chapter 3

# Class Index

## 3.1 Class List

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

# Chapter 4

# File Index

## 4.1 File List

Here is a list of all files with brief descriptions:

# Chapter 5

# Namespace Documentation

## 5.1 qpp Namespace Reference

### Namespaces

- ct
- gt
- internal
- stat
- types

### Classes

- class Exception
- class Timer

### Functions

- template<typename Scalar >
  double shannon (const types::DynMat< Scalar > &A)
- template<typename Scalar >
  double renyi (const double alpha, const types::DynMat< Scalar > &A)
- template<typename Scalar >
  double renyi_inf (const types::DynMat< Scalar > &A)
- template<typename Scalar >
  types::DynMat< Scalar > transpose (const types::DynMat< Scalar > &A)
- template<typename Scalar >
  types::DynMat< Scalar > conjugate (const types::DynMat< Scalar > &A)
- template<typename Scalar >
  types::DynMat< Scalar > adjoint (const types::DynMat< Scalar > &A)
- template<typename Scalar >
  Scalar trace (const types::DynMat< Scalar > &A)
- template<typename Scalar >
  Scalar det (const types::DynMat< Scalar > &A)
- template<typename Scalar >
  Scalar sum (const types::DynMat< Scalar > &A)
- template<typename Scalar >
  double norm (const types::DynMat< Scalar > &A)
- template<typename Scalar >
  types::cmat evals (const types::DynMat< Scalar > &A)

- template<typename Scalar >
  types::cmat evects (const types::DynMat< Scalar > &A)
- template<typename Scalar >
  types::cmat hevals (const types::DynMat< Scalar > &A)
- template<typename Scalar >
  types::cmat hevects (const types::DynMat< Scalar > &A)
- template<typename Scalar >
  types::cmat funm (const types::DynMat< Scalar > &A, types::cplx(*f)(const types::cplx &))
- template<typename Scalar >
  types::cmat absm (const types::DynMat< Scalar > &A)
- template<typename Scalar >
  types::cmat expm (const types::DynMat< Scalar > &A)
- template<typename Scalar >
  types::cmat logm (const types::DynMat< Scalar > &A)
- template<typename Scalar >
  types::cmat sqrtm (const types::DynMat< Scalar > &A)
- template<typename Scalar >
  types::cmat sinm (const types::DynMat< Scalar > &A)
- template<typename Scalar >
  types::cmat cosm (const types::DynMat< Scalar > &A)
- template<typename Scalar >
  types::cmat spectralpowm (const types::DynMat< Scalar > &A, const types::cplx z)
- template<typename Scalar >
  types::DynMat< Scalar > powm (const types::DynMat< Scalar > &A, size_t n)
- template<typename InputScalar , typename OutputScalar >
  types::DynMat< OutputScalar > fun (const types::DynMat< InputScalar > &A, OutputScalar(*f)(const InputScalar &))
- template<typename Scalar >
  types::DynMat< Scalar > kron (const types::DynMat< Scalar > &A, const types::DynMat< Scalar > &B)
- template<typename Scalar >
  types::DynMat< Scalar > kronlist (const std::vector< types::DynMat< Scalar >> &list)
- template<typename Scalar >
  types::DynMat< Scalar > kronpow (const types::DynMat< Scalar > &A, size_t n)
- template<typename Scalar >
  types::DynMat< Scalar > reshape (const types::DynMat< Scalar > &A, size_t rows, size_t cols)
- template<typename Scalar >
  types::DynMat< Scalar > syspermute (const types::DynMat< Scalar > &A, const std::vector< size_t > perm, const std::vector< size_t > &dims)
- template<typename Scalar >
  types::DynMat< Scalar > ptrace2 (const types::DynMat< Scalar > &A, const std::vector< size_t > dims)
- template<typename Scalar >
  types::DynMat< Scalar > ptrace (const types::DynMat< Scalar > &A, const std::vector< size_t > &subsys, const std::vector< size_t > &dims)
- template<typename Scalar >
  types::DynMat< Scalar > ptranspose (const types::DynMat< Scalar > &A, const std::vector< size_t > &subsys, const std::vector< size_t > &dims)
- template<typename Scalar >
  types::DynMat< Scalar > comm (const types::DynMat< Scalar > &A, const types::DynMat< Scalar > &B)
- template<typename Scalar >
  types::DynMat< Scalar > anticomm (const types::DynMat< Scalar > &A, const types::DynMat< Scalar > &B)
- template<typename Scalar >
  types::DynMat< Scalar > proj (const types::DynMat< Scalar > &V)
- template<typename Scalar >
  types::DynMat< Scalar > dya (const types::DynMat< Scalar > &V)

- template<typename Scalar >
  types::DynMat< Scalar > expandout (const types::DynMat< Scalar > &A, size_t pos, const std::vector< size_t > &dims)
- template<typename Scalar >
  types::DynMat< Scalar > grams (const std::vector< types::DynMat< Scalar >> &vecs)
- template<typename Scalar >
  types::DynMat< Scalar > grams (const types::DynMat< Scalar > &A)
- template<typename T >
  void disp (const T &x, const std::string &separator=" ", const std::string &start="[", const std::string &end="]", std::ostream &os=std::cout)
- template<typename T >
  void displn (const T &x, const std::string &separator=" ", const std::string &start="[", const std::string &end="]", std::ostream &os=std::cout)
- template<typename T >
  void disp (const T *x, const size_t n, const std::string &separator=" ", const std::string &start="[", const std::string &end="]", std::ostream &os=std::cout)
- template<typename T >
  void displn (const T *x, const size_t n, const std::string &separator=" ", const std::string &start="[", const std::string &end="]", std::ostream &os=std::cout)
- template<typename Scalar >
  void disp (const types::DynMat< Scalar > &A, double chop=ct::chop, std::ostream &os=std::cout)
- template<typename Scalar >
  void displn (const types::DynMat< Scalar > &A, double chop=ct::chop, std::ostream &os=std::cout)
- void disp (const types::cplx c, double chop=ct::chop, std::ostream &os=std::cout)
- void displn (const types::cplx c, double chop=ct::chop, std::ostream &os=std::cout)
- template<typename Scalar >
  void save (const types::DynMat< Scalar > &A, const std::string &fname)
- template<typename Scalar >
  types::DynMat< Scalar > load (const std::string &fname)
- template<typename Scalar >
  types::DynMat< Scalar > loadMATLABmatrix (const std::string &mat_file, const std::string &var_name)
- template<>
  types::DynMat< double > loadMATLABmatrix (const std::string &mat_file, const std::string &var_name)
- template<>
  types::DynMat< types::cplx > loadMATLABmatrix (const std::string &mat_file, const std::string &var_name)
- template<typename Scalar >
  void saveMATLABmatrix (const types::DynMat< Scalar > &A, const std::string &mat_file, const std::string &var_name, const std::string &mode)
- template<>
  void saveMATLABmatrix (const types::DynMat< double > &A, const std::string &mat_file, const std::string &var_name, const std::string &mode)
- template<>
  void saveMATLABmatrix (const types::DynMat< types::cplx > &A, const std::string &mat_file, const std::string &var_name, const std::string &mode)
- int _init ()
- template<typename Scalar >
  types::DynMat< Scalar > rand (size_t rows, size_t cols, double a=0, double b=1)
- template<>
  types::DynMat< double > rand (size_t rows, size_t cols, double a, double b)
- template<>
  types::DynMat< types::cplx > rand (size_t rows, size_t cols, double a, double b)
- double rand (double a=0, double b=1)
- template<typename Scalar >
  types::DynMat< Scalar > randn (size_t rows, size_t cols, double mean=0, double sigma=1)
- template<>
  types::DynMat< double > randn (size_t rows, size_t cols, double mean, double sigma)

- template<>
  types::DynMat< types::cplx > randn (size_t rows, size_t cols, double mean, double sigma)
- double randn (double mean=0, double sigma=1)
- types::cmat randU (size_t D)
- types::cmat randV (size_t Din, size_t Dout)
- types::cmat randH (size_t D)
- types::cmat randket (size_t D)
- types::cmat randrho (size_t D)

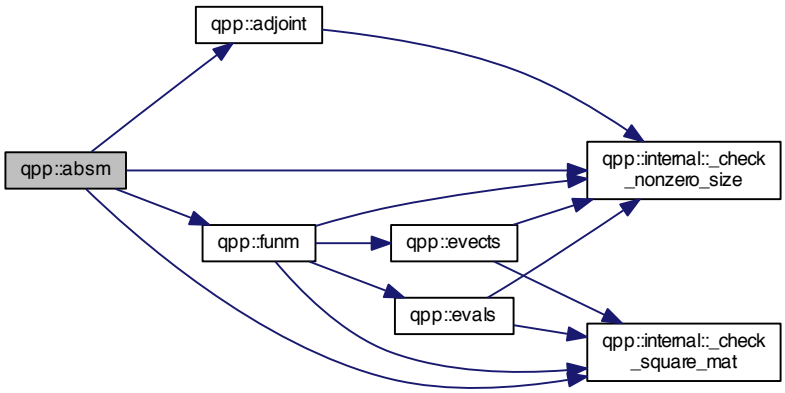
### 5.1.1 Function Documentation

#### 5.1.1.1 int qpp::_init ( )

Here is the call graph for this function:

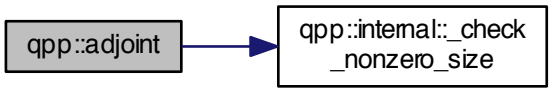

#### 5.1.1.2 template<typename Scalar > types::cmat qpp::absm ( const types::DynMat< Scalar > & *A* )

Here is the call graph for this function:



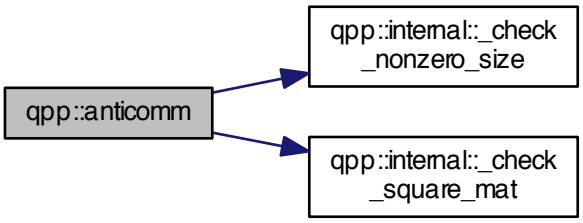
#### 5.1.1.3 template<typename Scalar > types::DynMat<Scalar> qpp::adjoint ( const types::DynMat< Scalar > & *A* )

Here is the call graph for this function:



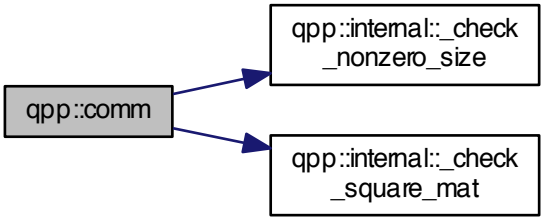

#### 5.1.1.4 template<typename Scalar > types::DynMat<Scalar> qpp::anticomm ( const types::DynMat< Scalar > & *A*, const types::DynMat< Scalar > & *B* )

Here is the call graph for this function:



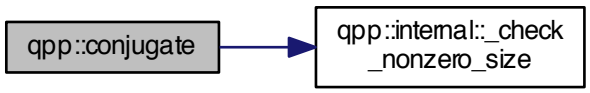

#### 5.1.1.5 template<typename Scalar > types::DynMat<Scalar> qpp::comm ( const types::DynMat< Scalar > & *A*, const types::DynMat< Scalar > & *B* )

Here is the call graph for this function:



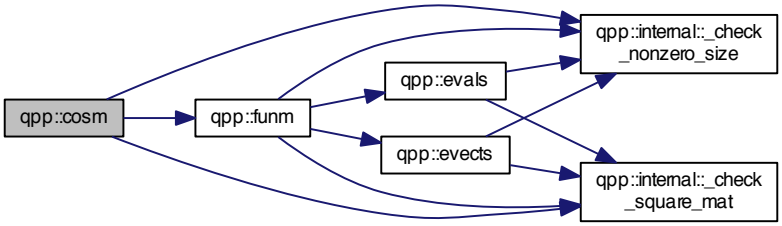
#### 5.1.1.6 template<typename Scalar > types::DynMat<Scalar> qpp::conjugate ( const types::DynMat< Scalar > & *A* )

Here is the call graph for this function:



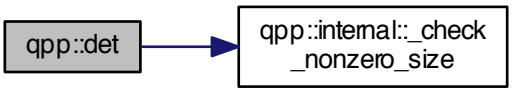

#### 5.1.1.7 template<typename Scalar > types::cmat qpp::cosm ( const types::DynMat< Scalar > & *A* )

Here is the call graph for this function:




#### 5.1.1.8 template<typename Scalar > Scalar qpp::det ( const types::DynMat< Scalar > & *A* )

Here is the call graph for this function:




#### 5.1.1.9 template<typename T > void qpp::disp ( const T & *x*, const std::string & *separator* = " ", const std::string & *start* = "[", const std::string & *end* = "]", std::ostream & *os* = std::cout )

#### 5.1.1.10 template<typename T > void qpp::disp ( const T * *x*, const size_t *n*, const std::string & *separator* = " ", const std::string & *start* = "[", const std::string & *end* = "]", std::ostream & *os* = std::cout )

5.1.1.11 template<typename Scalar > void qpp::disp ( const types::DynMat< Scalar > & *A*, double *chop* = `ct::chop`, std::ostream & *os* = `std::cout` )

5.1.1.12 void qpp::disp ( const types::cplx *c*, double *chop* = `ct::chop`, std::ostream & *os* = `std::cout` ) `[inline]`

Here is the call graph for this function:


5.1.1.13 template<typename T > void qpp::displn ( const T & *x*, const std::string & *separator* = `" "`, const std::string & *start* = `"["`, const std::string & *end* = `"]"`, std::ostream & *os* = `std::cout` )

Here is the call graph for this function:


5.1.1.14 template<typename T > void qpp::displn ( const T * *x*, const size_t *n*, const std::string & *separator* = `" "`, const std::string & *start* = `"["`, const std::string & *end* = `"]"`, std::ostream & *os* = `std::cout` )

Here is the call graph for this function:

#### 5.1.1.15 template<typename Scalar > void qpp::displn ( const types::DynMat< Scalar > & *A*, double *chop* = `ct::chop`, std::ostream & *os* = `std::cout` )

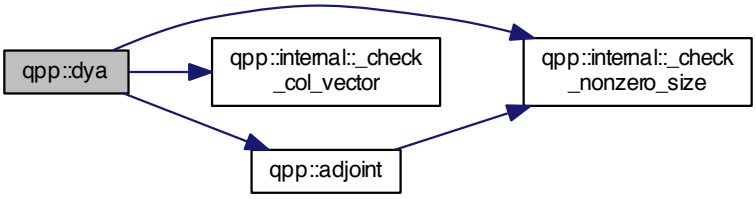
Here is the call graph for this function:


#### 5.1.1.16 void qpp::displn ( const types::cplx *c*, double *chop* = `ct::chop`, std::ostream & *os* = `std::cout` ) `[inline]`

Here is the call graph for this function:

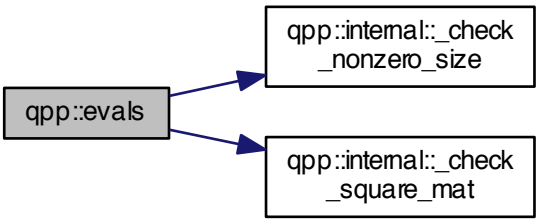

#### 5.1.1.17 template<typename Scalar > types::DynMat<Scalar> qpp::dya ( const types::DynMat< Scalar > & *V* )

Here is the call graph for this function:



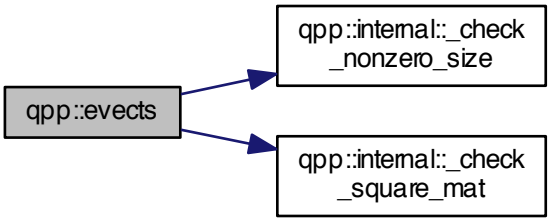
#### 5.1.1.18 template<typename Scalar > types::cmat qpp::evals ( const types::DynMat< Scalar > & *A* )

Here is the call graph for this function:



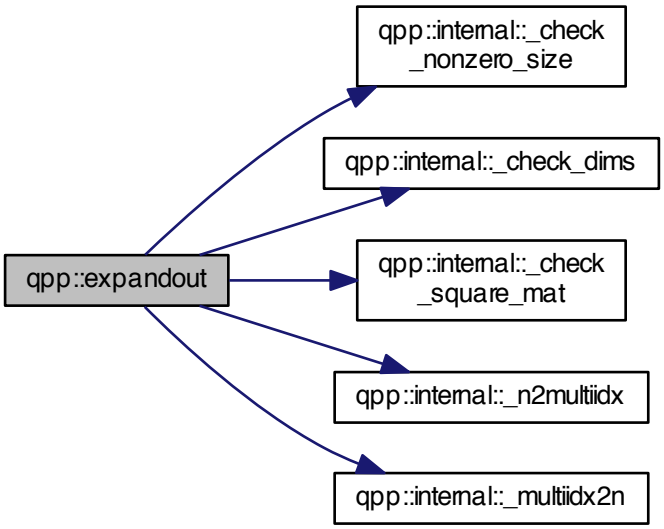

#### 5.1.1.19 template<typename Scalar > types::cmat qpp::evects ( const types::DynMat< Scalar > & *A* )

Here is the call graph for this function:



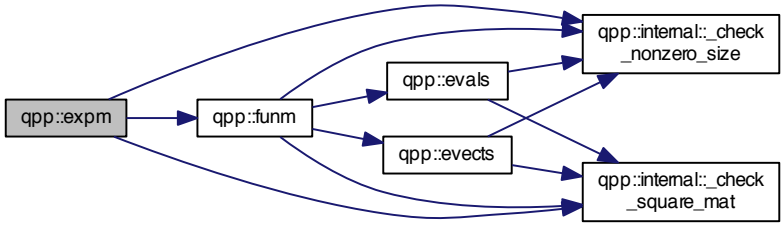
#### 5.1.1.20 template<typename Scalar > types::DynMat<Scalar> qpp::expandout ( const types::DynMat< Scalar > & *A*, size_t *pos*, const std::vector< size_t > & *dims* )

Here is the call graph for this function:



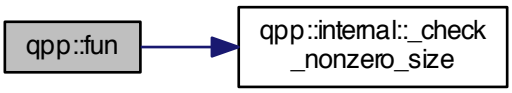

#### 5.1.1.21 template<typename Scalar > types::cmat qpp::expm ( const types::DynMat< Scalar > & *A* )

Here is the call graph for this function:



#### 5.1.1.22 template<typename InputScalar , typename OutputScalar > types::DynMat<OutputScalar> qpp::fun ( const types::DynMat< InputScalar > & *A*, OutputScalar(*)(const InputScalar &) *f* )

Here is the call graph for this function:




#### 5.1.1.23 template<typename Scalar > types::cmat qpp::funm ( const types::DynMat< Scalar > & *A*, types::cplx(*)(const types::cplx &) *f* )

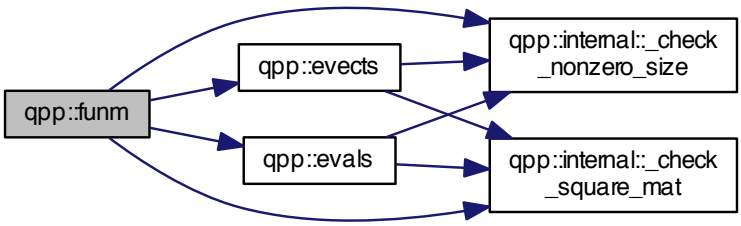
**Parameters**

| | |
|---|---|
| *A* | input matrix |
| *f* | function pointer |

**Returns**

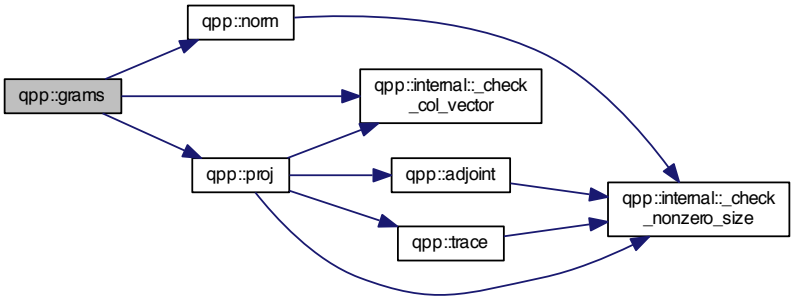
types::cmat

Here is the call graph for this function:



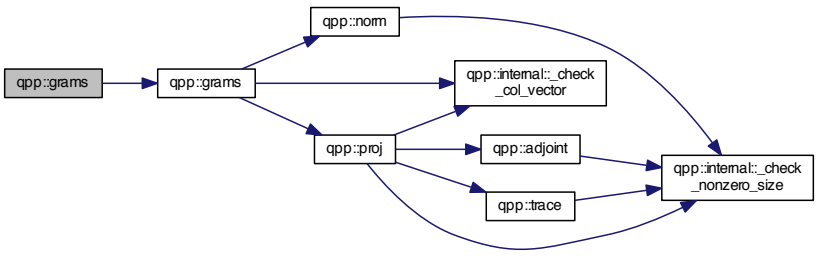
#### 5.1.1.24 template<typename Scalar > types::DynMat<Scalar> qpp::grams ( const std::vector< types::DynMat< Scalar >> & *vecs* )

Here is the call graph for this function:



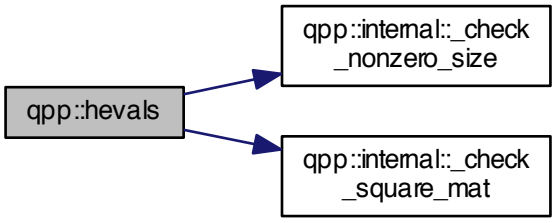

#### 5.1.1.25 template<typename Scalar > types::DynMat<Scalar> qpp::grams ( const types::DynMat< Scalar > & *A* )

Here is the call graph for this function:



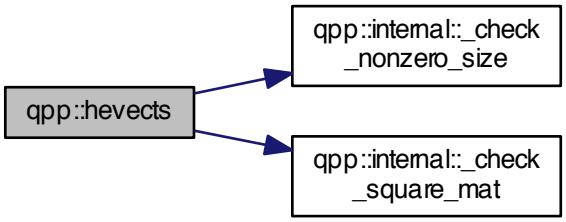
#### 5.1.1.26 template<typename Scalar > types::cmat qpp::hevals ( const types::DynMat< Scalar > & *A* )

Here is the call graph for this function:



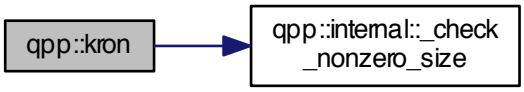

#### 5.1.1.27 template<typename Scalar > types::cmat qpp::hevects ( const types::DynMat< Scalar > & *A* )

Here is the call graph for this function:



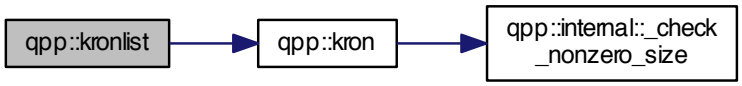

#### 5.1.1.28 template<typename Scalar > types::DynMat<Scalar> qpp::kron ( const types::DynMat< Scalar > & *A*, const types::DynMat< Scalar > & *B* )

Here is the call graph for this function:



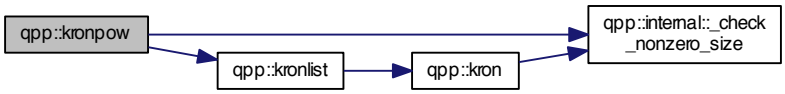
5.1.1.29 template<typename Scalar > types::DynMat<Scalar> qpp::kronlist ( const std::vector< types::DynMat< Scalar >> & *list* )

Here is the call graph for this function:




5.1.1.30 template<typename Scalar > types::DynMat<Scalar> qpp::kronpow ( const types::DynMat< Scalar > & *A*, size_t *n* )

Here is the call graph for this function:




5.1.1.31 template<typename Scalar > types::DynMat<Scalar> qpp::load ( const std::string & *fname* )

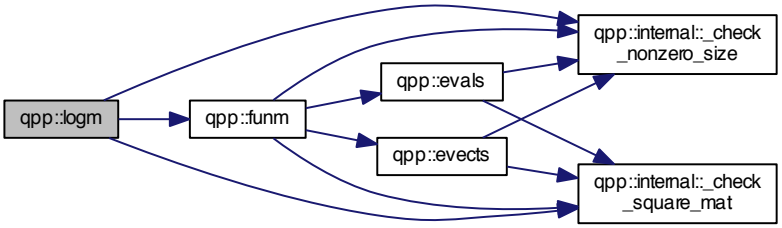
5.1.1.32 template<typename Scalar > types::DynMat<Scalar> qpp::loadMATLABmatrix ( const std::string & *mat_file*, const std::string & *var_name* )

5.1.1.33 template<> types::DynMat<double> qpp::loadMATLABmatrix ( const std::string & *mat_file*, const std::string & *var_name* ) [inline]

5.1.1.34 template<> types::DynMat<types::cplx> qpp::loadMATLABmatrix ( const std::string & *mat_file*, const std::string & *var_name* ) [inline]

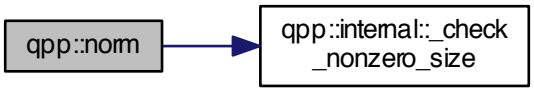
#### 5.1.1.35 template<typename Scalar > types::cmat qpp::logm ( const types::DynMat< Scalar > & *A* )

Here is the call graph for this function:



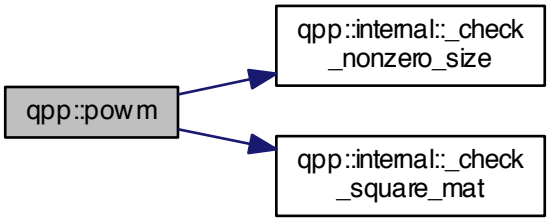

#### 5.1.1.36 template<typename Scalar > double qpp::norm ( const types::DynMat< Scalar > & *A* )

Here is the call graph for this function:



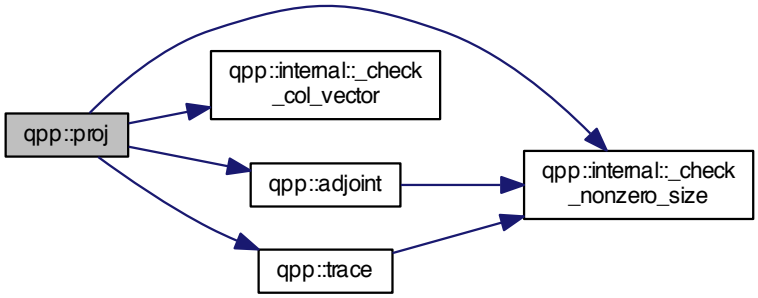

#### 5.1.1.37 template<typename Scalar > types::DynMat<Scalar> qpp::powm ( const types::DynMat< Scalar > & *A*, size_t *n* )

Here is the call graph for this function:



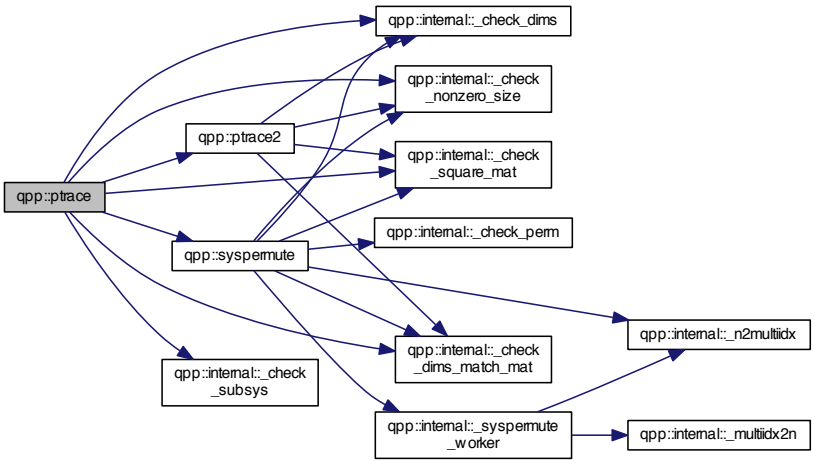
#### 5.1.1.38 template<typename Scalar > types::DynMat<Scalar> qpp::proj ( const types::DynMat< Scalar > & *V* )

Here is the call graph for this function:



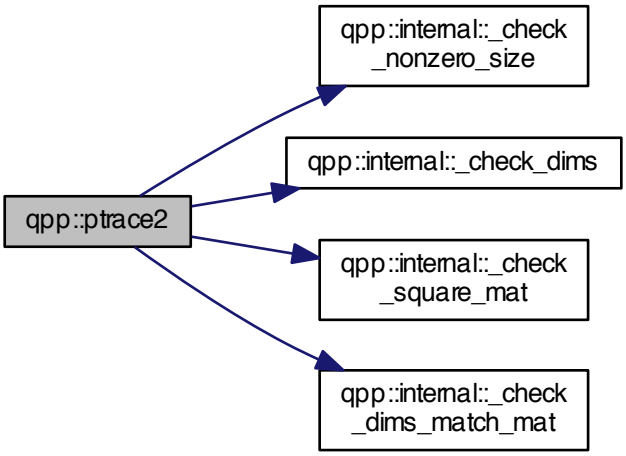

#### 5.1.1.39 template<typename Scalar > types::DynMat<Scalar> qpp::ptrace ( const types::DynMat< Scalar > & *A*, const std::vector< size_t > & *subsys*, const std::vector< size_t > & *dims* )

Here is the call graph for this function:



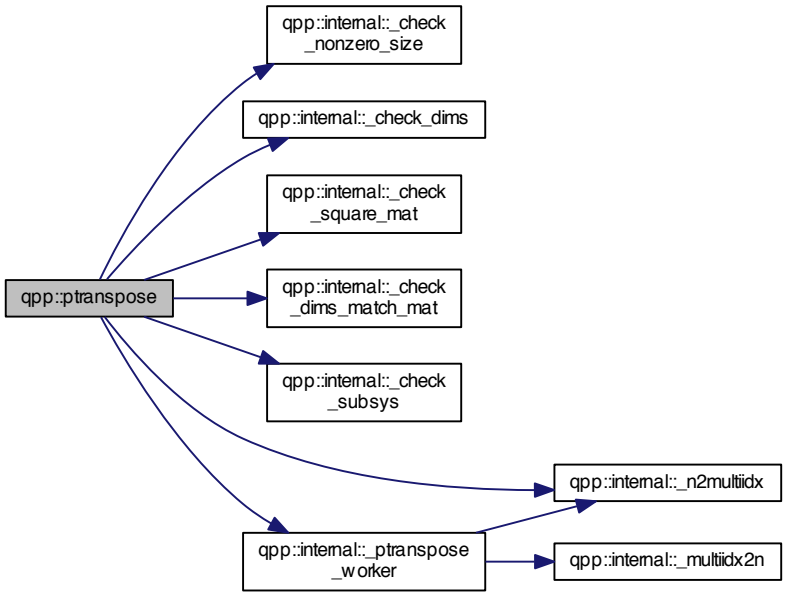
5.1.1.40 template<typename Scalar > types::DynMat<Scalar> qpp::ptrace2 ( const types::DynMat< Scalar > & *A*, const std::vector< size_t > *dims* )

Here is the call graph for this function:




5.1.1.41 template<typename Scalar > types::DynMat<Scalar> qpp::ptranspose ( const types::DynMat< Scalar > & *A*, const std::vector< size_t > & *subsys*, const std::vector< size_t > & *dims* )

Here is the call graph for this function:



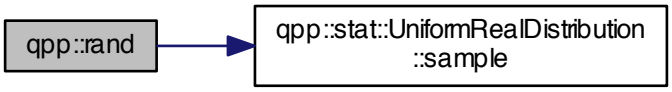
5.1.1.42 template<typename Scalar > types::DynMat<Scalar> qpp::rand ( size_t *rows*, size_t *cols*, double *a* = 0, double *b* = 1 ) [inline]

5.1.1.43 template<> types::DynMat<double> qpp::rand ( size_t *rows*, size_t *cols*, double *a*, double *b* ) [inline]

5.1.1.44 template<> types::DynMat<types::cplx> qpp::rand ( size_t *rows*, size_t *cols*, double *a*, double *b* ) [inline]

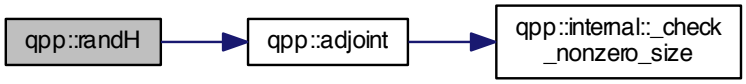
5.1.1.45 double qpp::rand ( double *a* = 0, double *b* = 1 ) [inline]

Here is the call graph for this function:



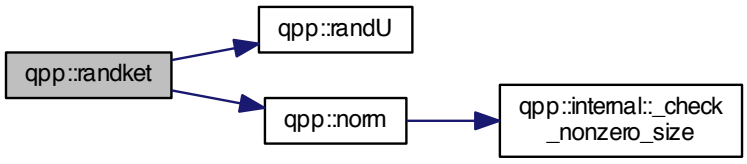

5.1.1.46 types::cmat qpp::randH ( size_t *D* ) [inline]

Here is the call graph for this function:




5.1.1.47 types::cmat qpp::randket ( size_t *D* ) [inline]

Here is the call graph for this function:



5.1.1.48 template<typename Scalar > types::DynMat<Scalar> qpp::randn ( size_t *rows*, size_t *cols*, double *mean* = 0, double *sigma* = 1 ) [inline]

5.1.1.49 template<> types::DynMat<double> qpp::randn ( size_t *rows*, size_t *cols*, double *mean*, double *sigma* ) [inline]

Here is the call graph for this function:


5.1.1.50 template<> types::DynMat<types::cplx> qpp::randn ( size_t *rows*, size_t *cols*, double *mean*, double *sigma* ) [inline]

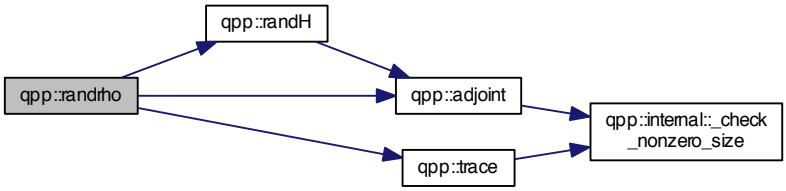
Here is the call graph for this function:


5.1.1.51 double qpp::randn ( double *mean* = 0, double *sigma* = 1 ) [inline]

Here is the call graph for this function:

#### 5.1.1.52 types::cmat qpp::randrho ( size_t *D* ) [inline]

Here is the call graph for this function:



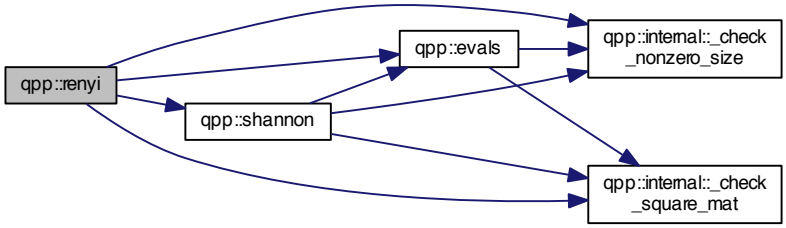

#### 5.1.1.53 types::cmat qpp::randU ( size_t *D* ) [inline]

#### 5.1.1.54 types::cmat qpp::randV ( size_t *Din*, size_t *Dout* ) [inline]

Here is the call graph for this function:

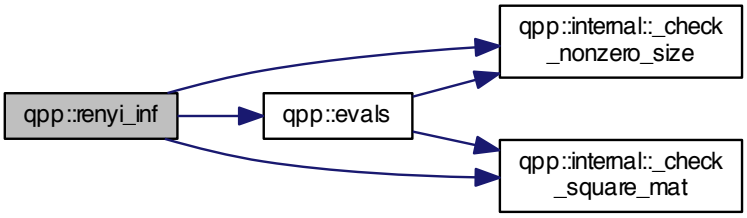

#### 5.1.1.55 template<typename Scalar > double qpp::renyi ( const double *alpha*, const types::DynMat< Scalar > & *A* )

Here is the call graph for this function:



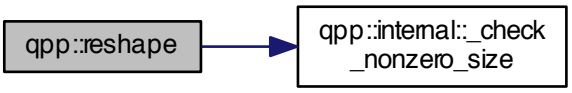
#### 5.1.1.56 template<typename Scalar > double qpp::renyi_inf ( const types::DynMat< Scalar > & *A* )

Here is the call graph for this function:



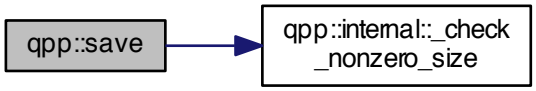

#### 5.1.1.57 template<typename Scalar > types::DynMat<Scalar> qpp::reshape ( const types::DynMat< Scalar > & *A*, size_t *rows*, size_t *cols* )

Here is the call graph for this function:




#### 5.1.1.58 template<typename Scalar > void qpp::save ( const types::DynMat< Scalar > & *A*, const std::string & *fname* )

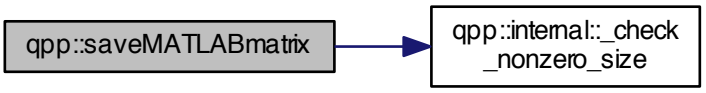
Here is the call graph for this function:




#### 5.1.1.59 template<typename Scalar > void qpp::saveMATLABmatrix ( const types::DynMat< Scalar > & *A*, const std::string & *mat_file*, const std::string & *var_name*, const std::string & *mode* )

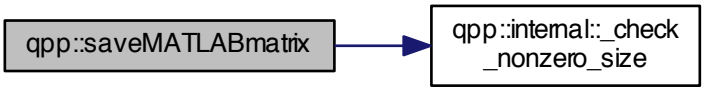
#### 5.1.1.60 template<> void qpp::saveMATLABmatrix ( const types::DynMat< double > & *A*, const std::string & *mat_file*, const std::string & *var_name*, const std::string & *mode* )

Here is the call graph for this function:



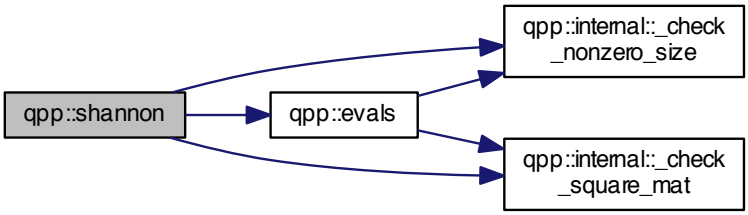

#### 5.1.1.61 template<> void qpp::saveMATLABmatrix ( const types::DynMat< types::cplx > & *A*, const std::string & *mat_file*, const std::string & *var_name*, const std::string & *mode* )

Here is the call graph for this function:



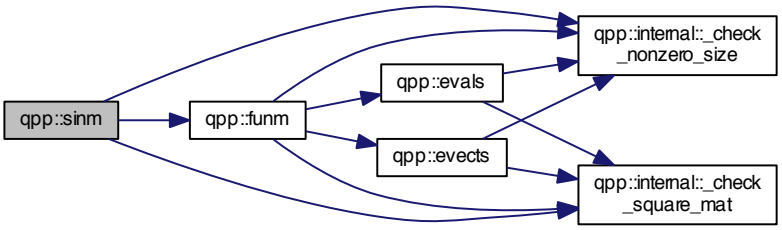

#### 5.1.1.62 template<typename Scalar > double qpp::shannon ( const types::DynMat< Scalar > & *A* )

Here is the call graph for this function:



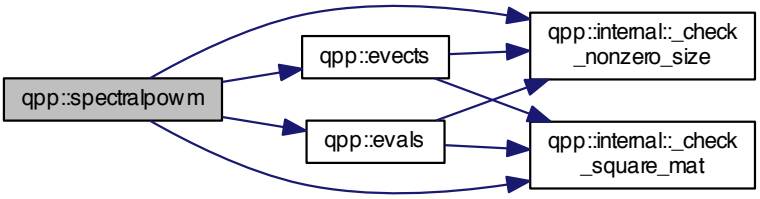
#### 5.1.1.63 template<typename Scalar > types::cmat qpp::sinm ( const types::DynMat< Scalar > & *A* )

Here is the call graph for this function:



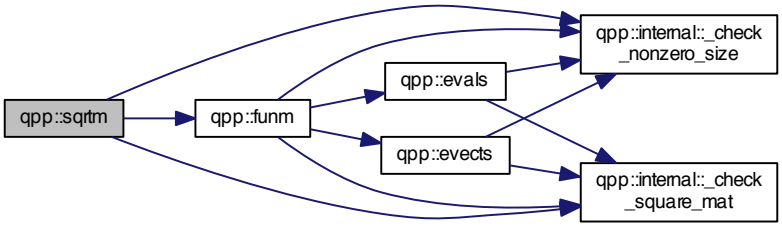

#### 5.1.1.64 template<typename Scalar > types::cmat qpp::spectralpowm ( const types::DynMat< Scalar > & *A*, const types::cplx *z* )

Here is the call graph for this function:



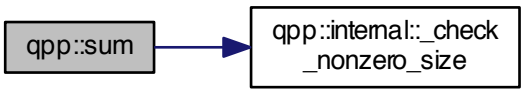

#### 5.1.1.65 template<typename Scalar > types::cmat qpp::sqrtm ( const types::DynMat< Scalar > & *A* )

Here is the call graph for this function:



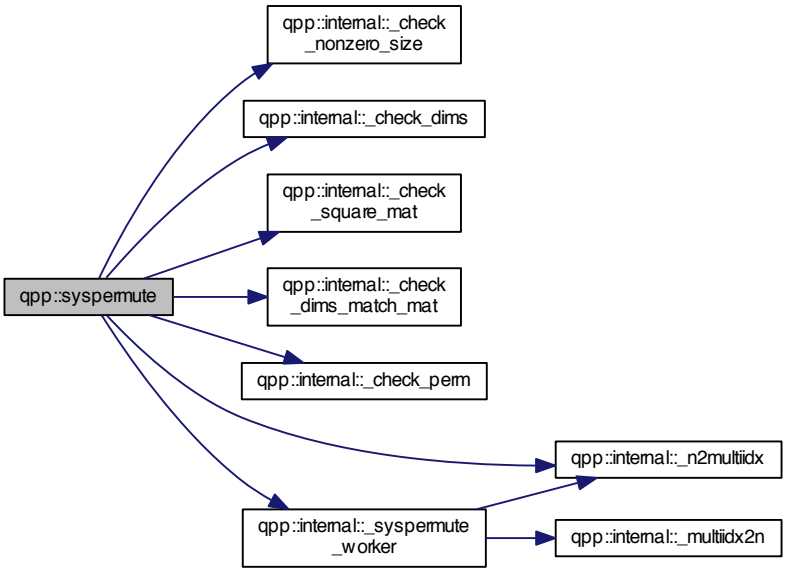
#### 5.1.1.66 template<typename Scalar > Scalar qpp::sum ( const types::DynMat< Scalar > & *A* )

Here is the call graph for this function:



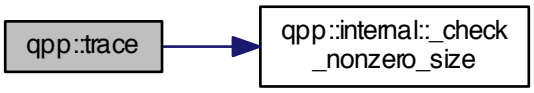

#### 5.1.1.67 template<typename Scalar > types::DynMat<Scalar> qpp::syspermute ( const types::DynMat< Scalar > & *A*, const std::vector< size_t > *perm*, const std::vector< size_t > & *dims* )

Here is the call graph for this function:



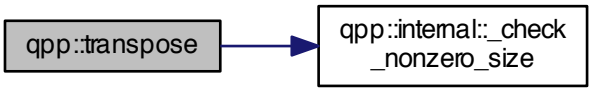
#### 5.1.1.68 template<typename Scalar > Scalar qpp::trace ( const types::DynMat< Scalar > & *A* )

Here is the call graph for this function:




#### 5.1.1.69 template<typename Scalar > types::DynMat<Scalar> qpp::transpose ( const types::DynMat< Scalar > & *A* )

Here is the call graph for this function:




## 5.2 qpp::ct Namespace Reference

### Functions

- std::complex< double > omega (size_t D)

### Variables

- const double chop = 1e-10
- const std::complex< double > ii = { 0, 1 }
- const double pi = 3.14159265358979323846264338327950288 4
- const double ee = 2.71828182845904523536028747135266249 7

### 5.2.1 Function Documentation

#### 5.2.1.1 std::complex<double> qpp::ct::omega ( size_t *D* ) [inline]

### 5.2.2 Variable Documentation

#### 5.2.2.1 const double qpp::ct::chop = 1e-10

#### 5.2.2.2 const double qpp::ct::ee = 2.71828182845904523536028747135266249 7

#### 5.2.2.3 const std::complex<double> qpp::ct::ii = { 0, 1 }

#### 5.2.2.4 const double qpp::ct::pi = 3.14159265358979323846264338327950288 4

## 5.3 qpp::gt Namespace Reference

### Functions

- void _init_gates ()
- types::cmat Rtheta (double theta)
- types::cmat Id (size_t D)
- types::cmat Zd (size_t D)
- types::cmat Fd (size_t D)
- types::cmat Xd (size_t D)
- types::cmat CTRL (const types::cmat &A, const std::vector< size_t > &ctrl, const std::vector< size_t > &gate, size_t n, size_t D=2)

### Variables

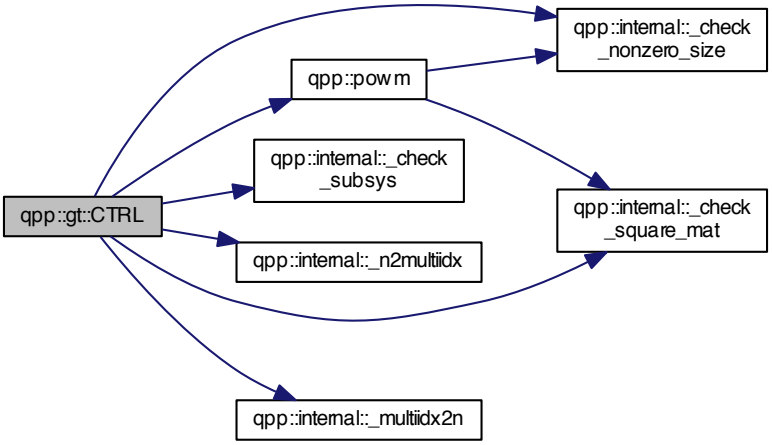
- types::cmat Id2
- types::cmat H
- types::cmat X
- types::cmat Y
- types::cmat Z
- types::cmat S
- types::cmat T
- types::cmat CNOTab
- types::cmat CNOTba
- types::cmat CZ
- types::cmat CS
- types::cmat SWAP
- types::cmat TOF
- types::cmat FRED
- types::cmat x0
- types::cmat x1
- types::cmat y0
- types::cmat y1
- types::cmat z0
- types::cmat z1
- types::cmat b00
- types::cmat b01
- types::cmat b10
- types::cmat b11

### 5.3.1 Function Documentation

#### 5.3.1.1 void qpp::gt::_init_gates ( ) [inline]

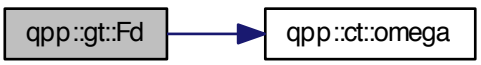
#### 5.3.1.2 types::cmat qpp::gt::CTRL ( const types::cmat & *A*, const std::vector< size_t > & *ctrl*, const std::vector< size_t > & *gate*, size_t *n*, size_t *D* = 2 ) [inline]

Here is the call graph for this function:




#### 5.3.1.3 types::cmat qpp::gt::Fd ( size_t *D* ) [inline]

Here is the call graph for this function:

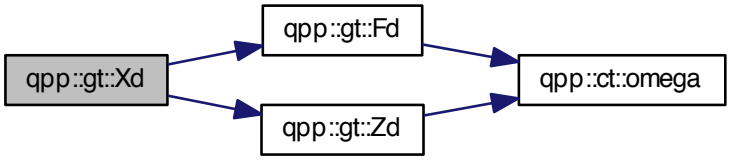



#### 5.3.1.4 types::cmat qpp::gt::Id ( size_t *D* ) [inline]

#### 5.3.1.5 types::cmat qpp::gt::Rtheta ( double *theta* ) [inline]

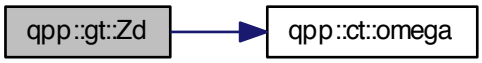
#### 5.3.1.6 types::cmat qpp::gt::Xd ( size_t *D* ) [inline]

Here is the call graph for this function:




#### 5.3.1.7 types::cmat qpp::gt::Zd ( size_t *D* ) [inline]

Here is the call graph for this function:




### 5.3.2 Variable Documentation

#### 5.3.2.1 types::cmat qpp::gt::b00

#### 5.3.2.2 types::cmat qpp::gt::b01

#### 5.3.2.3 types::cmat qpp::gt::b10

#### 5.3.2.4 types::cmat qpp::gt::b11

#### 5.3.2.5 types::cmat qpp::gt::CNOTab

#### 5.3.2.6 types::cmat qpp::gt::CNOTba

#### 5.3.2.7 types::cmat qpp::gt::CS

#### 5.3.2.8 types::cmat qpp::gt::CZ

#### 5.3.2.9 types::cmat qpp::gt::FRED

#### 5.3.2.10 types::cmat qpp::gt::H

#### 5.3.2.11 types::cmat qpp::gt::Id2

#### 5.3.2.12 types::cmat qpp::gt::S

#### 5.3.2.13 types::cmat qpp::gt::SWAP

#### 5.3.2.14 types::cmat qpp::gt::T

#### 5.3.2.15 types::cmat qpp::gt::TOF

#### 5.3.2.16 types::cmat qpp::gt::X

#### 5.3.2.17 types::cmat qpp::gt::x0

#### 5.3.2.18 types::cmat qpp::gt::x1

#### 5.3.2.19 types::cmat qpp::gt::Y

#### 5.3.2.20 types::cmat qpp::gt::y0

#### 5.3.2.21 types::cmat qpp::gt::y1

#### 5.3.2.22 types::cmat qpp::gt::Z

#### 5.3.2.23 types::cmat qpp::gt::z0

#### 5.3.2.24 types::cmat qpp::gt::z1

## 5.4 qpp::internal Namespace Reference

### Functions

- void _n2multiidx (size_t n, size_t numdims, const size_t *dims, size_t *result)
- size_t _multiidx2n (const size_t *midx, size_t numdims, const size_t *dims)
- template<typename Scalar >
  bool _check_square_mat (const types::DynMat< Scalar > &A)
- template<typename Scalar >
  bool _check_vector (const types::DynMat< Scalar > &A)
- template<typename Scalar >
  bool _check_row_vector (const types::DynMat< Scalar > &A)
- template<typename Scalar >
  bool _check_col_vector (const types::DynMat< Scalar > &A)
- template<typename T >
  bool _check_nonzero_size (const T &x)
- bool _check_dims (const std::vector< size_t > &dims)
- template<typename Scalar >
  bool _check_dims_match_mat (const std::vector< size_t > &dims, const types::DynMat< Scalar > &A)
- bool _check_eq_dims (const std::vector< size_t > &dims, size_t dim)
- bool _check_subsys (const std::vector< size_t > &subsys, const std::vector< size_t > &dims)
- bool _check_perm (const std::vector< size_t > &perm, const std::vector< size_t > &dims)
- template<typename Scalar >
  void _syspermute_worker (const size_t *midxcol, size_t numdims, const size_t *cdims, const size_t *cperm, size_t i, size_t j, size_t &iperm, size_t &jperm, const types::DynMat< Scalar > &A, types::DynMat< Scalar > &result)
- template<typename Scalar >
  void _ptranspose_worker (const size_t *midxcol, size_t numdims, size_t numsubsys, const size_t *cdims, const size_t *csubsys, size_t i, size_t j, size_t &iperm, size_t &jperm, const types::DynMat< Scalar > &A, types::DynMat< Scalar > &result)

### 5.4.1 Function Documentation

#### 5.4.1.1 template<typename Scalar > bool qpp::internal::_check_col_vector ( const types::DynMat< Scalar > & *A* )

#### 5.4.1.2 bool qpp::internal::_check_dims ( const std::vector< size_t > & *dims* ) [inline]

#### 5.4.1.3 template<typename Scalar > bool qpp::internal::_check_dims_match_mat ( const std::vector< size_t > & *dims*, const types::DynMat< Scalar > & *A* )

#### 5.4.1.4 bool qpp::internal::_check_eq_dims ( const std::vector< size_t > & *dims*, size_t *dim* ) [inline]

#### 5.4.1.5 template<typename T > bool qpp::internal::_check_nonzero_size ( const T & *x* )

#### 5.4.1.6 bool qpp::internal::_check_perm ( const std::vector< size_t > & *perm*, const std::vector< size_t > & *dims* ) [inline]

#### 5.4.1.7 template<typename Scalar > bool qpp::internal::_check_row_vector ( const types::DynMat< Scalar > & *A* )

#### 5.4.1.8 template<typename Scalar > bool qpp::internal::_check_square_mat ( const types::DynMat< Scalar > & *A* )

#### 5.4.1.9 bool qpp::internal::_check_subsys ( const std::vector< size_t > & *subsys*, const std::vector< size_t > & *dims* ) [inline]

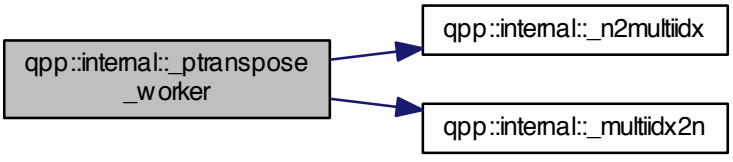
#### 5.4.1.10 template<typename Scalar > bool qpp::internal::_check_vector ( const types::DynMat< Scalar > & *A* )

#### 5.4.1.11 size_t qpp::internal::_multiidx2n ( const size_t * *midx*, size_t *numdims*, const size_t * *dims* ) [inline]

#### 5.4.1.12 void qpp::internal::_n2multiidx ( size_t *n*, size_t *numdims*, const size_t * *dims*, size_t * *result* ) [inline]

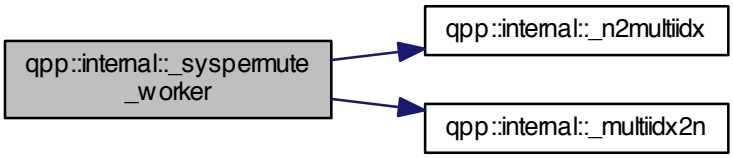
#### 5.4.1.13 template<typename Scalar > void qpp::internal::_ptranspose_worker ( const size_t * *midxcol*, size_t *numdims*, size_t *numsubsys*, const size_t * *cdims*, const size_t * *csubsys*, size_t *i*, size_t *j*, size_t & *iperm*, size_t & *jperm*, const types::DynMat< Scalar > & *A*, types::DynMat< Scalar > & *result* ) [inline]

Here is the call graph for this function:



#### 5.4.1.14 template<typename Scalar > void qpp::internal::_syspermute_worker ( const size_t * *midxcol*, size_t *numdims*, const size_t * *cdims*, const size_t * *cperm*, size_t *i*, size_t *j*, size_t & *iperm*, size_t & *jperm*, const types::DynMat< Scalar > & *A*, types::DynMat< Scalar > & *result* ) [inline]

Here is the call graph for this function:




## 5.5 qpp::stat Namespace Reference

### Classes

- class NormalDistribution
- class UniformRealDistribution
- class DiscreteDistribution
- class DiscreteDistributionFromComplex

### Variables

- std::random_device _rd
- std::mt19937 _rng

### 5.5.1 Variable Documentation

#### 5.5.1.1 std::random_device qpp::stat::_rd

#### 5.5.1.2 std::mt19937 qpp::stat::_rng

## 5.6 qpp::types Namespace Reference

### Typedefs

- typedef std::complex< double > cplx
- typedef Eigen::MatrixXcd cmat
- typedef Eigen::MatrixXd dmat
- typedef Eigen::MatrixXf fmat
- typedef Eigen::MatrixXi imat
- template<typename Expression >
  using Expression2DynMat = Eigen::Matrix< typename Expression::Scalar, Eigen::Dynamic, Eigen::Dynamic >
- template<typename Scalar >
  using DynMat = Eigen::Matrix< Scalar, Eigen::Dynamic, Eigen::Dynamic >

### 5.6.1 Typedef Documentation

#### 5.6.1.1 typedef Eigen::MatrixXcd qpp::types::cmat

#### 5.6.1.2 typedef std::complex<double> qpp::types::cplx

#### 5.6.1.3 typedef Eigen::MatrixXd qpp::types::dmat

#### 5.6.1.4 template<typename Scalar > using qpp::types::DynMat = typedef Eigen::Matrix<Scalar, Eigen::Dynamic, Eigen::Dynamic>

#### 5.6.1.5 template<typename Expression > using qpp::types::Expression2DynMat = typedef Eigen::Matrix<typename Expression::Scalar, Eigen::Dynamic, Eigen::Dynamic>

#### 5.6.1.6 typedef Eigen::MatrixXf qpp::types::fmat

#### 5.6.1.7 typedef Eigen::MatrixXi qpp::types::imat

# Chapter 6

# Class Documentation

## 6.1 qpp::stat::DiscreteDistribution Class Reference

`#include <stat.h>`

### Public Member Functions

- template<typename InputIterator >
  DiscreteDistribution (InputIterator first, InputIterator last)
- DiscreteDistribution (std::initializer_list< double > weights)
- DiscreteDistribution (std::vector< double > weights)
- size_t sample ()
- std::vector< double > probabilities ()

### Protected Attributes

- std::discrete_distribution
  < size_t > _d

### 6.1.1 Constructor & Destructor Documentation

#### 6.1.1.1 template<typename InputIterator > qpp::stat::DiscreteDistribution::DiscreteDistribution ( InputIterator *first,* InputIterator *last* ) [inline]

#### 6.1.1.2 qpp::stat::DiscreteDistribution::DiscreteDistribution ( std::initializer_list< double > *weights* ) [inline]

#### 6.1.1.3 qpp::stat::DiscreteDistribution::DiscreteDistribution ( std::vector< double > *weights* ) [inline]

### 6.1.2 Member Function Documentation

#### 6.1.2.1 std::vector<double> qpp::stat::DiscreteDistribution::probabilities ( ) [inline]

#### 6.1.2.2 size_t qpp::stat::DiscreteDistribution::sample ( ) [inline]

### 6.1.3 Member Data Documentation

#### 6.1.3.1 std::discrete_distribution<size_t> qpp::stat::DiscreteDistribution::_d [protected]

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

- include/stat.h

## 6.2 qpp::stat::DiscreteDistributionFromComplex Class Reference

`#include <stat.h>`

### Public Member Functions

- template<typename InputIterator >
  DiscreteDistributionFromComplex (InputIterator first, InputIterator last)
- DiscreteDistributionFromComplex (std::initializer_list< types::cplx > amplitudes)
- DiscreteDistributionFromComplex (std::vector< types::cplx > amplitudes)
- DiscreteDistributionFromComplex (const types::cmat &V)
- size_t sample ()
- std::vector< double > probabilities ()

### Protected Member Functions

- template<typename InputIterator >
  std::vector< double > cplx2amplitudes (InputIterator first, InputIterator last)

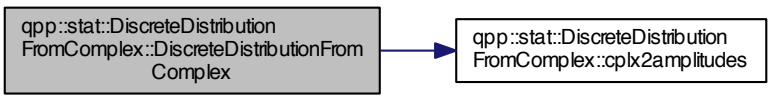
### Protected Attributes

- std::discrete_distribution
  < size_t > _d

### 6.2.1 Constructor & Destructor Documentation

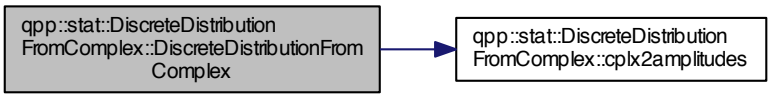
#### 6.2.1.1 template<typename InputIterator > qpp::stat::DiscreteDistributionFromComplex::DiscreteDistributionFromComplex ( InputIterator *first,* InputIterator *last* ) [inline]

Here is the call graph for this function:



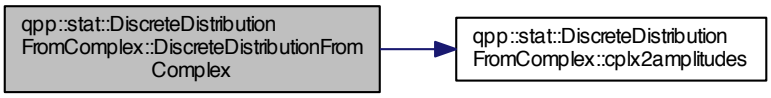
#### 6.2.1.2 qpp::stat::DiscreteDistributionFromComplex::DiscreteDistributionFromComplex ( std::initializer_list< types::cplx > *amplitudes* ) [inline]

Here is the call graph for this function:



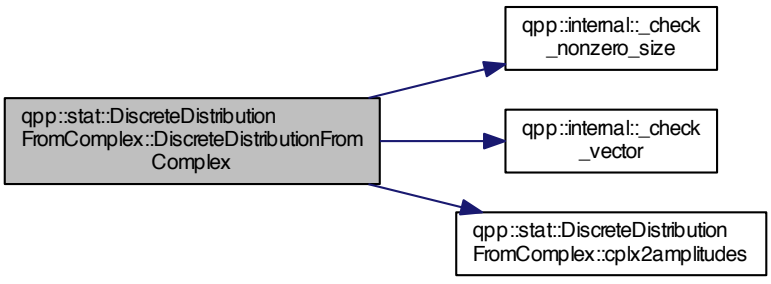

#### 6.2.1.3 qpp::stat::DiscreteDistributionFromComplex::DiscreteDistributionFromComplex ( std::vector< types::cplx > *amplitudes* ) [inline]

Here is the call graph for this function:




#### 6.2.1.4 qpp::stat::DiscreteDistributionFromComplex::DiscreteDistributionFromComplex ( const types::cmat & *V* ) [inline]

Here is the call graph for this function:




### 6.2.2 Member Function Documentation

#### 6.2.2.1 template<typename InputIterator > std::vector<double> qpp::stat::DiscreteDistribution-FromComplex::cplx2amplitudes ( InputIterator *first*, InputIterator *last* ) [inline], [protected]

#### 6.2.2.2 std::vector<double> qpp::stat::DiscreteDistributionFromComplex::probabilities ( ) [inline]

#### 6.2.2.3 size_t qpp::stat::DiscreteDistributionFromComplex::sample ( ) [inline]

### 6.2.3 Member Data Documentation

#### 6.2.3.1 std::discrete_distribution<size_t> qpp::stat::DiscreteDistributionFromComplex::_d [protected]

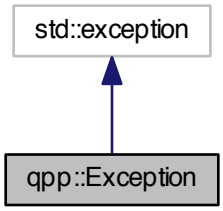
The documentation for this class was generated from the following file:

- include/stat.h

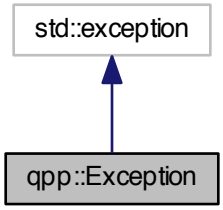
## 6.3 qpp::Exception Class Reference

`#include <exception.h>`

Inheritance diagram for qpp::Exception:




Collaboration diagram for qpp::Exception:



### Public Types

- enum Type {
  Type::UNKNOWN_EXCEPTION = 0, Type::ZERO_SIZE, Type::MATRIX_NOT_SQUARE, Type::MATRIX_NOT_CVECTOR,
  Type::MATRIX_NOT_RVECTOR, Type::MATRIX_NOT_VECTOR, Type::DIMS_INVALID, Type::DIMS_NOT_EQUAL,
  Type::DIMS_MISMATCH_MATRIX, Type::SUBSYS_MISMATCH_DIMS, Type::PERM_MISMATCH_DIMS, Type::NOT_QUBIT_GATE,
  Type::NOT_QUBIT_SUBSYS, Type::OUT_OF_RANGE, Type::UNDEFINED_TYPE, Type::CUSTOM_EXCEPTION }

### Public Member Functions

- Exception (const std::string &where, const Type &type)
- Exception (const std::string &where, const std::string &custom)
- virtual const char * what () const noexceptoverride
- virtual ~Exception () noexcept

### Private Member Functions

- std::string _construct_exception_msg ()

### Private Attributes

- std::string _where
- std::string _msg
- Type _type
- std::string _custom

## 6.3.1 Member Enumeration Documentation

### 6.3.1.1 enum qpp::Exception::Type [strong]

**Enumerator**

***UNKNOWN_EXCEPTION***

***ZERO_SIZE***

***MATRIX_NOT_SQUARE***

***MATRIX_NOT_CVECTOR***

***MATRIX_NOT_RVECTOR***

***MATRIX_NOT_VECTOR***

***DIMS_INVALID***

***DIMS_NOT_EQUAL***

***DIMS_MISMATCH_MATRIX***

***SUBSYS_MISMATCH_DIMS***

***PERM_MISMATCH_DIMS***

***NOT_QUBIT_GATE***

***NOT_QUBIT_SUBSYS***

***OUT_OF_RANGE***

***UNDEFINED_TYPE***

***CUSTOM_EXCEPTION***

### 6.3.2 Constructor & Destructor Documentation

#### 6.3.2.1 qpp::Exception::Exception ( const std::string & *where*, const Type & *type* ) [inline]

Here is the call graph for this function:


#### 6.3.2.2 qpp::Exception::Exception ( const std::string & *where*, const std::string & *custom* ) [inline]

Here is the call graph for this function:


#### 6.3.2.3 virtual qpp::Exception::~Exception ( ) [inline], [virtual], [noexcept]

### 6.3.3 Member Function Documentation

#### 6.3.3.1 std::string qpp::Exception::_construct_exception_msg ( ) [inline], [private]

#### 6.3.3.2 virtual const char* qpp::Exception::what ( ) const [inline], [override], [virtual], [noexcept]

### 6.3.4 Member Data Documentation

#### 6.3.4.1 std::string qpp::Exception::_custom [private]

#### 6.3.4.2 std::string qpp::Exception::_msg [private]

#### 6.3.4.3 Type qpp::Exception::_type [private]

#### 6.3.4.4 std::string qpp::Exception::_where [private]

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

- include/exception.h

## 6.4 qpp::stat::NormalDistribution Class Reference

`#include <stat.h>`

### Public Member Functions

- NormalDistribution (double mean=0, double sigma=1)
- double sample ()

### Protected Attributes

- std::normal_distribution _d

### 6.4.1 Constructor & Destructor Documentation

#### 6.4.1.1 qpp::stat::NormalDistribution::NormalDistribution ( double *mean* = 0, double *sigma* = 1 ) [inline]

### 6.4.2 Member Function Documentation

#### 6.4.2.1 double qpp::stat::NormalDistribution::sample ( ) [inline]

### 6.4.3 Member Data Documentation

#### 6.4.3.1 std::normal_distribution qpp::stat::NormalDistribution::_d [protected]

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

- include/stat.h

## 6.5 qpp::Timer Class Reference

`#include <timer.h>`

### Public Member Functions

- Timer ()
- void tic ()
- void toc ()
- double seconds () const
- virtual ~Timer ()=default

### Protected Attributes

- std::chrono::high_resolution_clock::time_point _start
- std::chrono::high_resolution_clock::time_point _end

### Friends

- std::ostream & operator<< (std::ostream &os, const Timer &rhs)

### 6.5.1 Constructor & Destructor Documentation

#### 6.5.1.1 qpp::Timer::Timer ( ) [inline]

#### 6.5.1.2 virtual qpp::Timer::~Timer ( ) [virtual], [default]

### 6.5.2 Member Function Documentation

#### 6.5.2.1 double qpp::Timer::seconds ( ) const [inline]

#### 6.5.2.2 void qpp::Timer::tic ( ) [inline]

#### 6.5.2.3 void qpp::Timer::toc ( ) [inline]

### 6.5.3 Friends And Related Function Documentation

#### 6.5.3.1 std::ostream& operator<< ( std::ostream & *os*, const Timer & *rhs* ) [friend]

### 6.5.4 Member Data Documentation

#### 6.5.4.1 std::chrono::high_resolution_clock::time_point qpp::Timer::_end [protected]

#### 6.5.4.2 std::chrono::high_resolution_clock::time_point qpp::Timer::_start [protected]

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

- include/timer.h

## 6.6 qpp::stat::UniformRealDistribution Class Reference

`#include <stat.h>`

### Public Member Functions

- UniformRealDistribution (double a=0, double b=1)
- double sample ()

### Protected Attributes

- std::uniform_real_distribution _d

### 6.6.1 Constructor & Destructor Documentation

#### 6.6.1.1 qpp::stat::UniformRealDistribution::UniformRealDistribution ( double *a* = 0, double *b* = 1 ) [inline]

### 6.6.2 Member Function Documentation

#### 6.6.2.1 double qpp::stat::UniformRealDistribution::sample ( ) [inline]

### 6.6.3 Member Data Documentation

#### 6.6.3.1 std::uniform_real_distribution qpp::stat::UniformRealDistribution::_d [protected]

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

- include/stat.h

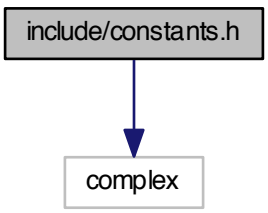
# Chapter 7

# File Documentation

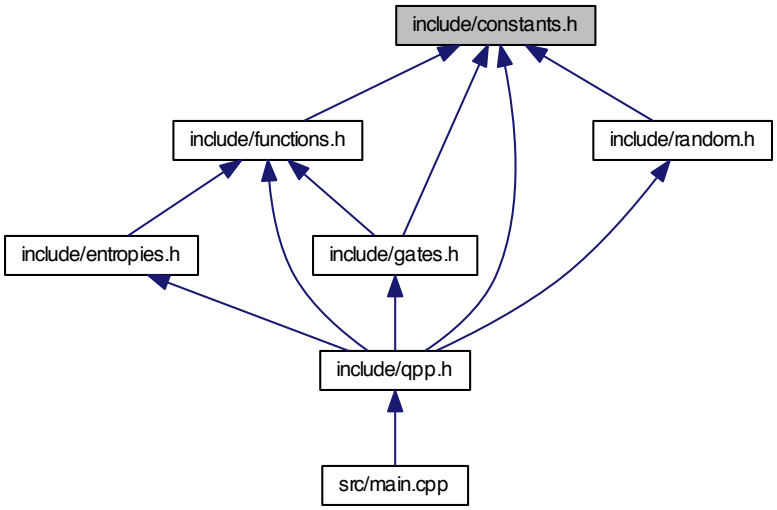
## 7.1 include/constants.h File Reference

```
#include <complex>
```

Include dependency graph for constants.h:



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




### Namespaces

- qpp
- qpp::ct

### Functions

- std::complex< double > qpp::ct::omega (size_t D)

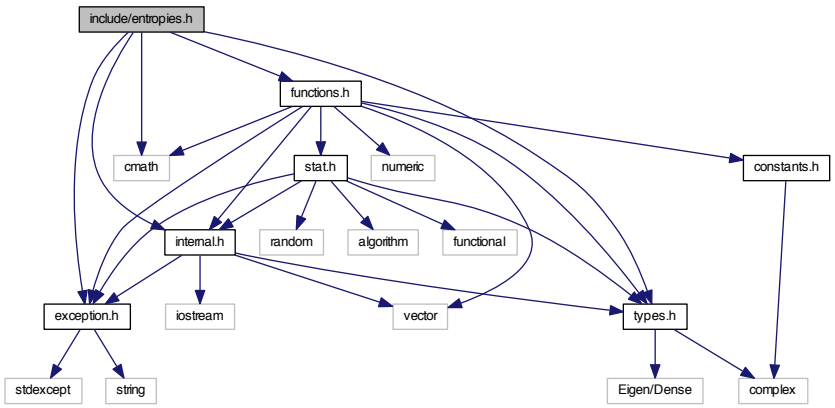
### Variables

- const double qpp::ct::chop = 1e-10
- const std::complex< double > qpp::ct::ii = { 0, 1 }
- const double qpp::ct::pi = 3.14159265358979323846264338327950288 4
- const double qpp::ct::ee = 2.71828182845904523536028747135266249 7

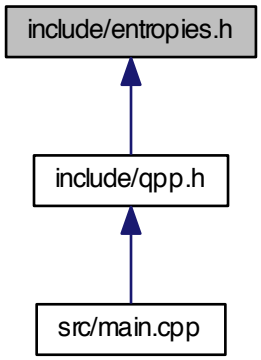
## 7.2 include/entropies.h File Reference

```
#include <cmath>
#include "types.h"
#include "functions.h"
#include "internal.h"
#include "exception.h"
```

Include dependency graph for entropies.h:




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




## Namespaces

- qpp

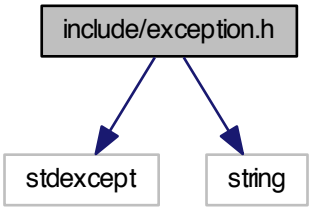
## Functions

- template<typename Scalar >
  double qpp::shannon (const types::DynMat< Scalar > &A)
- template<typename Scalar >
  double qpp::renyi (const double alpha, const types::DynMat< Scalar > &A)
- template<typename Scalar >
  double qpp::renyi_inf (const types::DynMat< Scalar > &A)

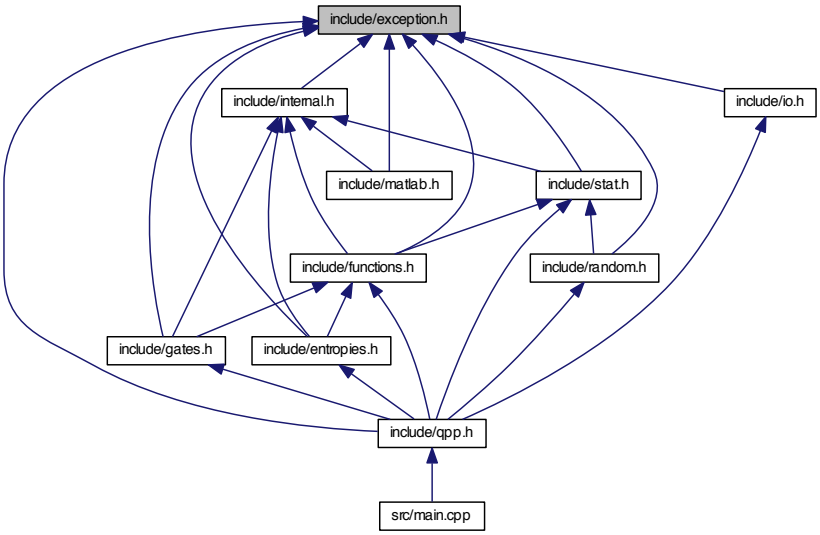
## 7.3 include/exception.h File Reference

```
#include <stdexcept>
#include <string>
```

Include dependency graph for exception.h:




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




### Classes

- class qpp::Exception

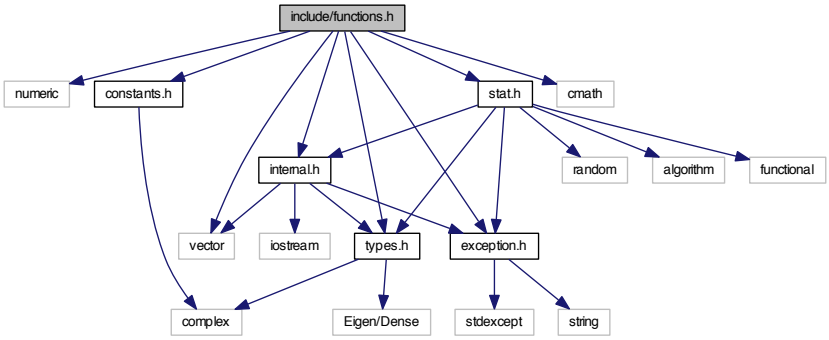
### Namespaces

- qpp

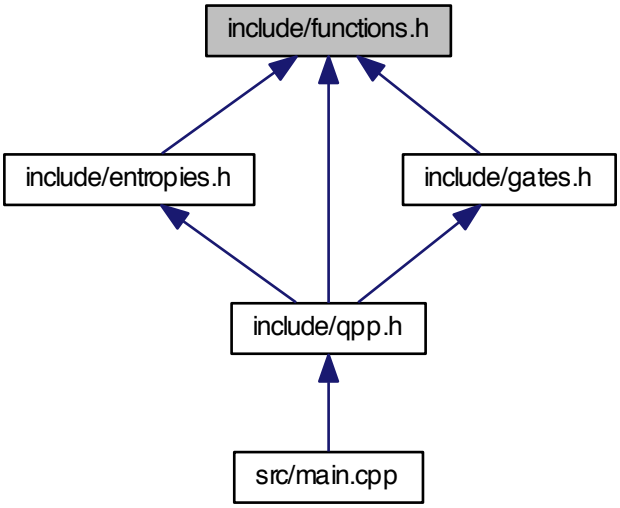
## 7.4 include/functions.h File Reference

```
#include <numeric>
#include <vector>
#include <cmath>
#include "types.h"
#include "internal.h"
#include "exception.h"
#include "constants.h"
#include "stat.h"
```

Include dependency graph for functions.h:




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




### Namespaces

- qpp

## Functions

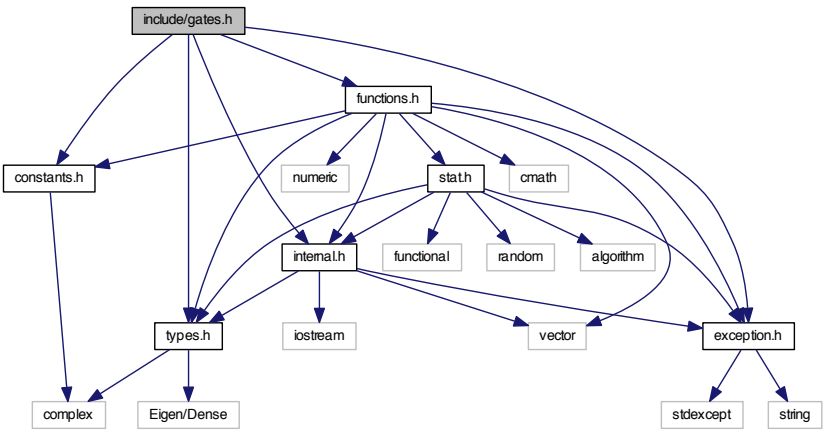
- template<typename Scalar >
  types::DynMat< Scalar > qpp::transpose (const types::DynMat< Scalar > &A)
- template<typename Scalar >
  types::DynMat< Scalar > qpp::conjugate (const types::DynMat< Scalar > &A)
- template<typename Scalar >
  types::DynMat< Scalar > qpp::adjoint (const types::DynMat< Scalar > &A)
- template<typename Scalar >
  Scalar qpp::trace (const types::DynMat< Scalar > &A)
- template<typename Scalar >
  Scalar qpp::det (const types::DynMat< Scalar > &A)
- template<typename Scalar >
  Scalar qpp::sum (const types::DynMat< Scalar > &A)
- template<typename Scalar >
  double qpp::norm (const types::DynMat< Scalar > &A)
- template<typename Scalar >
  types::cmat qpp::evals (const types::DynMat< Scalar > &A)
- template<typename Scalar >
  types::cmat qpp::evects (const types::DynMat< Scalar > &A)
- template<typename Scalar >
  types::cmat qpp::hevals (const types::DynMat< Scalar > &A)
- template<typename Scalar >
  types::cmat qpp::hevects (const types::DynMat< Scalar > &A)
- template<typename Scalar >
  types::cmat qpp::funm (const types::DynMat< Scalar > &A, types::cplx(*f)(const types::cplx &))
- template<typename Scalar >
  types::cmat qpp::absm (const types::DynMat< Scalar > &A)
- template<typename Scalar >
  types::cmat qpp::expm (const types::DynMat< Scalar > &A)
- template<typename Scalar >
  types::cmat qpp::logm (const types::DynMat< Scalar > &A)
- template<typename Scalar >
  types::cmat qpp::sqrtm (const types::DynMat< Scalar > &A)
- template<typename Scalar >
  types::cmat qpp::sinm (const types::DynMat< Scalar > &A)
- template<typename Scalar >
  types::cmat qpp::cosm (const types::DynMat< Scalar > &A)
- template<typename Scalar >
  types::cmat qpp::spectralpowm (const types::DynMat< Scalar > &A, const types::cplx z)
- template<typename Scalar >
  types::DynMat< Scalar > qpp::powm (const types::DynMat< Scalar > &A, size_t n)
- template<typename InputScalar , typename OutputScalar >
  types::DynMat< OutputScalar > qpp::fun (const types::DynMat< InputScalar > &A, OutputScalar(*f)(const InputScalar &))
- template<typename Scalar >
  types::DynMat< Scalar > qpp::kron (const types::DynMat< Scalar > &A, const types::DynMat< Scalar > &B)
- template<typename Scalar >
  types::DynMat< Scalar > qpp::kronlist (const std::vector< types::DynMat< Scalar >> &list)
- template<typename Scalar >
  types::DynMat< Scalar > qpp::kronpow (const types::DynMat< Scalar > &A, size_t n)
- template<typename Scalar >
  types::DynMat< Scalar > qpp::reshape (const types::DynMat< Scalar > &A, size_t rows, size_t cols)
- template<typename Scalar >
  types::DynMat< Scalar > qpp::syspermute (const types::DynMat< Scalar > &A, const std::vector< size_t > perm, const std::vector< size_t > &dims)

- template<typename Scalar >
  types::DynMat< Scalar > qpp::ptrace2 (const types::DynMat< Scalar > &A, const std::vector< size_t > dims)
- template<typename Scalar >
  types::DynMat< Scalar > qpp::ptrace (const types::DynMat< Scalar > &A, const std::vector< size_t > &subsys, const std::vector< size_t > &dims)
- template<typename Scalar >
  types::DynMat< Scalar > qpp::ptranspose (const types::DynMat< Scalar > &A, const std::vector< size_t > &subsys, const std::vector< size_t > &dims)
- template<typename Scalar >
  types::DynMat< Scalar > qpp::comm (const types::DynMat< Scalar > &A, const types::DynMat< Scalar > &B)
- template<typename Scalar >
  types::DynMat< Scalar > qpp::anticomm (const types::DynMat< Scalar > &A, const types::DynMat< Scalar > &B)
- template<typename Scalar >
  types::DynMat< Scalar > qpp::proj (const types::DynMat< Scalar > &V)
- template<typename Scalar >
  types::DynMat< Scalar > qpp::dya (const types::DynMat< Scalar > &V)
- template<typename Scalar >
  types::DynMat< Scalar > qpp::expandout (const types::DynMat< Scalar > &A, size_t pos, const std::vector< size_t > &dims)
- template<typename Scalar >
  types::DynMat< Scalar > qpp::grams (const std::vector< types::DynMat< Scalar >> &vecs)
- template<typename Scalar >
  types::DynMat< Scalar > qpp::grams (const types::DynMat< Scalar > &A)

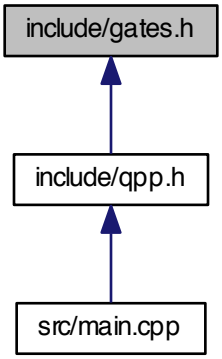
## 7.5 include/gates.h File Reference

```
#include "types.h"
#include "constants.h"
#include "functions.h"
#include "internal.h"
#include "exception.h"
```

Include dependency graph for gates.h:



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




## Namespaces

- qpp
- qpp::gt

## Functions

- void qpp::gt::_init_gates ()
- types::cmat qpp::gt::Rtheta (double theta)
- types::cmat qpp::gt::Id (size_t D)
- types::cmat qpp::gt::Zd (size_t D)
- types::cmat qpp::gt::Fd (size_t D)
- types::cmat qpp::gt::Xd (size_t D)
- types::cmat qpp::gt::CTRL (const types::cmat &A, const std::vector< size_t > &ctrl, const std::vector< size_t > &gate, size_t n, size_t D=2)

## Variables

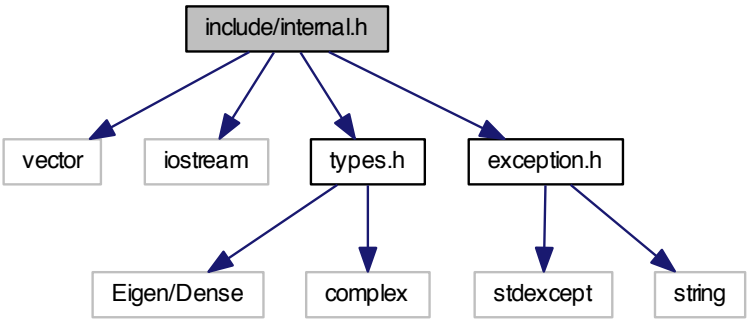
- types::cmat qpp::gt::Id2
- types::cmat qpp::gt::H
- types::cmat qpp::gt::X
- types::cmat qpp::gt::Y
- types::cmat qpp::gt::Z
- types::cmat qpp::gt::S
- types::cmat qpp::gt::T
- types::cmat qpp::gt::CNOTab
- types::cmat qpp::gt::CNOTba
- types::cmat qpp::gt::CZ
- types::cmat qpp::gt::CS
- types::cmat qpp::gt::SWAP
- types::cmat qpp::gt::TOF
- types::cmat qpp::gt::FRED
- types::cmat qpp::gt::x0

- types::cmat qpp::gt::x1
- types::cmat qpp::gt::y0
- types::cmat qpp::gt::y1
- types::cmat qpp::gt::z0
- types::cmat qpp::gt::z1
- types::cmat qpp::gt::b00
- types::cmat qpp::gt::b01
- types::cmat qpp::gt::b10
- types::cmat qpp::gt::b11

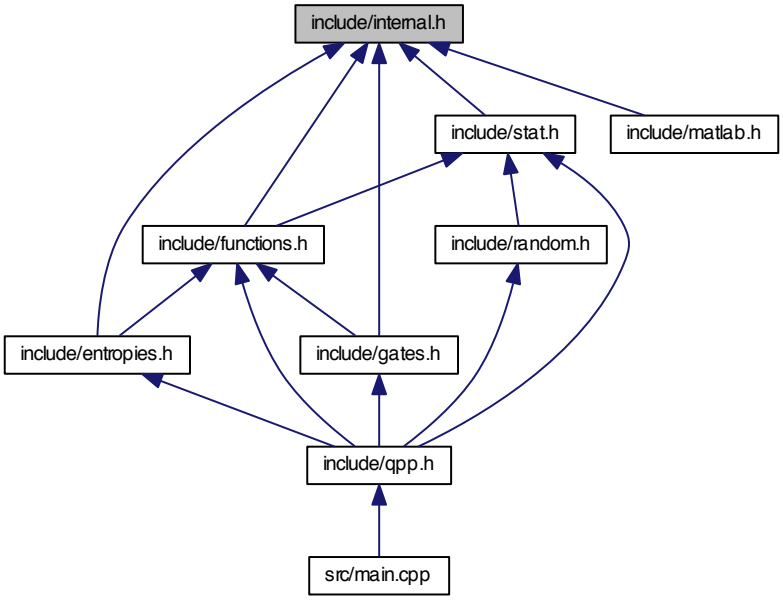
## 7.6 include/internal.h File Reference

```
#include <vector>
#include <iostream>
#include "types.h"
#include "exception.h"
```

Include dependency graph for internal.h:



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




## Namespaces

- qpp
- qpp::internal

## Functions

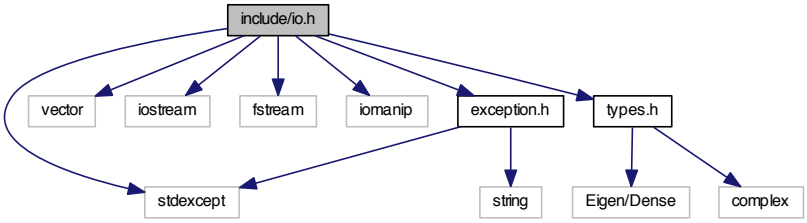
- void qpp::internal::_n2multiidx (size_t n, size_t numdims, const size_t *dims, size_t *result)
- size_t qpp::internal::_multiidx2n (const size_t *midx, size_t numdims, const size_t *dims)
- template<typename Scalar >
  bool qpp::internal::_check_square_mat (const types::DynMat< Scalar > &A)
- template<typename Scalar >
  bool qpp::internal::_check_vector (const types::DynMat< Scalar > &A)
- template<typename Scalar >
  bool qpp::internal::_check_row_vector (const types::DynMat< Scalar > &A)
- template<typename Scalar >
  bool qpp::internal::_check_col_vector (const types::DynMat< Scalar > &A)
- template<typename T >
  bool qpp::internal::_check_nonzero_size (const T &x)
- bool qpp::internal::_check_dims (const std::vector< size_t > &dims)
- template<typename Scalar >
  bool qpp::internal::_check_dims_match_mat (const std::vector< size_t > &dims, const types::DynMat< Scalar > &A)
- bool qpp::internal::_check_eq_dims (const std::vector< size_t > &dims, size_t dim)
- bool qpp::internal::_check_subsys (const std::vector< size_t > &subsys, const std::vector< size_t > &dims)
- bool qpp::internal::_check_perm (const std::vector< size_t > &perm, const std::vector< size_t > &dims)

- template<typename Scalar >
  void qpp::internal::_syspermute_worker (const size_t *midxcol, size_t numdims, const size_t *cdims, const size_t *cperm, size_t i, size_t j, size_t &iperm, size_t &jperm, const types::DynMat< Scalar > &A, types::DynMat< Scalar > &result)
- template<typename Scalar >
  void qpp::internal::_ptranspose_worker (const size_t *midxcol, size_t numdims, size_t numsubsys, const size_t *cdims, const size_t *csubsys, size_t i, size_t j, size_t &iperm, size_t &jperm, const types::DynMat< Scalar > &A, types::DynMat< Scalar > &result)

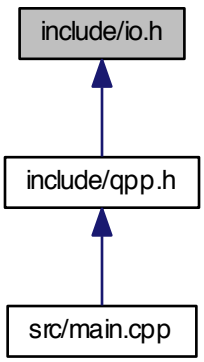
## 7.7 include/io.h File Reference

```
#include <stdexcept>
#include <vector>
#include <iostream>
#include <fstream>
#include <iomanip>
#include "types.h"
#include "exception.h"
```

Include dependency graph for io.h:




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



### Namespaces

- qpp

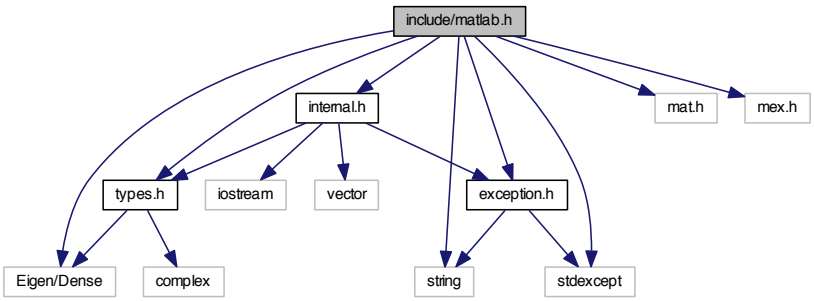
### Functions

- template<typename T >
  void qpp::disp (const T &x, const std::string &separator=" ", const std::string &start="[", const std::string &end="]", std::ostream &os=std::cout)
- template<typename T >
  void qpp::displn (const T &x, const std::string &separator=" ", const std::string &start="[", const std::string &end="]", std::ostream &os=std::cout)
- template<typename T >
  void qpp::disp (const T *x, const size_t n, const std::string &separator=" ", const std::string &start="[", const std::string &end="]", std::ostream &os=std::cout)
- template<typename T >
  void qpp::displn (const T *x, const size_t n, const std::string &separator=" ", const std::string &start="[", const std::string &end="]", std::ostream &os=std::cout)
- template<typename Scalar >
  void qpp::disp (const types::DynMat< Scalar > &A, double chop=ct::chop, std::ostream &os=std::cout)
- template<typename Scalar >
  void qpp::displn (const types::DynMat< Scalar > &A, double chop=ct::chop, std::ostream &os=std::cout)
- void qpp::disp (const types::cplx c, double chop=ct::chop, std::ostream &os=std::cout)
- void qpp::displn (const types::cplx c, double chop=ct::chop, std::ostream &os=std::cout)
- template<typename Scalar >
  void qpp::save (const types::DynMat< Scalar > &A, const std::string &fname)
- template<typename Scalar >
  types::DynMat< Scalar > qpp::load (const std::string &fname)

## 7.8 include/matlab.h File Reference

```
#include <Eigen/Dense>
#include <string>
#include <stdexcept>
#include "types.h"
#include "internal.h"
#include "exception.h"
#include "mat.h"
#include "mex.h"
```

Include dependency graph for matlab.h:



### Namespaces

- qpp

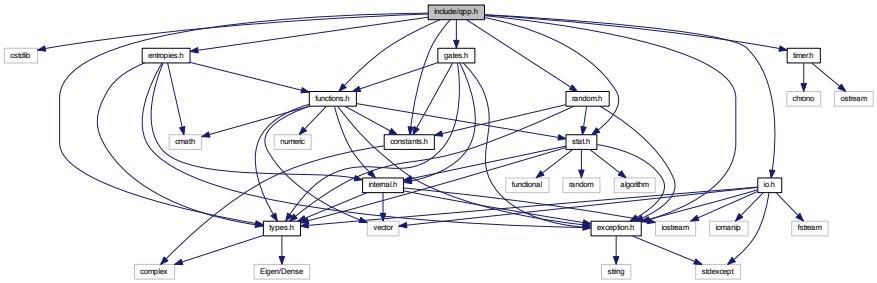
### Functions

- template<typename Scalar >
  types::DynMat< Scalar > qpp::loadMATLABmatrix (const std::string &mat_file, const std::string &var_name)
- template<>
  types::DynMat< double > qpp::loadMATLABmatrix (const std::string &mat_file, const std::string &var_name)
- template<>
  types::DynMat< types::cplx > qpp::loadMATLABmatrix (const std::string &mat_file, const std::string &var_name)
- template<typename Scalar >
  void qpp::saveMATLABmatrix (const types::DynMat< Scalar > &A, const std::string &mat_file, const std::string &var_name, const std::string &mode)
- template<>
  void qpp::saveMATLABmatrix (const types::DynMat< double > &A, const std::string &mat_file, const std::string &var_name, const std::string &mode)
- template<>
  void qpp::saveMATLABmatrix (const types::DynMat< types::cplx > &A, const std::string &mat_file, const std::string &var_name, const std::string &mode)

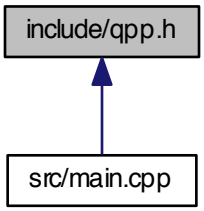
## 7.9 include/qpp.h File Reference

```
#include <cstdlib>
#include "types.h"
#include "constants.h"
#include "gates.h"
#include "stat.h"
#include "functions.h"
#include "random.h"
#include "entropies.h"
#include "io.h"
#include "timer.h"
#include "exception.h"
```

Include dependency graph for qpp.h:



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




### Namespaces

- qpp
- qpp::gt

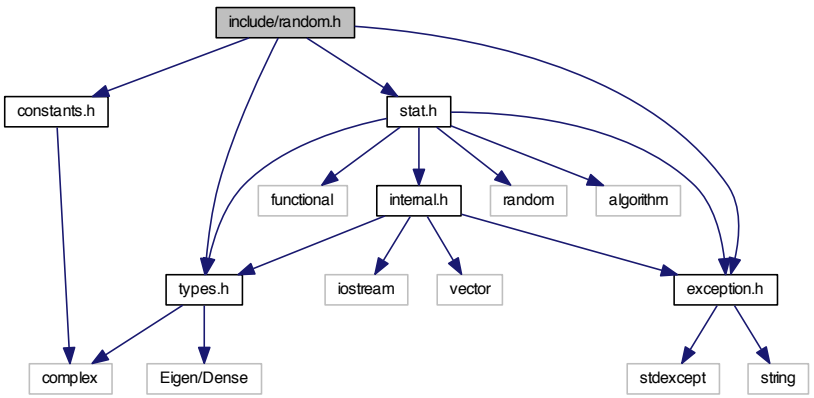
### Functions

- int qpp::_init ()

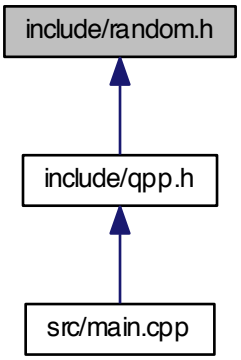
## 7.10 include/random.h File Reference

```
#include "types.h"
#include "stat.h"
#include "constants.h"
#include "exception.h"
```

Include dependency graph for random.h:



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




### Namespaces

- qpp

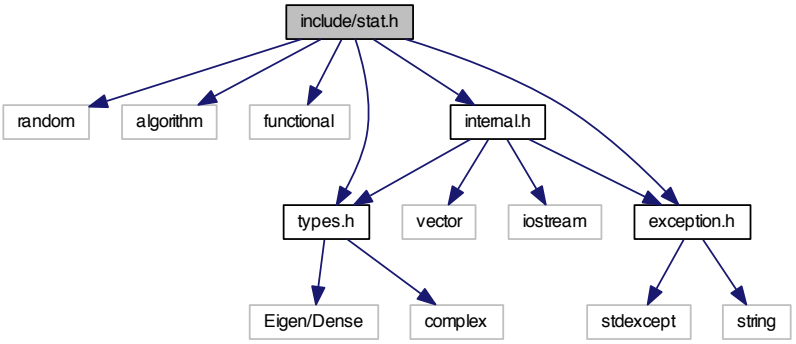
### Functions

- template<typename Scalar >
  types::DynMat< Scalar > qpp::rand (size_t rows, size_t cols, double a=0, double b=1)
- template<>
  types::DynMat< double > qpp::rand (size_t rows, size_t cols, double a, double b)
- template<>
  types::DynMat< types::cplx > qpp::rand (size_t rows, size_t cols, double a, double b)
- double qpp::rand (double a=0, double b=1)
- template<typename Scalar >
  types::DynMat< Scalar > qpp::randn (size_t rows, size_t cols, double mean=0, double sigma=1)
- template<>
  types::DynMat< double > qpp::randn (size_t rows, size_t cols, double mean, double sigma)
- template<>
  types::DynMat< types::cplx > qpp::randn (size_t rows, size_t cols, double mean, double sigma)
- double qpp::randn (double mean=0, double sigma=1)
- types::cmat qpp::randU (size_t D)
- types::cmat qpp::randV (size_t Din, size_t Dout)
- types::cmat qpp::randH (size_t D)
- types::cmat qpp::randket (size_t D)
- types::cmat qpp::randrho (size_t D)

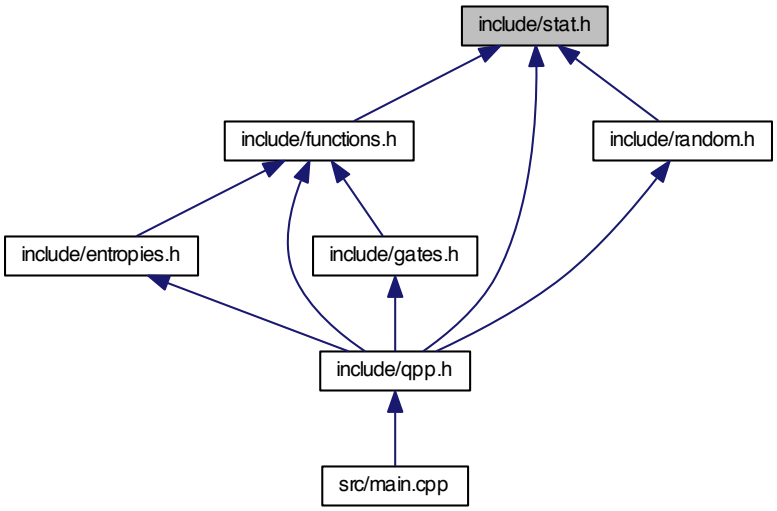
## 7.11 include/stat.h File Reference

```
#include <random>
#include <algorithm>
#include <functional>
#include "types.h"
#include "internal.h"
#include "exception.h"
```

Include dependency graph for stat.h:




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




## Classes

- class qpp::stat::NormalDistribution
- class qpp::stat::UniformRealDistribution
- class qpp::stat::DiscreteDistribution
- class qpp::stat::DiscreteDistributionFromComplex

## Namespaces

- qpp
- qpp::stat

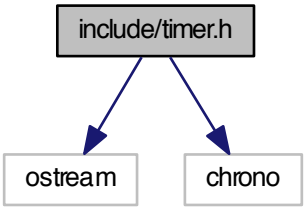
### Variables

- std::random_device qpp::stat::_rd
- std::mt19937 qpp::stat::_rng

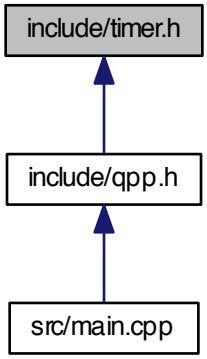
## 7.12 include/timer.h File Reference

```
#include <ostream>
#include <chrono>
```

Include dependency graph for timer.h:




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




### Classes

- class qpp::Timer

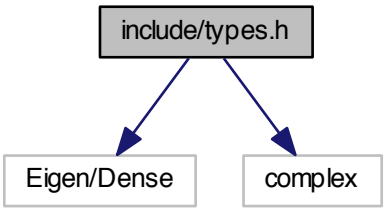
### Namespaces

- qpp

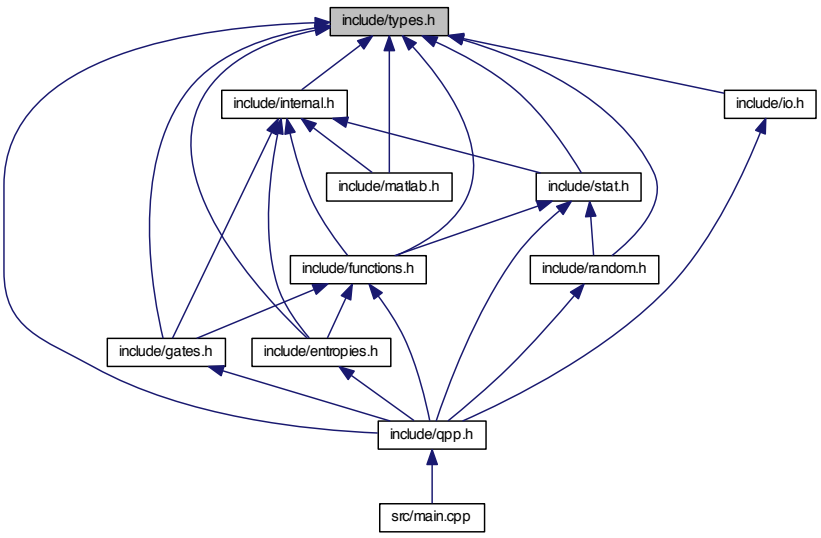
## 7.13 include/types.h File Reference

```
#include <Eigen/Dense>
#include <complex>
```

Include dependency graph for types.h:




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




### Namespaces

- qpp
- qpp::types

### Typedefs

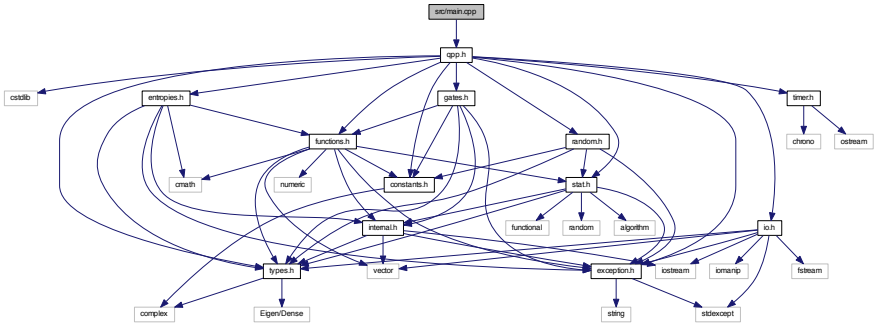
- typedef std::complex< double > qpp::types::cplx
- typedef Eigen::MatrixXcd qpp::types::cmat
- typedef Eigen::MatrixXd qpp::types::dmat

- typedef Eigen::MatrixXf qpp::types::fmat
- typedef Eigen::MatrixXi qpp::types::imat
- template<typename Expression >
  using qpp::types::Expression2DynMat = Eigen::Matrix< typename Expression::Scalar, Eigen::Dynamic, Eigen::Dynamic >
- template<typename Scalar >
  using qpp::types::DynMat = Eigen::Matrix< Scalar, Eigen::Dynamic, Eigen::Dynamic >

## 7.14 src/main.cpp File Reference

```
#include "qpp.h"
```

Include dependency graph for main.cpp:




### Functions

- int main ()

### 7.14.1 Function Documentation

#### 7.14.1.1 int main ( )

Here is the call graph for this function: