

qpp
0.1

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Mon Apr 7 2014 23:37:14

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Chapter 1

Namespace Index

1.1 Namespace List

Here is a list of all namespaces with brief descriptions:

qpp	9
qpp::ct	35
qpp::internal	35
qpp::stat	37
qpp::types	37

Chapter 2

Hierarchical Index

2.1 Class Hierarchy

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

qpp::stat::DiscreteDistribution	39
qpp::stat::DiscreteDistributionFromComplex	40
exception	
qpp::Exception	42
qpp::Gates	45
qpp::stat::NormalDistribution	49
qpp::RandomDevices	50
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Chapter 3

Class Index

3.1 Class List

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

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qpp::stat::DiscreteDistributionFromComplex	40
qpp::Exception	42
qpp::Gates	45
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Chapter 4

File Index

4.1 File List

Here is a list of all files with brief descriptions:

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include/constants.h	56
include/entropies.h	57
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include/functions.h	60
include/gates.h	62
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include/randevs.h	68
include/random.h	70
include/stat.h	71
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Chapter 5

Namespace Documentation

5.1 qpp Namespace Reference

Namespaces

- [ct](#)
- [internal](#)
- [stat](#)
- [types](#)

Classes

- class [Exception](#)
- class [Gates](#)
- class [RandomDevices](#)
- class [Timer](#)

Functions

- [types::cmat channel](#) (const [types::cmat](#) &rho, const std::vector< [types::cmat](#) > &Ks)
- [types::cmat super](#) (const std::vector< [types::cmat](#) > &Ks)
- [types::cmat choi](#) (const std::vector< [types::cmat](#) > &Ks)
- std::vector< [types::cmat](#) > [choi2kraus](#) (const [types::cmat](#) &A)
- 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 evecs (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 > 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)`
- `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)`
- `std::vector< types::cmat > randKraus (size_t n, size_t D)`
- `types::cmat randH (size_t D)`
- `types::cmat randket (size_t D)`
- `types::cmat randrho (size_t D)`

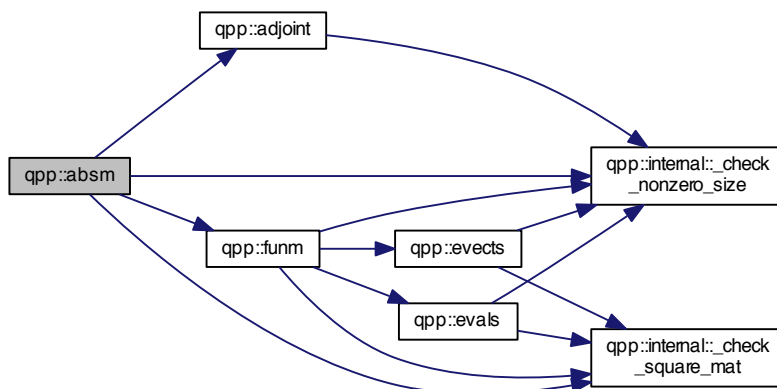
Variables

- `RandomDevices * rdevs = RandomDevices::getInstance()`
- `const Gates * gt = Gates::getInstance()`

5.1.1 Function Documentation

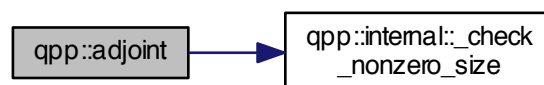
5.1.1.1 `template<typename Scalar > types::cmat qpp::absm (const types::DynMat< Scalar > & A)`

Here is the call graph for this function:



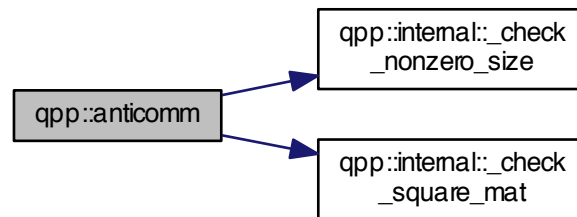
5.1.1.2 `template<typename Scalar > types::DynMat<Scalar> qpp::adjoint (const types::DynMat< Scalar > & A)`

Here is the call graph for this function:



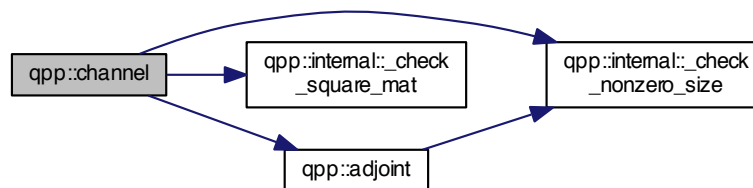
5.1.1.3 `template<typename Scalar > types::DynMat<Scalar> qpp::anticomm (const types::DynMat< Scalar > & A, const types::DynMat< Scalar > & B)`

Here is the call graph for this function:



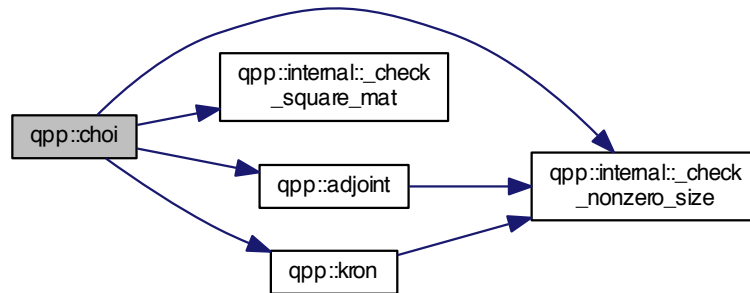
5.1.1.4 `types::cmat qpp::channel (const types::cmat & rho, const std::vector< types::cmat > & Ks)`

Here is the call graph for this function:



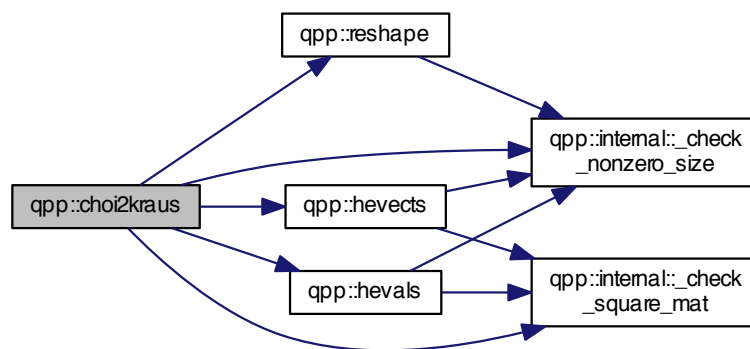
5.1.1.5 `types::cmat qpp::choi (const std::vector< types::cmat > & Ks)`

Here is the call graph for this function:



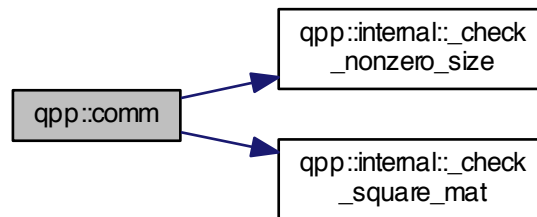
5.1.1.6 `std::vector<types::cmat> qpp::choi2kraus (const types::cmat & A)`

Here is the call graph for this function:



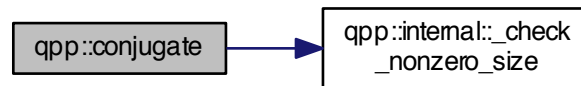
5.1.1.7 `template<typename Scalar > types::DynMat<Scalar> qpp::comm (const types::DynMat< Scalar > & A, const types::DynMat< Scalar > & B)`

Here is the call graph for this function:



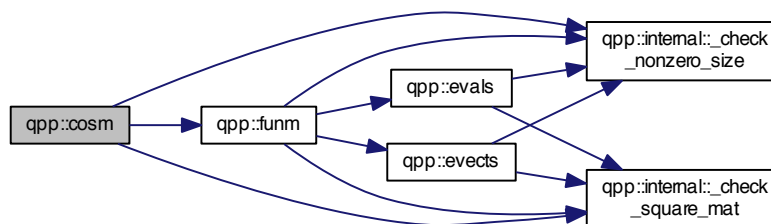
5.1.1.8 `template<typename Scalar > types::DynMat<Scalar> qpp::conjugate (const types::DynMat< Scalar > & A)`

Here is the call graph for this function:



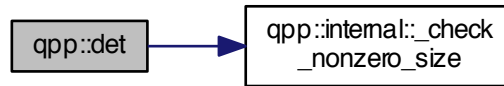
5.1.1.9 `template<typename Scalar > types::cmat qpp::cosm (const types::DynMat< Scalar > & A)`

Here is the call graph for this function:



5.1.1.10 `template<typename Scalar > Scalar qpp::det (const types::DynMat< Scalar > & A)`

Here is the call graph for this function:



5.1.1.11 `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)`

5.1.1.12 `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)`

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

5.1.1.14 `void qpp::disp (const types::cplx c, double chop = ct::chop, std::ostream & os = std::cout)`

Here is the call graph for this function:



5.1.1.15 `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:



5.1.1.16 `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:



5.1.1.17 `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:



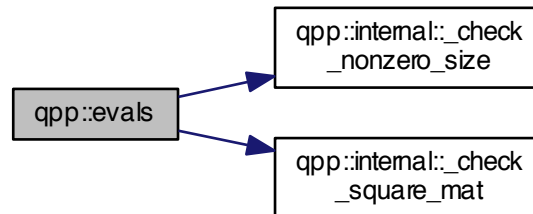
5.1.1.18 `void qpp::displn (const types::cplx c, double chop = ct::chop, std::ostream & os = std::cout)`

Here is the call graph for this function:



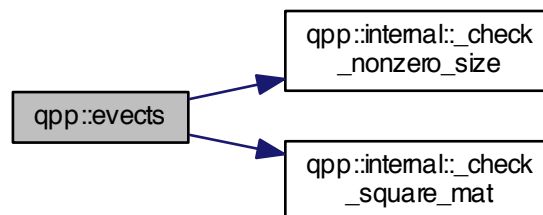
5.1.1.19 `template<typename Scalar > types::cmat qpp::evals (const types::DynMat< Scalar > & A)`

Here is the call graph for this function:



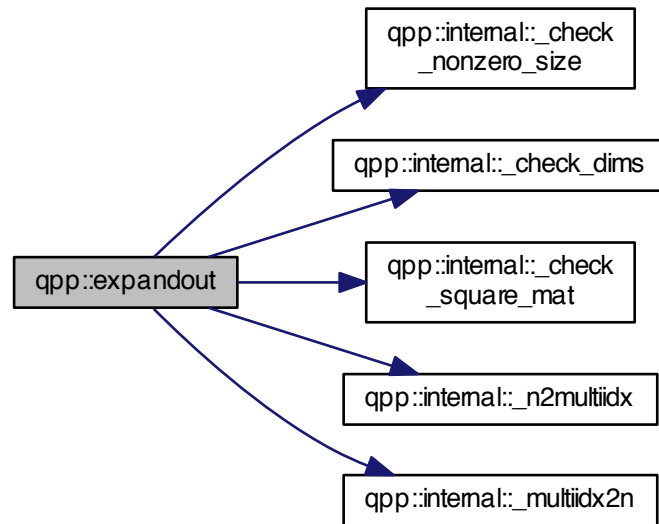
5.1.1.20 `template<typename Scalar > types::cmat qpp::evecs (const types::DynMat< Scalar > & A)`

Here is the call graph for this function:



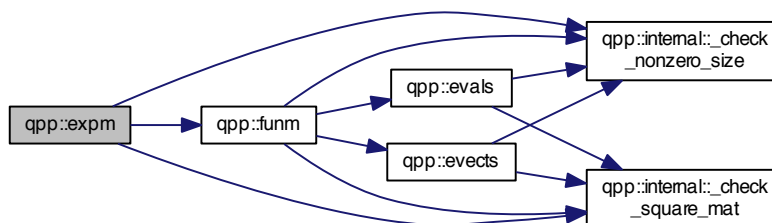
5.1.1.21 `template<typename Scalar > types::DynMat<Scalar> qpp::expandout (const types::DynMat< Scalar > & A,
size_t pos, const std::vector< size_t > & dims)`

Here is the call graph for this function:



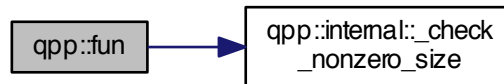
5.1.1.22 `template<typename Scalar > types::cmat qpp::expm (const types::DynMat< Scalar > & A)`

Here is the call graph for this function:



5.1.1.23 `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:



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

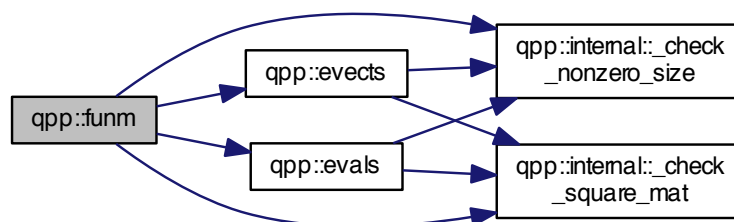
Parameters

<i>A</i>	input matrix
<i>f</i>	function pointer

Returns

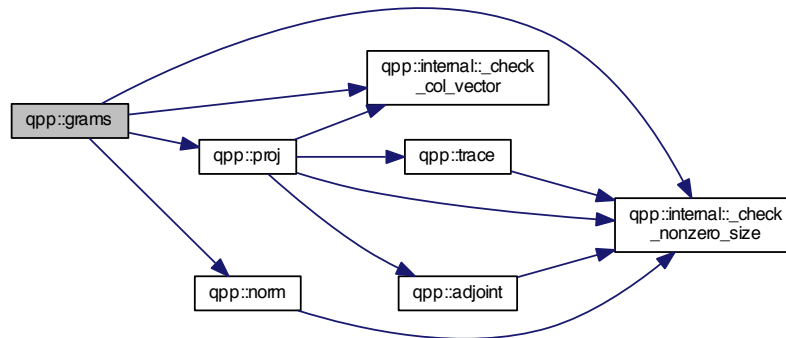
[types::cmat](#)

Here is the call graph for this function:



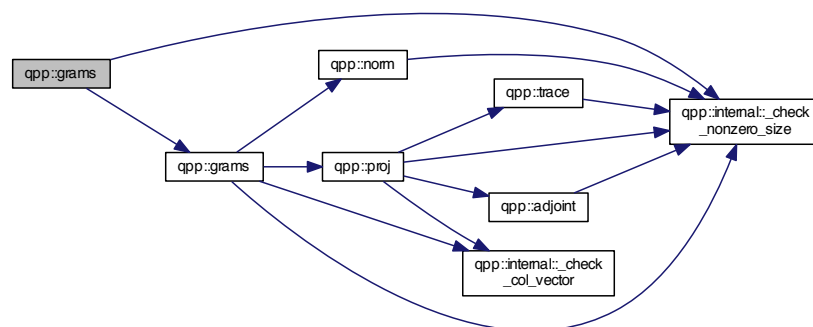
5.1.1.25 `template<typename Scalar> types::DynMat<Scalar> qpp::grams (const std::vector< types::DynMat< Scalar>> & vecs)`

Here is the call graph for this function:



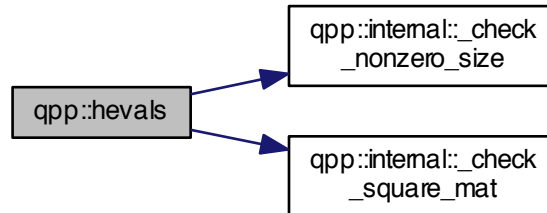
5.1.1.26 `template<typename Scalar> types::DynMat<Scalar> qpp::grams (const types::DynMat< Scalar> & A)`

Here is the call graph for this function:



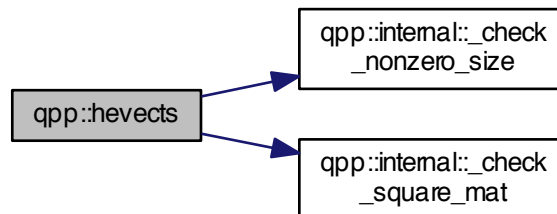
5.1.1.27 `template<typename Scalar > types::cmat qpp::hevals (const types::DynMat< Scalar > & A)`

Here is the call graph for this function:



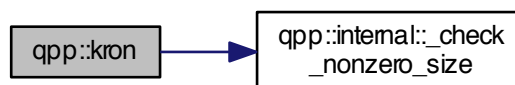
5.1.1.28 `template<typename Scalar > types::cmat qpp::hevects (const types::DynMat< Scalar > & A)`

Here is the call graph for this function:



5.1.1.29 `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:



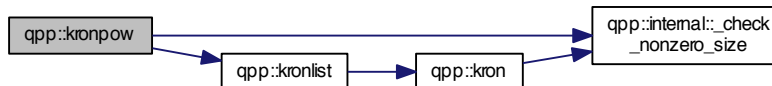
5.1.1.30 `template<typename Scalar > types::DynMat<Scalar> qpp::kronlist (const std::vector< types::DynMat< Scalar >> & list)`

Here is the call graph for this function:



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

Here is the call graph for this function:



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

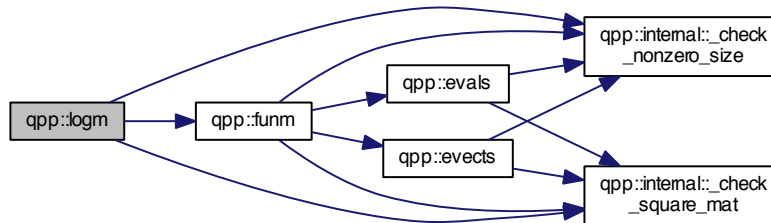
5.1.1.33 `template<typename Scalar > types::DynMat<Scalar> qpp::loadMATLABmatrix (const std::string & mat_file, const std::string & var_name)`

5.1.1.34 `template<> types::DynMat<double> qpp::loadMATLABmatrix (const std::string & mat_file, const std::string & var_name)`

5.1.1.35 `template<> types::DynMat<types::cplx> qpp::loadMATLABmatrix (const std::string & mat_file, const std::string & var_name)`

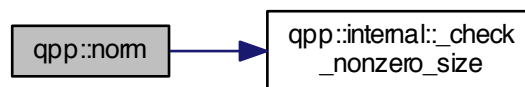
5.1.1.36 `template<typename Scalar > types::cmat qpp::logm (const types::DynMat< Scalar > & A)`

Here is the call graph for this function:



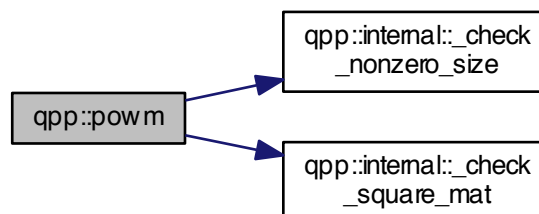
5.1.1.37 `template<typename Scalar > double qpp::norm (const types::DynMat< Scalar > & A)`

Here is the call graph for this function:



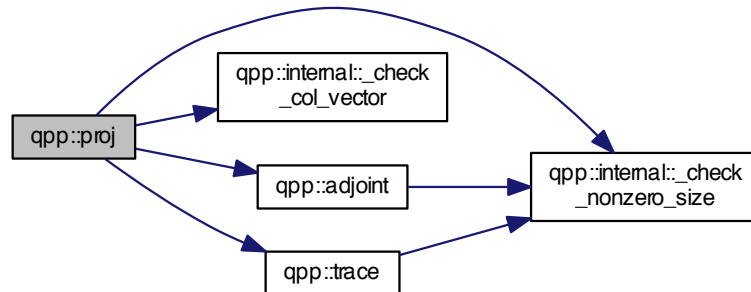
5.1.1.38 `template<typename Scalar > types::DynMat<Scalar> qpp::powm (const types::DynMat< Scalar > & A, size_t n)`

Here is the call graph for this function:



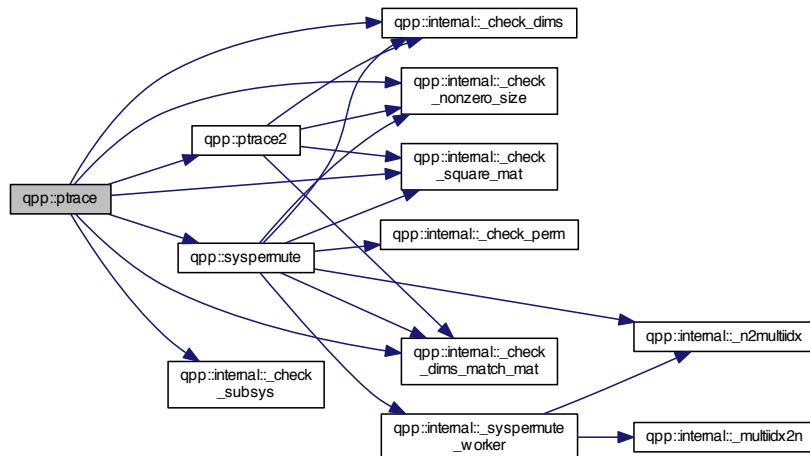
5.1.1.39 `template<typename Scalar > types::DynMat<Scalar> qpp::proj (const types::DynMat< Scalar > & V)`

Here is the call graph for this function:



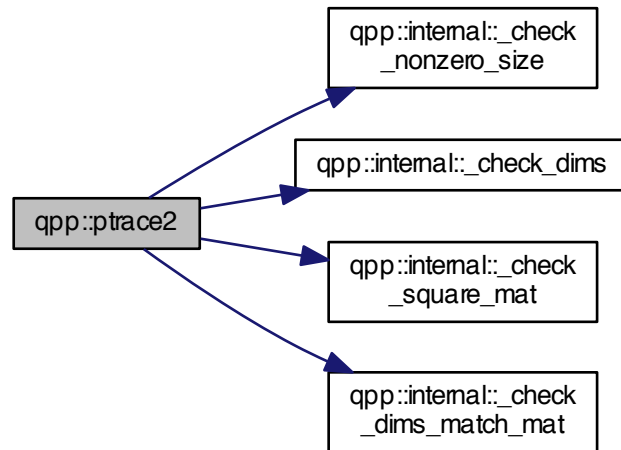
5.1.1.40 `template<typename Scalar > types::DynMat<Scalar> qpp::ptrace (const types::DynMat< Scalar > & A, const std::vector< size_t > & subsys, const std::vector< size_t > & dims)`

Here is the call graph for this function:



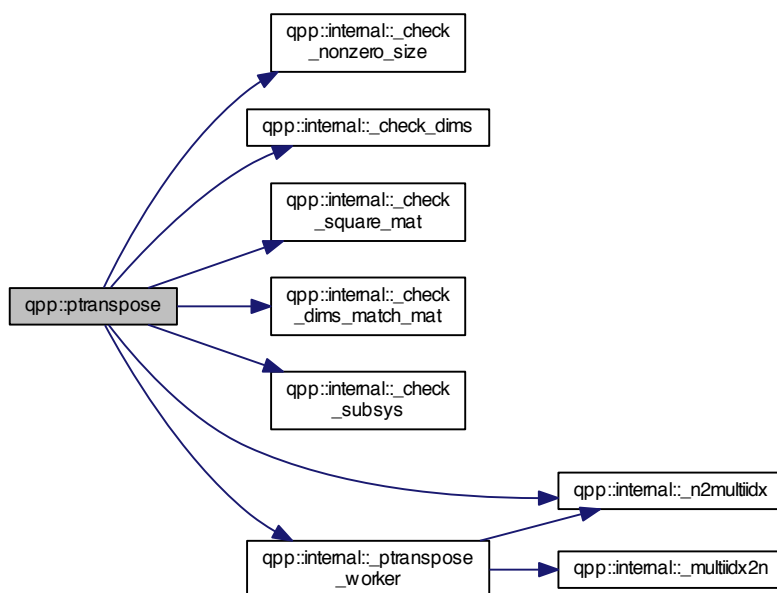
5.1.1.41 `template<typename Scalar > types::DynMat<Scalar> qpp::ptrace2 (const types::DynMat< Scalar > & A, const std::vector< size_t > dims)`

Here is the call graph for this function:



5.1.1.42 `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:



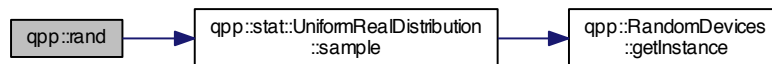
5.1.1.43 `template<typename Scalar > types::DynMat<Scalar> qpp::rand (size_t rows, size_t cols, double a = 0, double b = 1)`

5.1.1.44 `template<> types::DynMat<double> qpp::rand (size_t rows, size_t cols, double a, double b)`

5.1.1.45 `template<> types::DynMat<types::cplx> qpp::rand (size_t rows, size_t cols, double a, double b)`

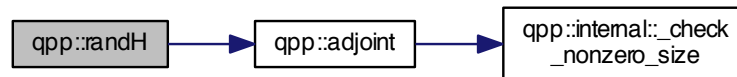
5.1.1.46 `double qpp::rand (double a = 0, double b = 1)`

Here is the call graph for this function:



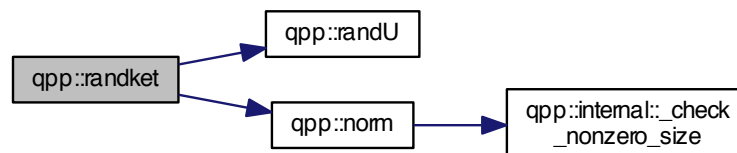
5.1.1.47 `types::cmat qpp::randH (size_t D)`

Here is the call graph for this function:



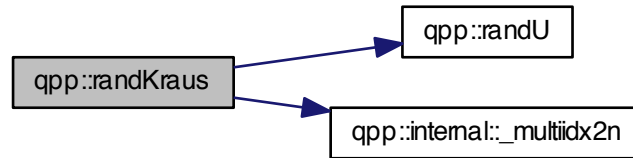
5.1.1.48 `types::cmat qpp::randket (size_t D)`

Here is the call graph for this function:



5.1.1.49 `std::vector<types::cmat> qpp::randKraus (size_t n, size_t D)`

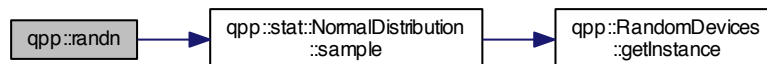
Here is the call graph for this function:



5.1.1.50 `template<typename Scalar > types::DynMat<Scalar> qpp::randn (size_t rows, size_t cols, double mean = 0, double sigma = 1)`

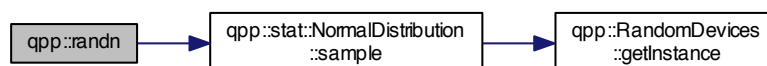
5.1.1.51 `template<> types::DynMat<double> qpp::randn (size_t rows, size_t cols, double mean, double sigma)`

Here is the call graph for this function:



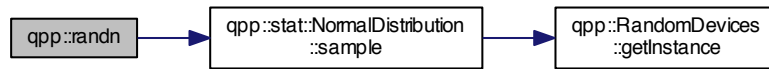
5.1.1.52 `template<> types::DynMat<types::cplx> qpp::randn (size_t rows, size_t cols, double mean, double sigma)`

Here is the call graph for this function:



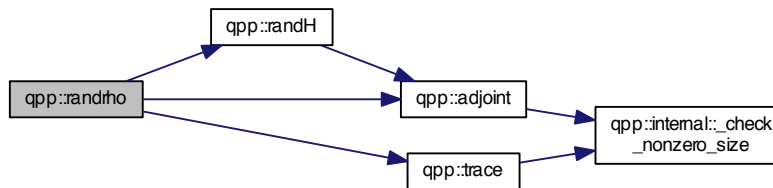
5.1.1.53 `double qpp::randn (double mean = 0, double sigma = 1)`

Here is the call graph for this function:



5.1.1.54 `types::cmat qpp::randrho (size_t D)`

Here is the call graph for this function:



5.1.1.55 `types::cmat qpp::randU (size_t D)`

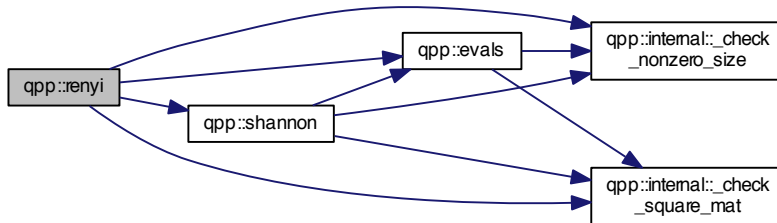
5.1.1.56 `types::cmat qpp::randV (size_t Din, size_t Dout)`

Here is the call graph for this function:



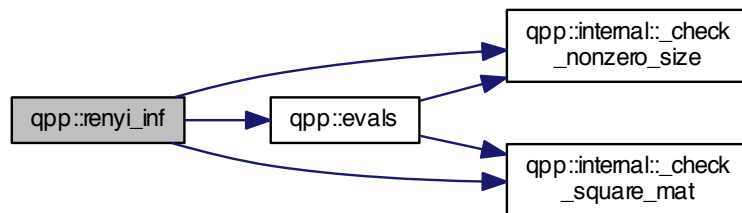
5.1.1.57 `template<typename Scalar > double qpp::renyi (const double alpha, const types::DynMat< Scalar > & A)`

Here is the call graph for this function:



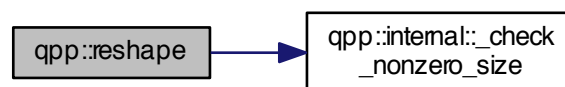
5.1.1.58 `template<typename Scalar > double qpp::renyi_inf (const types::DynMat< Scalar > & A)`

Here is the call graph for this function:



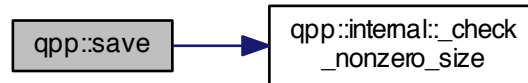
5.1.1.59 `template<typename Scalar > types::DynMat<Scalar> qpp::reshape (const types::DynMat< Scalar > & A, size_t rows, size_t cols)`

Here is the call graph for this function:



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

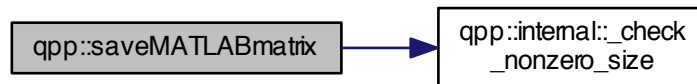
Here is the call graph for this function:



5.1.1.61 `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)`

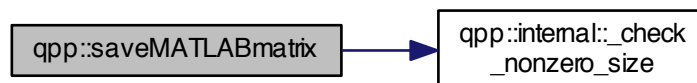
5.1.1.62 `template<> void qpp::saveMATLABmatrix (const types::DynMat< double > & A, const std::string & mat_file, const std::string & var_name, const std::string & mode)`

Here is the call graph for this function:



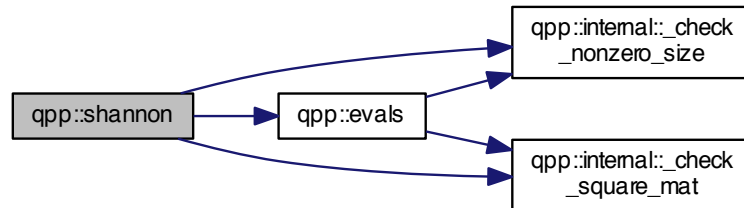
5.1.1.63 `template<> void qpp::saveMATLABmatrix (const types::DynMat< types::cplx > & A, const std::string & mat_file, const std::string & var_name, const std::string & mode)`

Here is the call graph for this function:



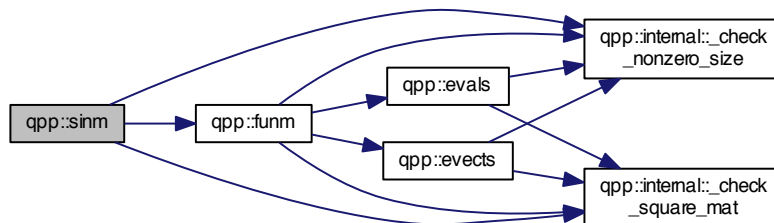
5.1.1.64 `template<typename Scalar > double qpp::shannon (const types::DynMat< Scalar > & A)`

Here is the call graph for this function:



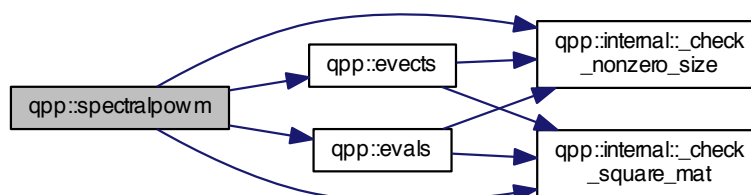
5.1.1.65 `template<typename Scalar > types::cmat qpp::sinm (const types::DynMat< Scalar > & A)`

Here is the call graph for this function:



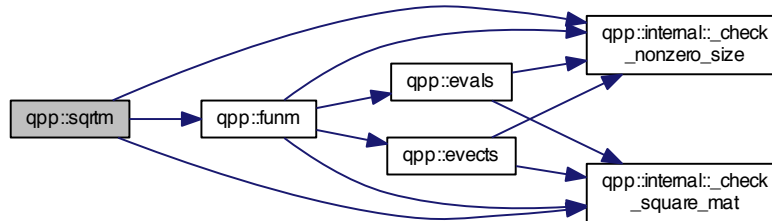
5.1.1.66 `template<typename Scalar > types::cmat qpp::spectralpowm (const types::DynMat< Scalar > & A, const types::cplx z)`

Here is the call graph for this function:



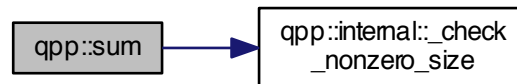
5.1.1.67 `template<typename Scalar > types::cmat qpp::sqrtm (const types::DynMat< Scalar > & A)`

Here is the call graph for this function:



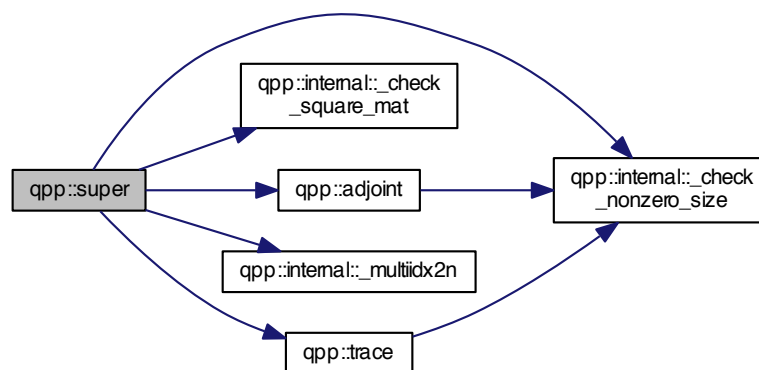
5.1.1.68 `template<typename Scalar > Scalar qpp::sum (const types::DynMat< Scalar > & A)`

Here is the call graph for this function:



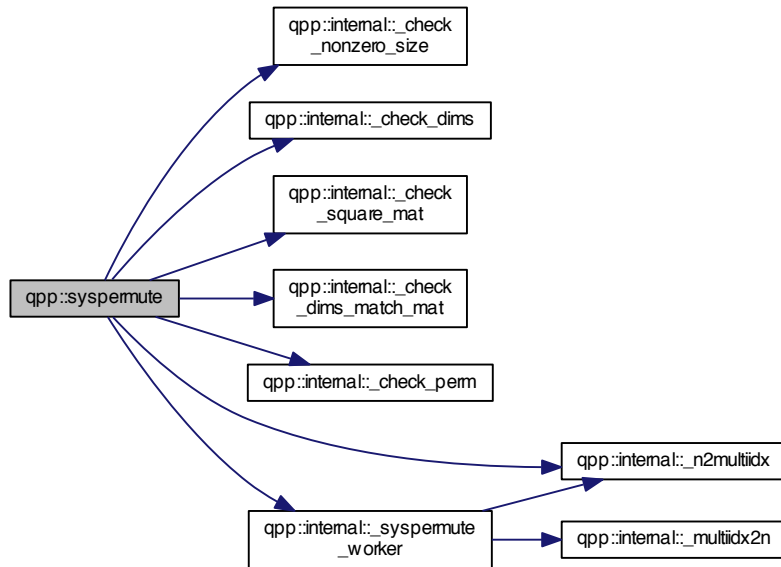
5.1.1.69 `types::cmat qpp::super (const std::vector< types::cmat > & Ks)`

Here is the call graph for this function:



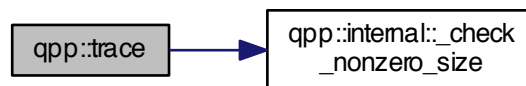
5.1.1.70 `template<typename Scalar > types::DynMat<Scalar> qpp::syspermute (const types::DynMat< Scalar > & A,
const std::vector< size_t > perm, const std::vector< size_t > & dims)`

Here is the call graph for this function:



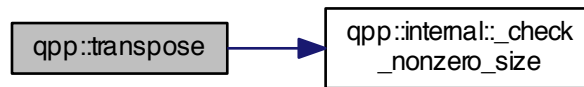
5.1.1.71 `template<typename Scalar > Scalar qpp::trace (const types::DynMat< Scalar > & A)`

Here is the call graph for this function:



5.1.1.72 `template<typename Scalar > types::DynMat<Scalar> qpp::transpose (const types::DynMat< Scalar > & A)`

Here is the call graph for this function:



5.1.2 Variable Documentation

5.1.2.1 `const Gates* qpp::gt = Gates::getInstance()`

5.1.2.2 `RandomDevices* qpp::rdevs = RandomDevices::getInstance()`

5.2 qpp::ct Namespace Reference

Functions

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

Variables

- `const double chop = 1e-10`
- `const double eps = 1e-14`
- `const std::complex< double > ii = { 0, 1 }`
- `const double pi = 3.141592653589793238462643383279502884`
- `const double ee = 2.718281828459045235360287471352662497`

5.2.1 Function Documentation

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

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 = 2.718281828459045235360287471352662497`

5.2.2.3 `const double qpp::ct::eps = 1e-14`

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

5.2.2.5 `const double qpp::ct::pi = 3.141592653589793238462643383279502884`

5.3 qpp::internal Namespace Reference

Functions

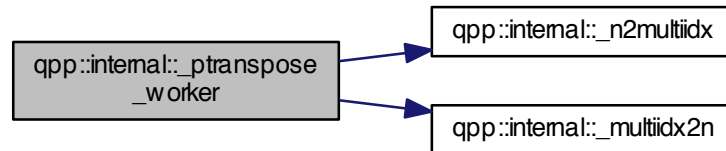
- void `_n2multiidx` (size_t n, size_t numdims, const size_t *dims, size_t *result)
- size_t `_multiidx2n` (const size_t *midx, size_t numdims, const size_t *dims)
- template<typename Scalar >
bool `_check_square_mat` (const `types::DynMat`< Scalar > &A)
- template<typename Scalar >
bool `_check_vector` (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)

5.3.1 Function Documentation

- 5.3.1.1 template<typename Scalar > bool `qpp::internal::_check_col_vector` (const `types::DynMat`< Scalar > &A)
- 5.3.1.2 bool `qpp::internal::_check_dims` (const std::vector< size_t > &dims)
- 5.3.1.3 template<typename Scalar > bool `qpp::internal::_check_dims_match_mat` (const std::vector< size_t > &dims, const `types::DynMat`< Scalar > &A)
- 5.3.1.4 bool `qpp::internal::_check_eq_dims` (const std::vector< size_t > &dims, size_t dim)
- 5.3.1.5 template<typename T > bool `qpp::internal::_check_nonzero_size` (const T &x)
- 5.3.1.6 bool `qpp::internal::_check_perm` (const std::vector< size_t > &perm, const std::vector< size_t > &dims)
- 5.3.1.7 template<typename Scalar > bool `qpp::internal::_check_row_vector` (const `types::DynMat`< Scalar > &A)
- 5.3.1.8 template<typename Scalar > bool `qpp::internal::_check_square_mat` (const `types::DynMat`< Scalar > &A)
- 5.3.1.9 bool `qpp::internal::_check_subsys` (const std::vector< size_t > &subsys, const std::vector< size_t > &dims)
- 5.3.1.10 template<typename Scalar > bool `qpp::internal::_check_vector` (const `types::DynMat`< Scalar > &A)
- 5.3.1.11 size_t `qpp::internal::_multiidx2n` (const size_t *midx, size_t numdims, const size_t *dims)
- 5.3.1.12 void `qpp::internal::_n2multiidx` (size_t n, size_t numdims, const size_t *dims, size_t *result)

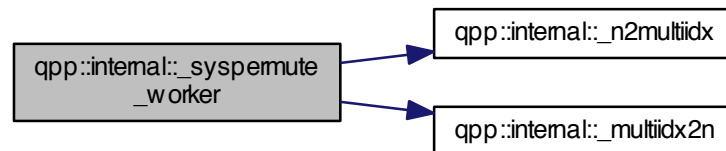
5.3.1.13 `template<typename Scalar > void qpp::internal::_pttranspose_worker (const size_t * midxcol, size_t numdims, size_t numsubsys, const size_t * cdims, const size_t * csubsys, size_t i, size_t j, size_t & iperm, size_t & jperm, const types::DynMat< Scalar > & A, types::DynMat< Scalar > & result)`

Here is the call graph for this function:



5.3.1.14 `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)`

Here is the call graph for this function:



5.4 qpp::stat Namespace Reference

Classes

- class [NormalDistribution](#)
- class [UniformRealDistribution](#)
- class [DiscreteDistribution](#)
- class [DiscreteDistributionFromComplex](#)

5.5 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 >

5.5.1 Typedef Documentation

5.5.1.1 typedef Eigen::MatrixXcd [qpp::types::cmat](#)

5.5.1.2 typedef std::complex<double> [qpp::types::cplx](#)

5.5.1.3 typedef Eigen::MatrixXd [qpp::types::dmat](#)

5.5.1.4 template<typename Scalar > using [qpp::types::DynMat](#) = typedef Eigen::Matrix<Scalar, Eigen::Dynamic, Eigen::Dynamic>

5.5.1.5 template<typename Expression > using [qpp::types::Expression2DynMat](#) = typedef Eigen::Matrix<typename Expression::Scalar, Eigen::Dynamic, Eigen::Dynamic>

5.5.1.6 typedef Eigen::MatrixXf [qpp::types::fmat](#)

5.5.1.7 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]`

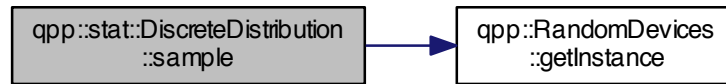
6.1.1.3 `qpp::stat::DiscreteDistribution::DiscreteDistribution (std::vector< double > weights) [inline]`

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]

Here is the call graph for this function:



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

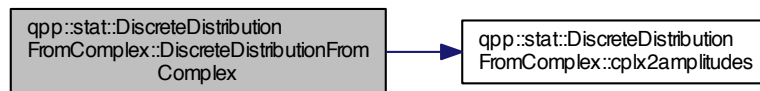
6.2.1.1 `template<typename InputIterator> qpp::stat::DiscreteDistributionFromComplex::DiscreteDistributionFromComplex (InputIterator first, InputIterator last) [inline]`

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:



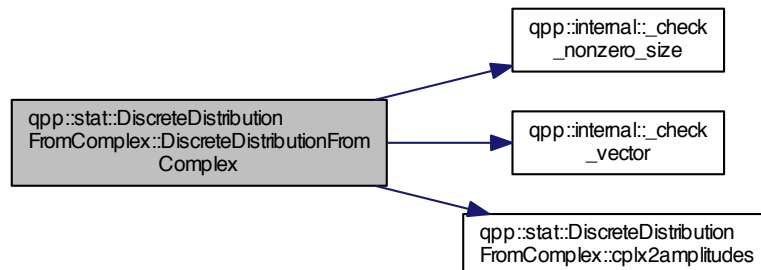
6.2.1.3 `qpp::stat::DiscreteDistributionFromComplex::DiscreteDistributionFromComplex (std::vector< types::cplx > amplitudes) [inline]`

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:



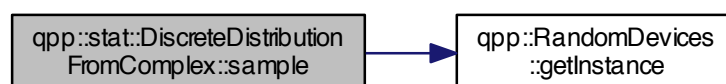
6.2.2 Member Function Documentation

6.2.2.1 `template<typename InputIterator > std::vector<double> qpp::stat::DiscreteDistributionFromComplex::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]`

Here is the call graph for this function:



6.2.3 Member Data Documentation

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

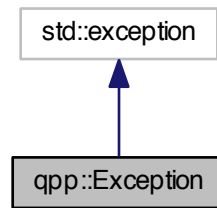
The documentation for this class was generated from the following file:

- [include/stat.h](#)

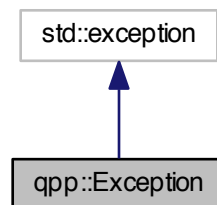
6.3 qpp::Exception Class Reference

```
#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 noexcept override
- 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]`

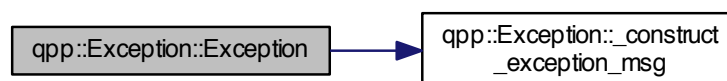
Enumerator

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

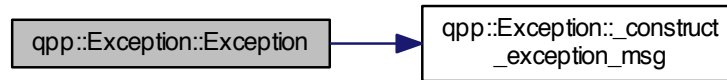
6.3.2.1 `qpp::Exception::Exception (const std::string & where, const Type & type)` `[inline]`

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::Gates Class Reference

```
#include <gates.h>
```

Public Member Functions

- [Gates](#) (const [Gates](#) &)=delete
- [Gates](#) & [operator=](#) (const [Gates](#) &)=delete
- [types::cmat Rtheta](#) (double theta) const
- [types::cmat Id](#) (size_t D) const
- [types::cmat Zd](#) (size_t D) const
- [types::cmat Fd](#) (size_t D) const
- [types::cmat Xd](#) (size_t D) const
- [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) const

Static Public Member Functions

- static const [Gates](#) * [getInstance](#) ()

Public Attributes

- [types::cmat](#) [ld2](#)
- [types::cmat](#) [H](#)
- [types::cmat](#) [X](#)
- [types::cmat](#) [Y](#)
- [types::cmat](#) [Z](#)
- [types::cmat](#) [S](#)
- [types::cmat](#) [T](#)
- [types::cmat](#) [CNOTab](#)
- [types::cmat](#) [CZ](#)
- [types::cmat](#) [CS](#)
- [types::cmat](#) [CNOTba](#)
- [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](#)

Private Member Functions

- [Gates](#) ()
- void [_init_gates](#) ()

6.4.1 Constructor & Destructor Documentation

6.4.1.1 `qpp::Gates::Gates ()` `[inline]`, `[private]`

Here is the call graph for this function:



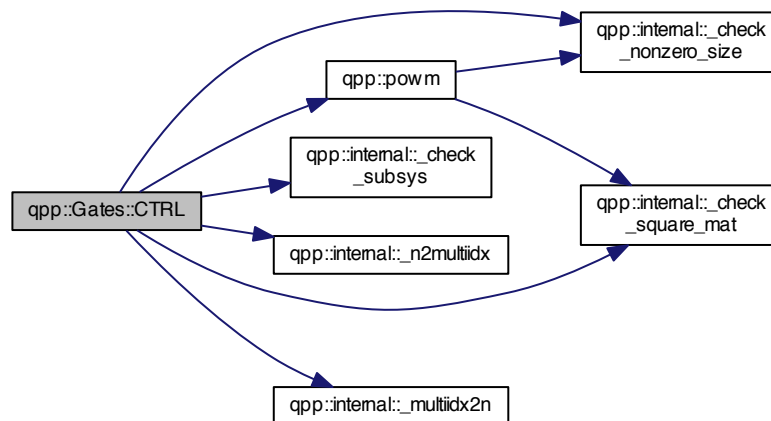
6.4.1.2 `qpp::Gates::Gates (const Gates &)` `[delete]`

6.4.2 Member Function Documentation

6.4.2.1 `void qpp::Gates::_init_gates ()` `[inline],[private]`

6.4.2.2 `types::cmat qpp::Gates::CTRL (const types::cmat & A, const std::vector< size_t > & ctrl, const std::vector< size_t > & gate, size_t n, size_t D = 2) const` `[inline]`

Here is the call graph for this function:



6.4.2.3 `types::cmat qpp::Gates::Fd (size_t D) const` `[inline]`

Here is the call graph for this function:



6.4.2.4 `static const Gates* qpp::Gates::getInstance ()` `[inline],[static]`

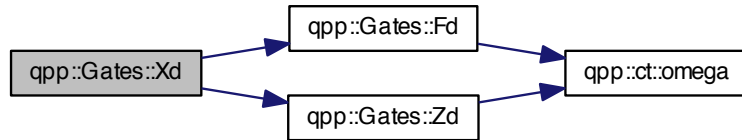
6.4.2.5 `types::cmat qpp::Gates::Id (size_t D) const` `[inline]`

6.4.2.6 `Gates& qpp::Gates::operator= (const Gates &)` `[delete]`

6.4.2.7 `types::cmat qpp::Gates::Rtheta (double theta) const` `[inline]`

6.4.2.8 `types::cmat qpp::Gates::Xd (size_t D) const [inline]`

Here is the call graph for this function:



6.4.2.9 `types::cmat qpp::Gates::Zd (size_t D) const [inline]`

Here is the call graph for this function:



6.4.3 Member Data Documentation

6.4.3.1 `types::cmat qpp::Gates::b00`

6.4.3.2 `types::cmat qpp::Gates::b01`

6.4.3.3 `types::cmat qpp::Gates::b10`

6.4.3.4 `types::cmat qpp::Gates::b11`

6.4.3.5 `types::cmat qpp::Gates::CNOTab`

6.4.3.6 `types::cmat qpp::Gates::CNOTba`

6.4.3.7 `types::cmat qpp::Gates::CS`

6.4.3.8 `types::cmat qpp::Gates::CZ`

6.4.3.9 `types::cmat qpp::Gates::FRED`

6.4.3.10 `types::cmat qpp::Gates::H`

6.4.3.11 `types::cmat qpp::Gates::Id2`

- 6.4.3.12 `types::cmat qpp::Gates::S`
- 6.4.3.13 `types::cmat qpp::Gates::SWAP`
- 6.4.3.14 `types::cmat qpp::Gates::T`
- 6.4.3.15 `types::cmat qpp::Gates::TOF`
- 6.4.3.16 `types::cmat qpp::Gates::X`
- 6.4.3.17 `types::cmat qpp::Gates::x0`
- 6.4.3.18 `types::cmat qpp::Gates::x1`
- 6.4.3.19 `types::cmat qpp::Gates::Y`
- 6.4.3.20 `types::cmat qpp::Gates::y0`
- 6.4.3.21 `types::cmat qpp::Gates::y1`
- 6.4.3.22 `types::cmat qpp::Gates::Z`
- 6.4.3.23 `types::cmat qpp::Gates::z0`
- 6.4.3.24 `types::cmat qpp::Gates::z1`

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

- [include/gates.h](#)

6.5 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`

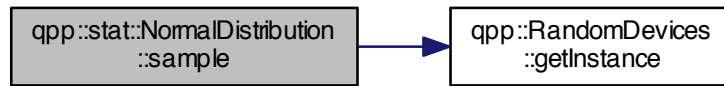
6.5.1 Constructor & Destructor Documentation

6.5.1.1 `qpp::stat::NormalDistribution::NormalDistribution (double mean = 0, double sigma = 1)` `[inline]`

6.5.2 Member Function Documentation

6.5.2.1 `double qpp::stat::NormalDistribution::sample () [inline]`

Here is the call graph for this function:



6.5.3 Member Data Documentation

6.5.3.1 `std::normal_distribution qpp::stat::NormalDistribution::_d [protected]`

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

- [include/stat.h](#)

6.6 qpp::RandomDevices Class Reference

```
#include <randevs.h>
```

Public Member Functions

- [RandomDevices](#) (const [RandomDevices](#) &)=delete
- [RandomDevices](#) & [operator=](#) (const [RandomDevices](#) &)=delete
- virtual [~RandomDevices](#) ()=default

Static Public Member Functions

- static [RandomDevices](#) * [getInstance](#) ()

Public Attributes

- [std::mt19937 _rng](#)

Private Member Functions

- [RandomDevices](#) ()

Private Attributes

- [std::random_device _rd](#)

6.6.1 Constructor & Destructor Documentation

6.6.1.1 `qpp::RandomDevices::RandomDevices ()` `[inline]`,`[private]`

6.6.1.2 `qpp::RandomDevices::RandomDevices (const RandomDevices &)` `[delete]`

6.6.1.3 `virtual qpp::RandomDevices::~~RandomDevices ()` `[virtual]`,`[default]`

6.6.2 Member Function Documentation

6.6.2.1 `static RandomDevices* qpp::RandomDevices::getInstance ()` `[inline]`,`[static]`

6.6.2.2 `RandomDevices& qpp::RandomDevices::operator= (const RandomDevices &)` `[delete]`

6.6.3 Member Data Documentation

6.6.3.1 `std::random_device qpp::RandomDevices::_rd` `[private]`

6.6.3.2 `std::mt19937 qpp::RandomDevices::_rng`

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

- [include/randevs.h](#)

6.7 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)`

6.7.1 Constructor & Destructor Documentation

6.7.1.1 `qpp::Timer::Timer ()` `[inline]`

6.7.1.2 `virtual qpp::Timer::~~Timer ()` `[virtual]`,`[default]`

6.7.2 Member Function Documentation

6.7.2.1 `double qpp::Timer::seconds () const` `[inline]`

6.7.2.2 `void qpp::Timer::tic ()` `[inline]`

6.7.2.3 `void qpp::Timer::toc ()` `[inline]`

6.7.3 Friends And Related Function Documentation

6.7.3.1 `std::ostream& operator<< (std::ostream & os, const Timer & rhs)` `[friend]`

6.7.4 Member Data Documentation

6.7.4.1 `std::chrono::high_resolution_clock::time_point qpp::Timer::_end` `[protected]`

6.7.4.2 `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](#)

6.8 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`

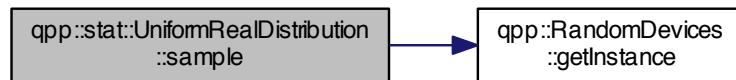
6.8.1 Constructor & Destructor Documentation

6.8.1.1 `qpp::stat::UniformRealDistribution::UniformRealDistribution (double a = 0, double b = 1)` `[inline]`

6.8.2 Member Function Documentation

6.8.2.1 `double qpp::stat::UniformRealDistribution::sample () [inline]`

Here is the call graph for this function:



6.8.3 Member Data Documentation

6.8.3.1 `std::uniform_real_distribution qpp::stat::UniformRealDistribution::_d [protected]`

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

- [include/stat.h](#)

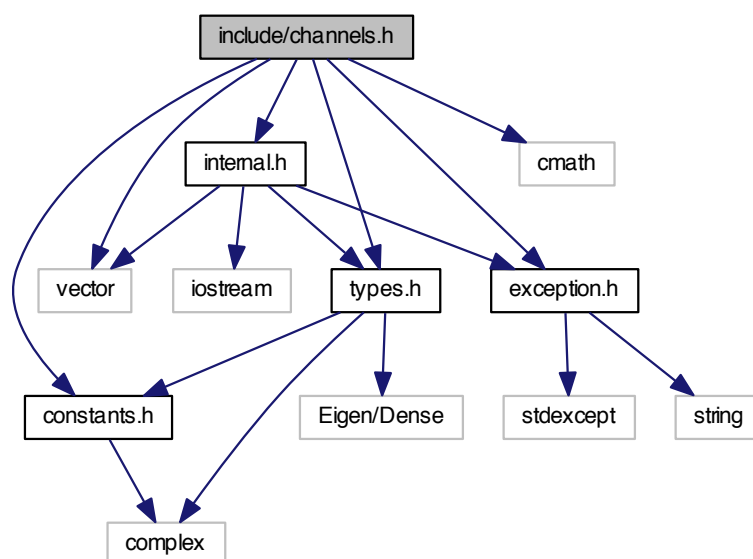
Chapter 7

File Documentation

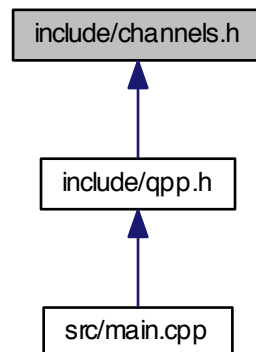
7.1 include/channels.h File Reference

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

Include dependency graph for channels.h:



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



Namespaces

- [qpp](#)

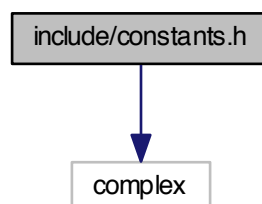
Functions

- `types::cmat` [qpp::channel](#) (`const types::cmat &rho`, `const std::vector< types::cmat > &Ks`)
- `types::cmat` [qpp::super](#) (`const std::vector< types::cmat > &Ks`)
- `types::cmat` [qpp::choi](#) (`const std::vector< types::cmat > &Ks`)
- `std::vector< types::cmat >` [qpp::choi2kraus](#) (`const types::cmat &A`)

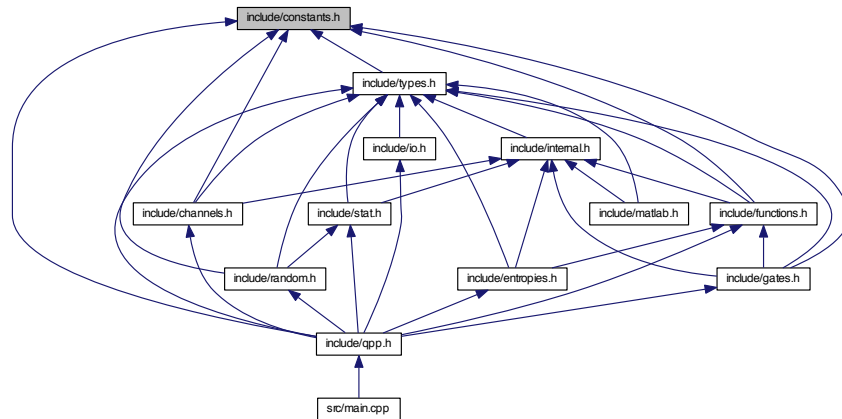
7.2 include/constants.h File Reference

```
#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 double qpp::ct::eps = 1e-14`
- `const std::complex< double > qpp::ct::ii = { 0, 1 }`
- `const double qpp::ct::pi = 3.141592653589793238462643383279502884`
- `const double qpp::ct::ee = 2.718281828459045235360287471352662497`

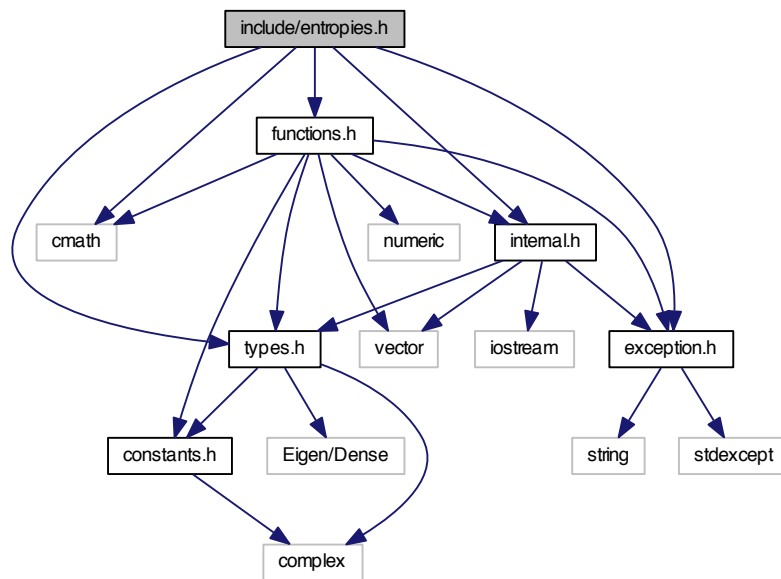
7.3 include/entropies.h File Reference

```

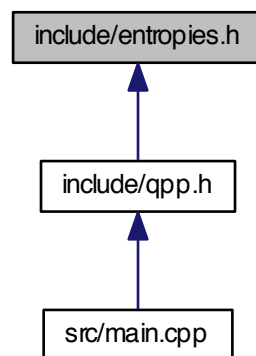
#include <cmath>
#include "types.h"
#include "functions.h"
#include "internal.h"
#include "exception.h"

```

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)`

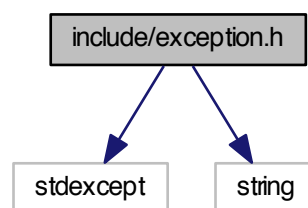
- `template<typename Scalar >`
`double qpp::renyi (const double alpha, const types::DynMat< Scalar > &A)`
- `template<typename Scalar >`
`double qpp::renyi_inf (const types::DynMat< Scalar > &A)`

7.4 include/exception.h File Reference

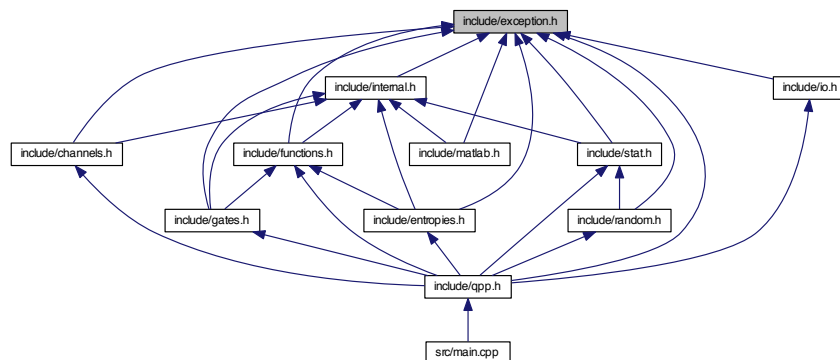
```
#include <stdexcept>
```

```
#include <string>
```

Include dependency graph for exception.h:



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



Classes

- class [qpp::Exception](#)

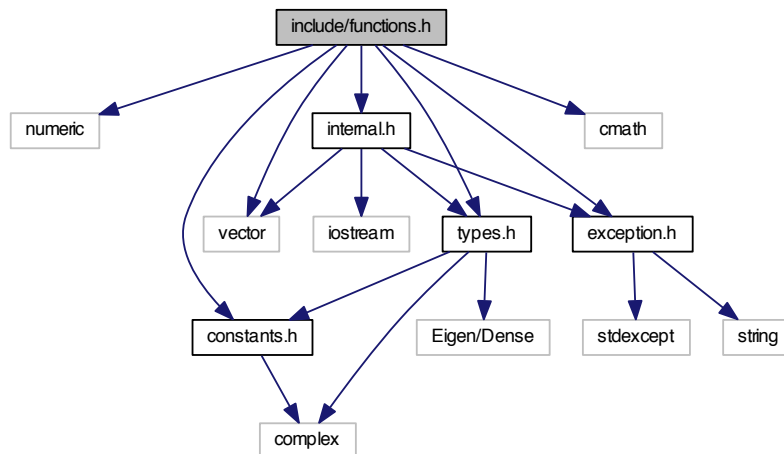
Namespaces

- [qpp](#)

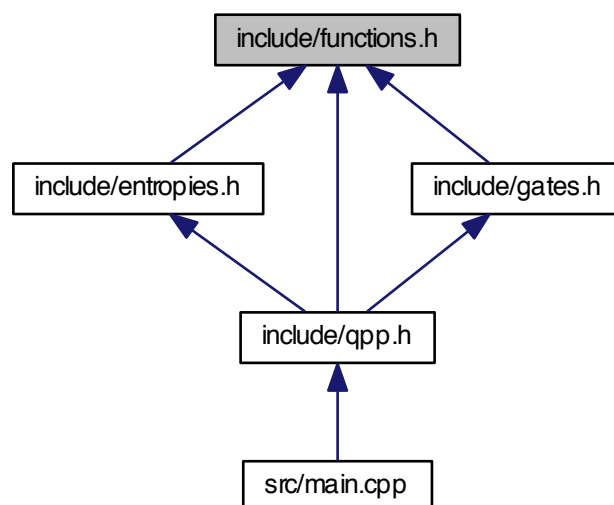
7.5 include/functions.h File Reference

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

Include dependency graph for functions.h:



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



Namespaces

- [qpp](#)

Functions

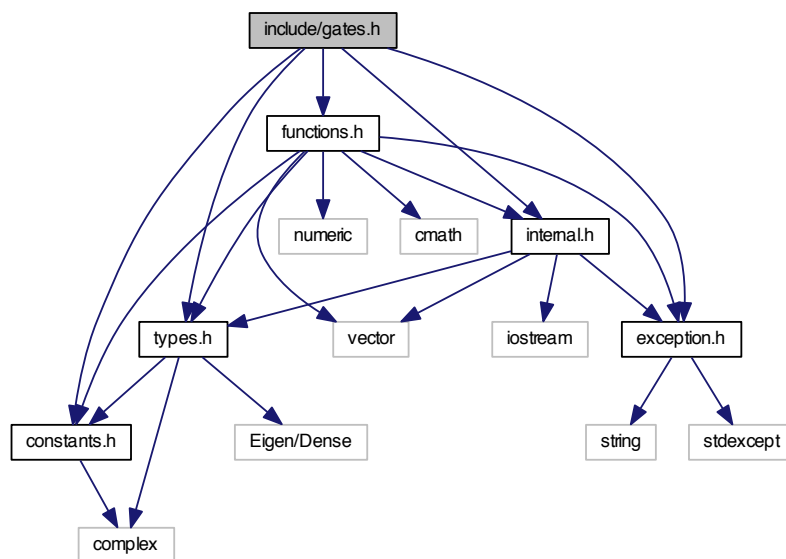
- `template<typename Scalar >`
`types::DynMat< Scalar > qpp::transpose (const types::DynMat< Scalar > &A)`
- `template<typename Scalar >`
`types::DynMat< Scalar > qpp::conjugate (const types::DynMat< Scalar > &A)`
- `template<typename Scalar >`
`types::DynMat< Scalar > qpp::adjoint (const types::DynMat< 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::evecs (const types::DynMat< Scalar > &A)`
- `template<typename Scalar >`
`types::cmat qpp::hevals (const types::DynMat< Scalar > &A)`
- `template<typename Scalar >`
`types::cmat qpp::hevecs (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::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)`

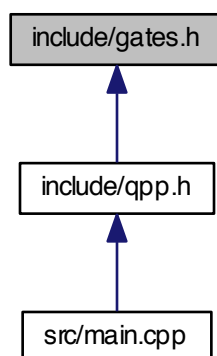
7.6 include/gates.h File Reference

```
#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:



Classes

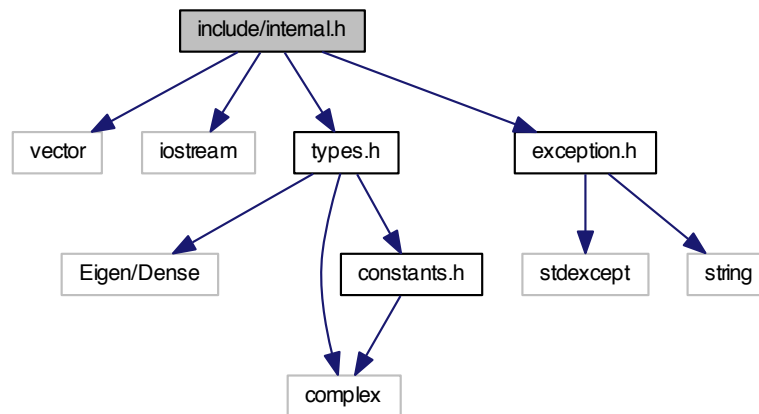
- class `qpp::Gates`

Namespaces

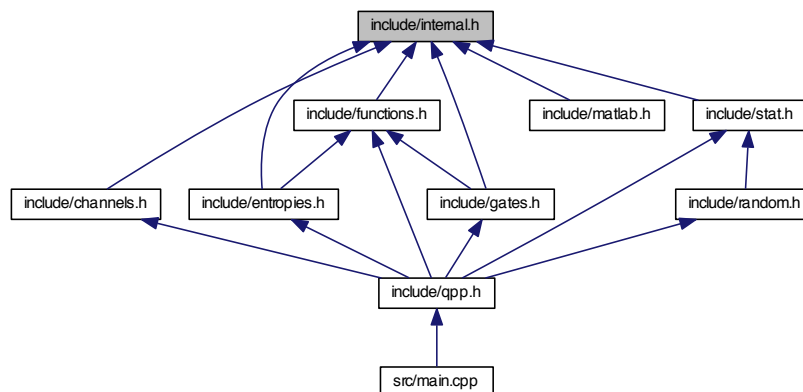
- `qpp`

7.7 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

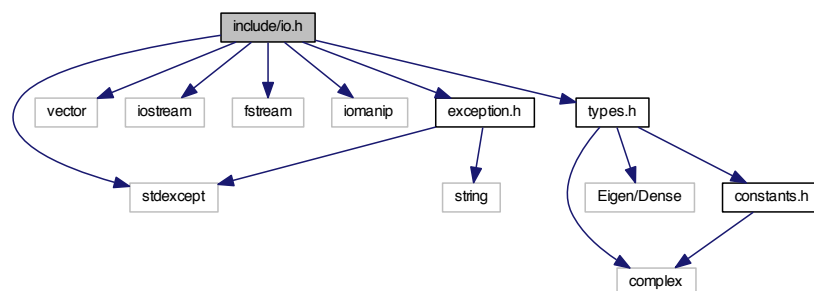
- void `qpp::internal::_n2multiidx` (size_t n, size_t numdims, const size_t *dims, size_t *result)

- `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::_ptrtranspose_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`)

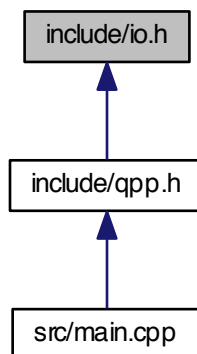
7.8 include/io.h File Reference

```
#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

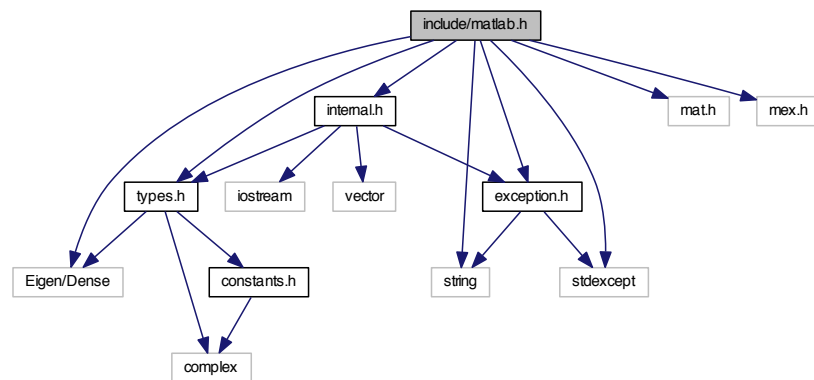
- `template<typename T >`
`void qpp::disp (const T &x, const std::string &separator=" ", const std::string &start="[" , const std::string &end="]", std::ostream &os=std::cout)`
- `template<typename T >`
`void qpp::displn (const T &x, const std::string &separator=" ", const std::string &start="[" , const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

7.9 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](#)

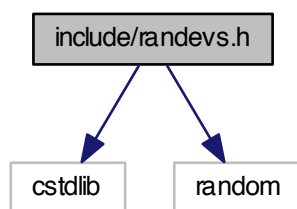
Functions

- `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)`

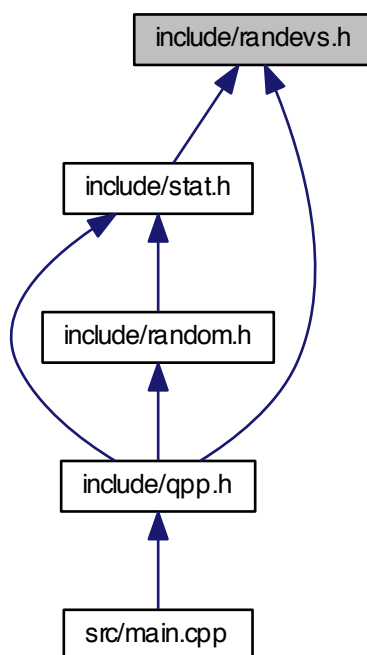
7.10 include/qpp.h File Reference

```
#include "types.h"
```


Include dependency graph for randevs.h:



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



Classes

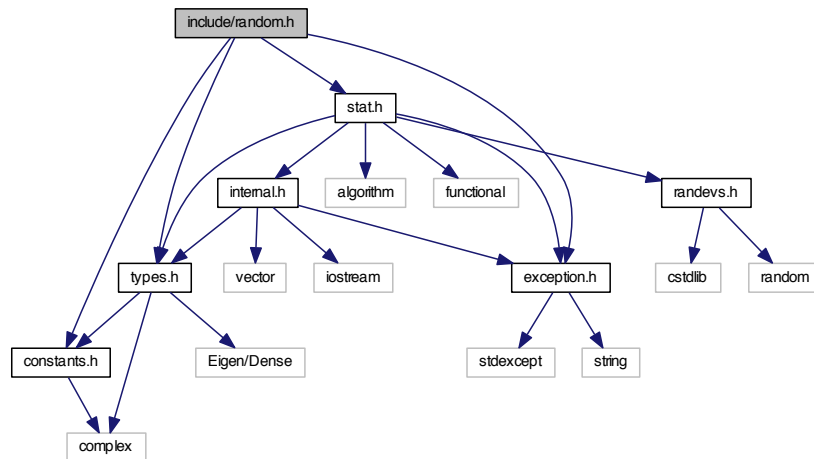
- class [qpp::RandomDevices](#)

Namespaces

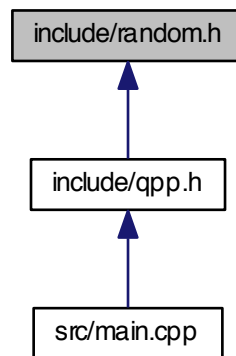
- [qpp](#)

7.12 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](#)

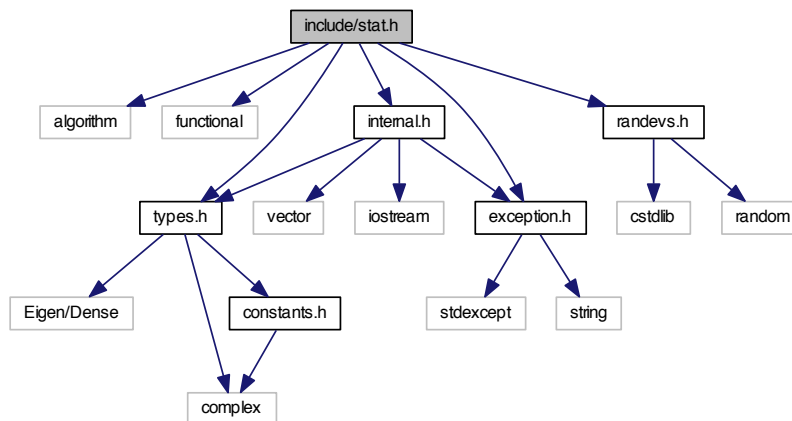
Functions

- `template<typename Scalar >`

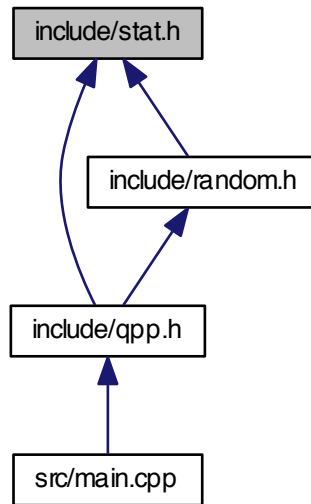
- types::DynMat< Scalar > [qpp::rand](#) (size_t rows, size_t cols, double a=0, double b=1)
- template<>
types::DynMat< double > [qpp::rand](#) (size_t rows, size_t cols, double a, double b)
 - template<>
types::DynMat< types::cplx > [qpp::rand](#) (size_t rows, size_t cols, double a, double b)
 - double [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)
 - std::vector< types::cmat > [qpp::randKraus](#) (size_t n, size_t D)
 - types::cmat [qpp::randH](#) (size_t D)
 - types::cmat [qpp::randket](#) (size_t D)
 - types::cmat [qpp::randrho](#) (size_t D)

7.13 include/stat.h File Reference

```
#include <algorithm>
#include <functional>
#include "types.h"
#include "internal.h"
#include "exception.h"
#include "randevs.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](#)

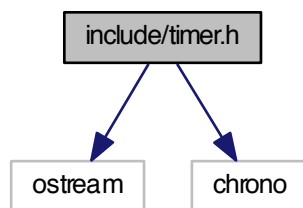
Namespaces

- [qpp](#)
- [qpp::stat](#)

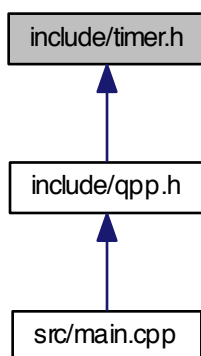
7.14 include/timer.h File Reference

```
#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](#)

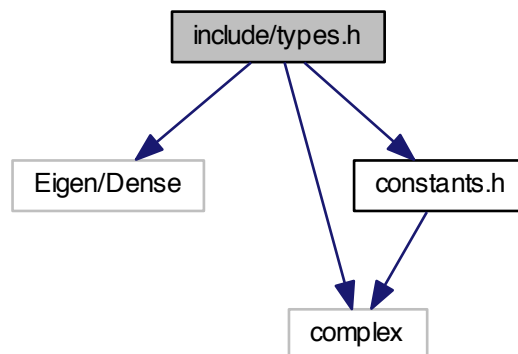
Namespaces

- [qpp](#)

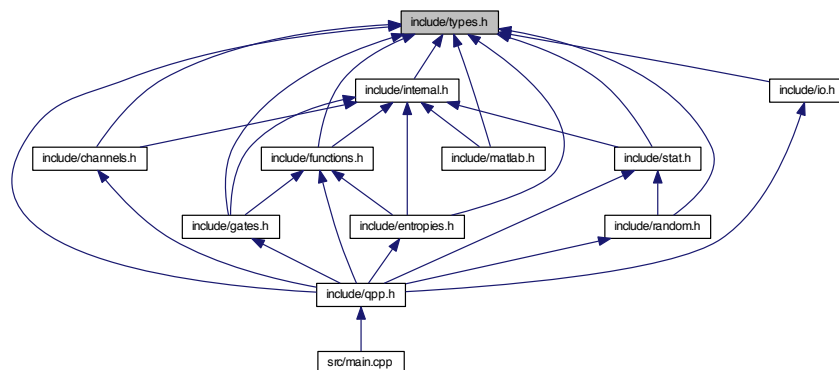
7.15 include/types.h File Reference

```
#include <Eigen/Dense>
#include <complex>
#include "constants.h"
```

Include dependency graph for types.h:



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



Namespaces

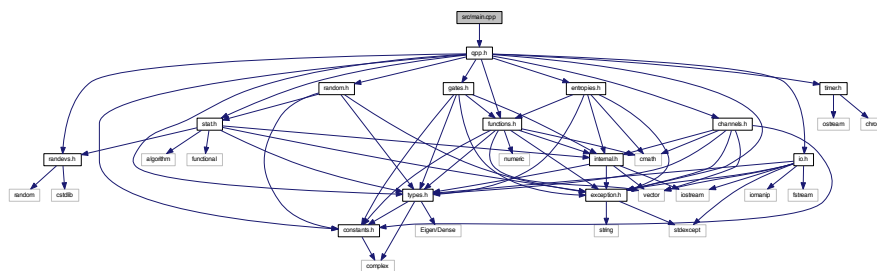
- `qpp`
- `qpp::types`

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 >`

- ## 7.16 src/main.cpp File Reference

Include dependency graph for main.cpp:



- `template<typename T >`
`types::Expression2DynMat< T > test (const Eigen::MatrixBase< T > &A)`
- `int main ()`

7.16.1.1 int main ()

```

graph LR
    main[main] --> ctrl[qpp::Gates::CTRL]
    ctrl --> powm[qpp::powm]
    ctrl --> check_n2multidx[qpp::internal::_check_n2multidx]
    ctrl --> multidx2n[qpp::internal::_multidx2n]
    main --> multidx2n
    powm --> check_square_mat[qpp::internal::_check_square_mat]
    check_n2multidx --> check_square_mat
    multidx2n --> check_square_mat
    check_square_mat --> return[return]
  
```

Generated on Mon Apr 7 2014 23:37:14 for qpp by Doxygen