

qpp
0.1

Generated by Doxygen 1.8.5

Fri May 16 2014 01:53:32

Contents

1	Namespace Index	1
1.1	Namespace List	1
2	Hierarchical Index	3
2.1	Class Hierarchy	3
3	Class Index	5
3.1	Class List	5
4	File Index	7
4.1	File List	7
5	Namespace Documentation	9
5.1	qpp Namespace Reference	9
5.1.1	Function Documentation	13
5.1.1.1	absm	13
5.1.1.2	adjoint	14
5.1.1.3	anticomm	14
5.1.1.4	channel	14
5.1.1.5	channel	15
5.1.1.6	choi	15
5.1.1.7	choi2kraus	16
5.1.1.8	comm	16
5.1.1.9	compperm	17
5.1.1.10	conjugate	17
5.1.1.11	cosm	17
5.1.1.12	cwise	18
5.1.1.13	det	18
5.1.1.14	disp	18
5.1.1.15	disp	18
5.1.1.16	disp	18
5.1.1.17	disp	18
5.1.1.18	displn	19

5.1.1.19	displn	19
5.1.1.20	displn	19
5.1.1.21	displn	20
5.1.1.22	entanglement	20
5.1.1.23	evals	21
5.1.1.24	evecs	21
5.1.1.25	expandout	22
5.1.1.26	expm	22
5.1.1.27	funm	22
5.1.1.28	gconcurrency	23
5.1.1.29	grams	24
5.1.1.30	grams	24
5.1.1.31	grams	24
5.1.1.32	hevals	25
5.1.1.33	hevecs	25
5.1.1.34	inverse	25
5.1.1.35	invperm	26
5.1.1.36	kron	26
5.1.1.37	kron	26
5.1.1.38	kron	26
5.1.1.39	kron	27
5.1.1.40	kronpow	27
5.1.1.41	load	27
5.1.1.42	loadMATLABmatrix	27
5.1.1.43	loadMATLABmatrix	27
5.1.1.44	loadMATLABmatrix	27
5.1.1.45	logdet	28
5.1.1.46	logm	28
5.1.1.47	mket	28
5.1.1.48	mket	29
5.1.1.49	mket	29
5.1.1.50	multiidx2n	29
5.1.1.51	n2multiidx	30
5.1.1.52	norm	30
5.1.1.53	powm	30
5.1.1.54	prj	31
5.1.1.55	ptrace	32
5.1.1.56	ptrace1	33
5.1.1.57	ptrace2	33
5.1.1.58	ptranspose	34

5.1.1.59	qmutualinfo	35
5.1.1.60	rand	35
5.1.1.61	rand	35
5.1.1.62	rand	35
5.1.1.63	rand	36
5.1.1.64	randH	36
5.1.1.65	randint	36
5.1.1.66	randket	37
5.1.1.67	randkraus	37
5.1.1.68	randn	37
5.1.1.69	randn	37
5.1.1.70	randn	37
5.1.1.71	randn	38
5.1.1.72	randperm	38
5.1.1.73	randrho	38
5.1.1.74	randU	38
5.1.1.75	randV	39
5.1.1.76	renyi	39
5.1.1.77	renyi_inf	39
5.1.1.78	reshape	40
5.1.1.79	save	40
5.1.1.80	saveMATLABmatrix	40
5.1.1.81	saveMATLABmatrix	40
5.1.1.82	saveMATLABmatrix	40
5.1.1.83	schmidtcoeff	41
5.1.1.84	schmidtprob	41
5.1.1.85	schmidtU	42
5.1.1.86	schmidtV	42
5.1.1.87	shannon	43
5.1.1.88	sinm	43
5.1.1.89	spectralpowm	43
5.1.1.90	sqrtn	44
5.1.1.91	sum	44
5.1.1.92	super	44
5.1.1.93	syspermute	45
5.1.1.94	trace	45
5.1.1.95	transpose	46
5.1.1.96	tsallis	46
5.1.2	Variable Documentation	46
5.1.2.1	gt	46

5.1.2.2	rdevs	46
5.1.2.3	st	46
5.2	qpp::ct Namespace Reference	46
5.2.1	Function Documentation	47
5.2.1.1	omega	47
5.2.2	Variable Documentation	47
5.2.2.1	chop	47
5.2.2.2	ee	47
5.2.2.3	eps	47
5.2.2.4	ii	47
5.2.2.5	maxn	47
5.2.2.6	pi	47
5.3	qpp::internal Namespace Reference	47
5.3.1	Function Documentation	48
5.3.1.1	_check_col_vector	48
5.3.1.2	_check_dims	48
5.3.1.3	_check_dims_match_cvect	48
5.3.1.4	_check_dims_match_mat	48
5.3.1.5	_check_dims_match_rvect	48
5.3.1.6	_check_eq_dims	48
5.3.1.7	_check_nonzero_size	48
5.3.1.8	_check_perm	48
5.3.1.9	_check_row_vector	48
5.3.1.10	_check_square_mat	48
5.3.1.11	_check_subsys_match_dims	48
5.3.1.12	_check_vector	48
5.3.1.13	_kron2	48
5.3.1.14	_multiidx2n	49
5.3.1.15	_n2multiidx	49
5.3.1.16	variadic_vector_emplace	49
5.3.1.17	variadic_vector_emplace	49
5.4	qpp::types Namespace Reference	49
5.4.1	Typedef Documentation	49
5.4.1.1	bra	49
5.4.1.2	cmat	49
5.4.1.3	cplx	49
5.4.1.4	dmat	49
5.4.1.5	DynMat	49
5.4.1.6	ket	49

6	Class Documentation	51
6.1	qpp::DiscreteDistribution Class Reference	51
6.1.1	Constructor & Destructor Documentation	51
6.1.1.1	DiscreteDistribution	51
6.1.1.2	DiscreteDistribution	51
6.1.1.3	DiscreteDistribution	51
6.1.2	Member Function Documentation	51
6.1.2.1	probabilities	51
6.1.2.2	sample	52
6.1.3	Member Data Documentation	52
6.1.3.1	_d	52
6.2	qpp::DiscreteDistributionAbsSquare Class Reference	52
6.2.1	Constructor & Destructor Documentation	52
6.2.1.1	DiscreteDistributionAbsSquare	53
6.2.1.2	DiscreteDistributionAbsSquare	53
6.2.1.3	DiscreteDistributionAbsSquare	53
6.2.1.4	DiscreteDistributionAbsSquare	54
6.2.2	Member Function Documentation	54
6.2.2.1	cplx2weights	54
6.2.2.2	probabilities	54
6.2.2.3	sample	54
6.2.3	Member Data Documentation	54
6.2.3.1	_d	54
6.3	qpp::Exception Class Reference	54
6.3.1	Member Enumeration Documentation	56
6.3.1.1	Type	56
6.3.2	Constructor & Destructor Documentation	57
6.3.2.1	Exception	57
6.3.2.2	Exception	57
6.3.2.3	~Exception	57
6.3.3	Member Function Documentation	57
6.3.3.1	_construct_exception_msg	57
6.3.3.2	what	57
6.3.4	Member Data Documentation	57
6.3.4.1	_custom	57
6.3.4.2	_msg	57
6.3.4.3	_type	57
6.3.4.4	_where	57
6.4	qpp::Gates Class Reference	58
6.4.1	Constructor & Destructor Documentation	59

6.4.1.1	~Gates	59
6.4.1.2	Gates	59
6.4.1.3	Gates	59
6.4.2	Member Function Documentation	59
6.4.2.1	apply	59
6.4.2.2	CTRL	60
6.4.2.3	Fd	60
6.4.2.4	getInstance	60
6.4.2.5	Id	60
6.4.2.6	operator=	60
6.4.2.7	Rn	60
6.4.2.8	Xd	61
6.4.2.9	Zd	61
6.4.3	Member Data Documentation	61
6.4.3.1	CNOTab	61
6.4.3.2	CNOTba	61
6.4.3.3	CZ	61
6.4.3.4	FRED	61
6.4.3.5	H	61
6.4.3.6	Id2	61
6.4.3.7	S	61
6.4.3.8	SWAP	61
6.4.3.9	T	61
6.4.3.10	TOF	61
6.4.3.11	X	61
6.4.3.12	Y	62
6.4.3.13	Z	62
6.5	qpp::NormalDistribution Class Reference	62
6.5.1	Constructor & Destructor Documentation	62
6.5.1.1	NormalDistribution	62
6.5.2	Member Function Documentation	62
6.5.2.1	sample	62
6.5.3	Member Data Documentation	62
6.5.3.1	_d	62
6.6	qpp::Qudit Class Reference	63
6.6.1	Constructor & Destructor Documentation	63
6.6.1.1	Qudit	63
6.6.1.2	~Qudit	63
6.6.2	Member Function Documentation	63
6.6.2.1	getD	63

6.6.2.2	getRho	63
6.6.2.3	measure	64
6.6.2.4	measure	64
6.6.3	Member Data Documentation	64
6.6.3.1	_D	64
6.6.3.2	_rho	64
6.7	qpp::RandomDevices Class Reference	65
6.7.1	Constructor & Destructor Documentation	65
6.7.1.1	~RandomDevices	65
6.7.1.2	RandomDevices	65
6.7.1.3	RandomDevices	65
6.7.2	Member Function Documentation	65
6.7.2.1	getInstance	65
6.7.2.2	operator=	65
6.7.3	Member Data Documentation	65
6.7.3.1	_rd	65
6.7.3.2	_rng	65
6.8	qpp::States Class Reference	65
6.8.1	Constructor & Destructor Documentation	66
6.8.1.1	~States	66
6.8.1.2	States	66
6.8.1.3	States	66
6.8.2	Member Function Documentation	66
6.8.2.1	getInstance	66
6.8.2.2	operator=	67
6.8.3	Member Data Documentation	67
6.8.3.1	b00	67
6.8.3.2	b01	67
6.8.3.3	b10	67
6.8.3.4	b11	67
6.8.3.5	GHZ	67
6.8.3.6	pb00	67
6.8.3.7	pb01	67
6.8.3.8	pb10	67
6.8.3.9	pb11	67
6.8.3.10	pGHZ	67
6.8.3.11	pW	67
6.8.3.12	px0	67
6.8.3.13	px1	67
6.8.3.14	py0	67

6.8.3.15	py1	67
6.8.3.16	pz0	67
6.8.3.17	pz1	67
6.8.3.18	W	67
6.8.3.19	x0	67
6.8.3.20	x1	67
6.8.3.21	y0	67
6.8.3.22	y1	67
6.8.3.23	z0	67
6.8.3.24	z1	67
6.9	qpp::Timer Class Reference	68
6.9.1	Constructor & Destructor Documentation	68
6.9.1.1	Timer	68
6.9.1.2	~Timer	68
6.9.2	Member Function Documentation	68
6.9.2.1	seconds	68
6.9.2.2	tic	68
6.9.2.3	toc	68
6.9.3	Friends And Related Function Documentation	68
6.9.3.1	operator<<	68
6.9.4	Member Data Documentation	68
6.9.4.1	_end	68
6.9.4.2	_start	68
6.10	qpp::UniformRealDistribution Class Reference	68
6.10.1	Constructor & Destructor Documentation	69
6.10.1.1	UniformRealDistribution	69
6.10.2	Member Function Documentation	69
6.10.2.1	sample	69
6.10.3	Member Data Documentation	69
6.10.3.1	_d	69
7	File Documentation	71
7.1	include/channels.h File Reference	71
7.2	include/classes/exception.h File Reference	72
7.3	include/classes/gates.h File Reference	73
7.4	include/classes/qudit.h File Reference	74
7.5	include/classes/randevs.h File Reference	75
7.6	include/classes/stat.h File Reference	76
7.7	include/classes/states.h File Reference	77
7.8	include/classes/timer.h File Reference	79

7.9	include/constants.h File Reference	79
7.10	include/entanglement.h File Reference	81
7.11	include/entropies.h File Reference	82
7.12	include/functions.h File Reference	83
7.13	include/internal.h File Reference	86
7.14	include/io.h File Reference	88
7.15	include/matlab.h File Reference	89
7.16	include/qpp.h File Reference	90
7.17	include/random.h File Reference	91
7.18	include/types.h File Reference	93

Chapter 1

Namespace Index

1.1 Namespace List

Here is a list of all namespaces with brief descriptions:

qpp	9
qpp::ct	46
qpp::internal	47
qpp::types	49

Chapter 2

Hierarchical Index

2.1 Class Hierarchy

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

qpp::DiscreteDistribution	51
qpp::DiscreteDistributionAbsSquare	52
exception	
qpp::Exception	54
qpp::Gates	58
qpp::NormalDistribution	62
qpp::Qudit	63
qpp::RandomDevices	65
qpp::States	65
qpp::Timer	68
qpp::UniformRealDistribution	68

Chapter 3

Class Index

3.1 Class List

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

qpp::DiscreteDistribution	51
qpp::DiscreteDistributionAbsSquare	52
qpp::Exception	54
qpp::Gates	58
qpp::NormalDistribution	62
qpp::Qudit	63
qpp::RandomDevices	65
qpp::States	65
qpp::Timer	68
qpp::UniformRealDistribution	68

Chapter 4

File Index

4.1 File List

Here is a list of all files with brief descriptions:

include/channels.h	71
include/constants.h	79
include/entanglement.h	81
include/entropies.h	82
include/functions.h	83
include/internal.h	86
include/io.h	88
include/matlab.h	89
include/qpp.h	90
include/random.h	91
include/types.h	93
include/classes/exception.h	72
include/classes/gates.h	73
include/classes/qudit.h	74
include/classes/randevs.h	75
include/classes/stat.h	76
include/classes/states.h	77
include/classes/timer.h	79

Chapter 5

Namespace Documentation

5.1 qpp Namespace Reference

Namespaces

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

Classes

- class [Exception](#)
- class [Gates](#)
- class [Qudit](#)
- class [RandomDevices](#)
- class [NormalDistribution](#)
- class [UniformRealDistribution](#)
- class [DiscreteDistribution](#)
- class [DiscreteDistributionAbsSquare](#)
- class [States](#)
- class [Timer](#)

Functions

- [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 Derived >
[types::cmat channel](#) (const Eigen::MatrixBase< Derived > &rho, const std::vector< [types::cmat](#) > &Ks)
- template<typename Derived >
[types::cmat channel](#) (const Eigen::MatrixBase< Derived > &rho, const std::vector< [types::cmat](#) > &Ks,
const std::vector< size_t > &subsys, const std::vector< size_t > &dims)
- template<typename Derived >
[types::cmat schmidtcoeff](#) (const Eigen::MatrixBase< Derived > &A, const std::vector< size_t > &dims)
- template<typename Derived >
[types::cmat schmidtU](#) (const Eigen::MatrixBase< Derived > &A, const std::vector< size_t > &dims)
- template<typename Derived >
[types::cmat schmidtV](#) (const Eigen::MatrixBase< Derived > &A, const std::vector< size_t > &dims)

- `template<typename Derived >`
`types::cmat schmidtprob` (const Eigen::MatrixBase< Derived > &A, const std::vector< size_t > &dims)
- `template<typename Derived >`
`double entanglement` (const Eigen::MatrixBase< Derived > &A, const std::vector< size_t > &dims)
- `template<typename Derived >`
`double gconcurrency` (const Eigen::MatrixBase< Derived > &A)
- `template<typename Derived >`
`double shannon` (const Eigen::MatrixBase< Derived > &A)
- `template<typename Derived >`
`double renyi` (const double alpha, const Eigen::MatrixBase< Derived > &A)
- `template<typename Derived >`
`double renyi_inf` (const Eigen::MatrixBase< Derived > &A)
- `template<typename Derived >`
`double tsallis` (const double alpha, const Eigen::MatrixBase< Derived > &A)
- `template<typename Derived >`
`double qmutualinfo` (const Eigen::MatrixBase< Derived > &A, const std::vector< size_t > &subsys, const std::vector< size_t > &dims)
- `template<typename Derived >`
`types::DynMat< typename`
`Derived::Scalar > transpose` (const Eigen::MatrixBase< Derived > &A)
- `template<typename Derived >`
`types::DynMat< typename`
`Derived::Scalar > conjugate` (const Eigen::MatrixBase< Derived > &A)
- `template<typename Derived >`
`types::DynMat< typename`
`Derived::Scalar > adjoint` (const Eigen::MatrixBase< Derived > &A)
- `template<typename Derived >`
`types::DynMat< typename`
`Derived::Scalar > inverse` (const Eigen::MatrixBase< Derived > &A)
- `template<typename Derived >`
`Derived::Scalar trace` (const Eigen::MatrixBase< Derived > &A)
- `template<typename Derived >`
`Derived::Scalar det` (const Eigen::MatrixBase< Derived > &A)
- `template<typename Derived >`
`Derived::Scalar logdet` (const Eigen::MatrixBase< Derived > &A)
- `template<typename Derived >`
`Derived::Scalar sum` (const Eigen::MatrixBase< Derived > &A)
- `template<typename Derived >`
`double norm` (const Eigen::MatrixBase< Derived > &A)
- `template<typename Derived >`
`types::cmat evals` (const Eigen::MatrixBase< Derived > &A)
- `template<typename Derived >`
`types::cmat evecs` (const Eigen::MatrixBase< Derived > &A)
- `template<typename Derived >`
`types::dmat hevals` (const Eigen::MatrixBase< Derived > &A)
- `template<typename Derived >`
`types::cmat hevecs` (const Eigen::MatrixBase< Derived > &A)
- `template<typename Derived >`
`types::cmat funm` (const Eigen::MatrixBase< Derived > &A, `types::cplx`(*f)(const `types::cplx` &))
- `template<typename Derived >`
`types::cmat sqrtm` (const Eigen::MatrixBase< Derived > &A)
- `template<typename Derived >`
`types::cmat absm` (const Eigen::MatrixBase< Derived > &A)
- `template<typename Derived >`
`types::cmat expm` (const Eigen::MatrixBase< Derived > &A)
- `template<typename Derived >`
`types::cmat logm` (const Eigen::MatrixBase< Derived > &A)

- `template<typename Derived >`
`types::cmat sinm` (const Eigen::MatrixBase< Derived > &A)
- `template<typename Derived >`
`types::cmat cosm` (const Eigen::MatrixBase< Derived > &A)
- `template<typename Derived >`
`types::cmat spectralpowm` (const Eigen::MatrixBase< Derived > &A, const `types::cplx` z)
- `template<typename Derived >`
`types::DynMat< typename`
`Derived::Scalar > powm` (const Eigen::MatrixBase< Derived > &A, size_t n)
- `template<typename OutputScalar, typename Derived >`
`types::DynMat< OutputScalar > cwise` (const Eigen::MatrixBase< Derived > &A, OutputScalar (*)(const
typename Derived::Scalar &))
- `template<typename T >`
`types::DynMat< typename T::Scalar > kron` (const T &head)
- `template<typename T, typename... Args>`
`types::DynMat< typename T::Scalar > kron` (const T &head, const Args &...tail)
- `template<typename Derived >`
`types::DynMat< typename`
`Derived::Scalar > kron` (const std::vector< Derived > &As)
- `template<typename Derived >`
`types::DynMat< typename`
`Derived::Scalar > kron` (const std::initializer_list< Derived > &As)
- `template<typename Derived >`
`types::DynMat< typename`
`Derived::Scalar > kronpow` (const Eigen::MatrixBase< Derived > &A, size_t n)
- `template<typename Derived >`
`types::DynMat< typename`
`Derived::Scalar > reshape` (const Eigen::MatrixBase< Derived > &A, size_t rows, size_t cols)
- `template<typename Derived >`
`types::DynMat< typename`
`Derived::Scalar > syspermute` (const Eigen::MatrixBase< Derived > &A, const std::vector< size_t > &perm,
const std::vector< size_t > &dims)
- `template<typename Derived >`
`types::DynMat< typename`
`Derived::Scalar > ptrace1` (const Eigen::MatrixBase< Derived > &A, const std::vector< size_t > &dims)
- `template<typename Derived >`
`types::DynMat< typename`
`Derived::Scalar > ptrace2` (const Eigen::MatrixBase< Derived > &A, const std::vector< size_t > &dims)
- `template<typename Derived >`
`types::DynMat< typename`
`Derived::Scalar > ptrace` (const Eigen::MatrixBase< Derived > &A, const std::vector< size_t > &subsyst,
const std::vector< size_t > &dims)
- `template<typename Derived >`
`types::DynMat< typename`
`Derived::Scalar > ptranspose` (const Eigen::MatrixBase< Derived > &A, const std::vector< size_t > &sub-
syst, const std::vector< size_t > &dims)
- `template<typename Derived1, typename Derived2 >`
`types::DynMat< typename`
`Derived1::Scalar > comm` (const Eigen::MatrixBase< Derived1 > &A, const Eigen::MatrixBase< Derived2
> &B)
- `template<typename Derived1, typename Derived2 >`
`types::DynMat< typename`
`Derived1::Scalar > anticomm` (const Eigen::MatrixBase< Derived1 > &A, const Eigen::MatrixBase< De-
rived2 > &B)
- `template<typename Derived >`
`types::DynMat< typename`
`Derived::Scalar > prj` (const Eigen::MatrixBase< Derived > &V)

- `template<typename Derived >`
`types::DynMat< typename`
`Derived::Scalar > expandout` (const Eigen::MatrixBase< Derived > &A, size_t pos, const std::vector< size_t > &dims)
- `template<typename Derived >`
`types::DynMat< typename`
`Derived::Scalar > grams` (const std::vector< Derived > &Vs)
- `template<typename Derived >`
`types::DynMat< typename`
`Derived::Scalar > grams` (const std::initializer_list< Derived > &Vs)
- `template<typename Derived >`
`types::DynMat< typename`
`Derived::Scalar > grams` (const Eigen::MatrixBase< Derived > &A)
- `std::vector< size_t > n2multiidx` (size_t n, const std::vector< size_t > &dims)
- `size_t multiidx2n` (const std::vector< size_t > &midx, const std::vector< size_t > &dims)
- `types::ket mket` (const std::vector< size_t > &mask)
- `types::ket mket` (const std::vector< size_t > &mask, const std::vector< size_t > &dims)
- `types::ket mket` (const std::vector< size_t > &mask, size_t d)
- `std::vector< size_t > invperm` (const std::vector< size_t > &perm)
- `std::vector< size_t > compperm` (const std::vector< size_t > &perm, const std::vector< size_t > &sigma)
- `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 Derived >`
`void disp` (const Eigen::MatrixBase< Derived > &A, double chop=ct::chop, std::ostream &os=std::cout)
- `template<typename Derived >`
`void displn` (const Eigen::MatrixBase< Derived > &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 Derived >`
`void save` (const Eigen::MatrixBase< Derived > &A, const std::string &fname)
- `template<typename Derived >`
`types::DynMat< typename`
`Derived::Scalar > load` (const std::string &fname)
- `template<typename Derived >`
`Derived loadMATLABmatrix` (const std::string &mat_file, const std::string &var_name)
- `template<>`
`types::dmat loadMATLABmatrix` (const std::string &mat_file, const std::string &var_name)
- `template<>`
`types::cmat loadMATLABmatrix` (const std::string &mat_file, const std::string &var_name)
- `template<typename Derived >`
`void saveMATLABmatrix` (const Eigen::MatrixBase< Derived > &A, const std::string &mat_file, const std::string &var_name, const std::string &mode)
- `template<>`
`void saveMATLABmatrix` (const Eigen::MatrixBase< typename types::dmat > &A, const std::string &mat_file, const std::string &var_name, const std::string &mode)

- `template<>`
void `saveMATLABmatrix` (const Eigen::MatrixBase< typename `types::cmat` > &A, const std::string &mat_file, const std::string &var_name, const std::string &mode)
- `template<typename Derived >`
Derived `rand` (size_t rows, size_t cols, double a=0, double b=1)
- `template<>`
`types::dmat rand` (size_t rows, size_t cols, double a, double b)
- `template<>`
`types::cmat rand` (size_t rows, size_t cols, double a, double b)
- double `rand` (double a=0, double b=1)
- long long `randint` (long long a, long long b)
- `template<typename Derived >`
Derived `randn` (size_t rows, size_t cols, double mean=0, double sigma=1)
- `template<>`
`types::dmat randn` (size_t rows, size_t cols, double mean, double sigma)
- `template<>`
`types::cmat 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::ket randket` (size_t D)
- `types::cmat randrho` (size_t D)
- `std::vector< size_t > randperm` (size_t n)

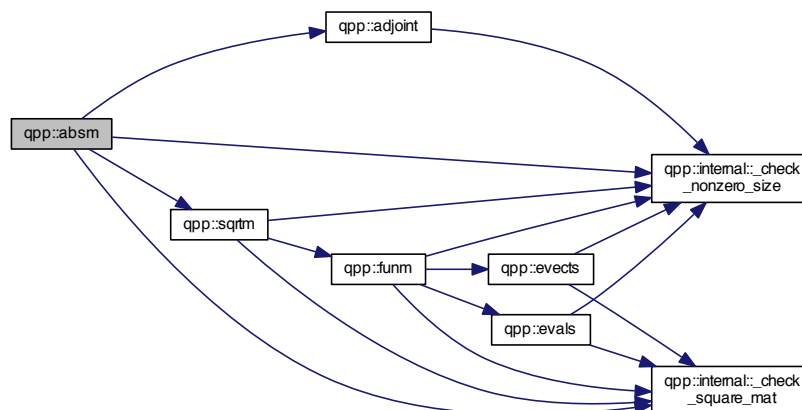
Variables

- `RandomDevices` & `rdevs` = `RandomDevices::getInstance()`
- const `Gates` & `gt` = `Gates::getInstance()`
- const `States` & `st` = `States::getInstance()`

5.1.1 Function Documentation

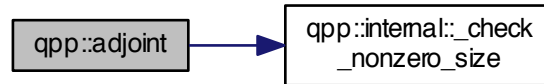
5.1.1.1 `template<typename Derived > types::cmat qpp::absm (const Eigen::MatrixBase< Derived > &A)`

Here is the call graph for this function:



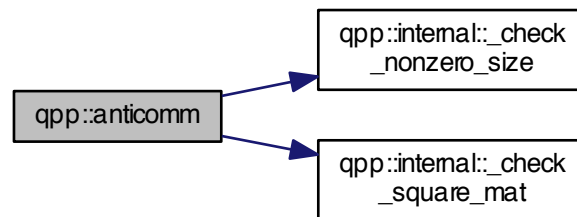
5.1.1.2 `template<typename Derived > types::DynMat<typename Derived::Scalar> qpp::adjoint (const Eigen::MatrixBase< Derived > & A)`

Here is the call graph for this function:



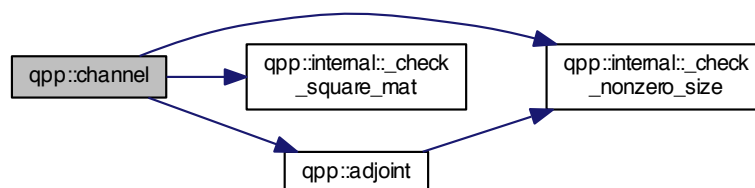
5.1.1.3 `template<typename Derived1 , typename Derived2 > types::DynMat<typename Derived1::Scalar> qpp::anticomm (const Eigen::MatrixBase< Derived1 > & A, const Eigen::MatrixBase< Derived2 > & B)`

Here is the call graph for this function:



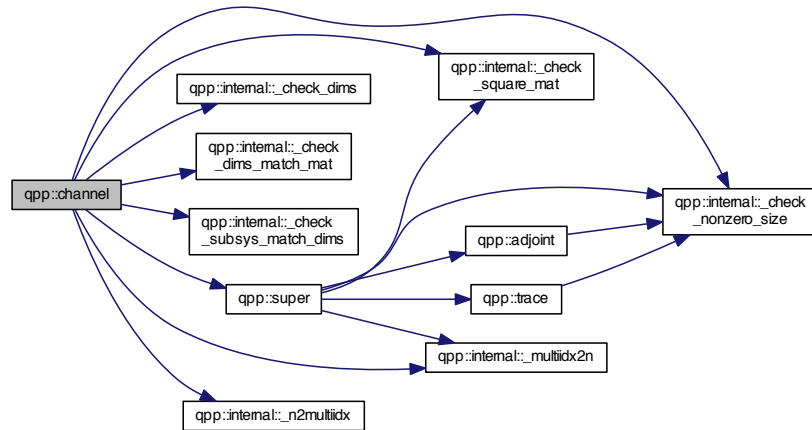
5.1.1.4 `template<typename Derived > types::cmat qpp::channel (const Eigen::MatrixBase< Derived > & rho, const std::vector< types::cmat > & Ks)`

Here is the call graph for this function:



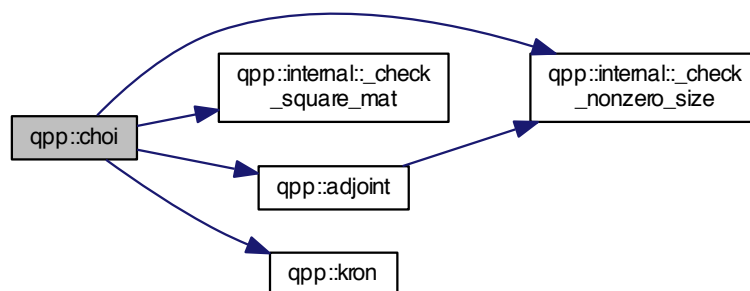
5.1.1.5 `template<typename Derived > types::cmat qpp::channel (const Eigen::MatrixBase< Derived > & rho, const std::vector< types::cmat > & Ks, const std::vector< size_t > & subsys, const std::vector< size_t > & dims)`

Here is the call graph for this function:



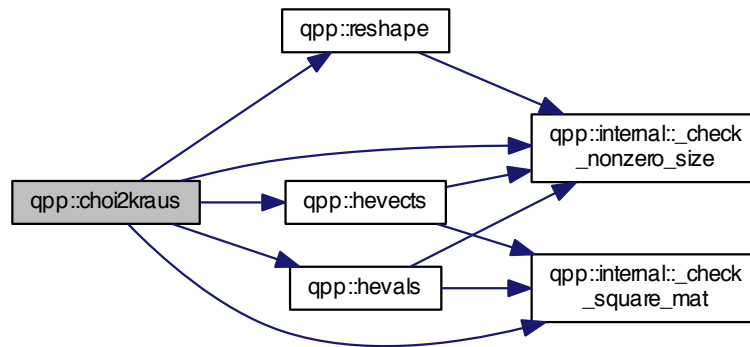
5.1.1.6 `types::cmat qpp::choi (const std::vector< types::cmat > & Ks)`

Here is the call graph for this function:



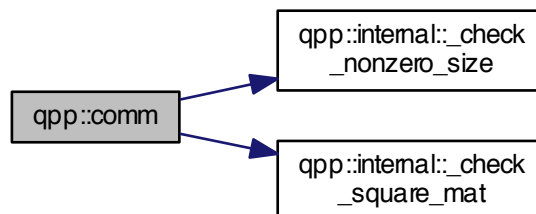
5.1.1.7 `std::vector<types::cmat> qpp::choi2kraus (const types::cmat & A)`

Here is the call graph for this function:



5.1.1.8 `template<typename Derived1 , typename Derived2 > types::DynMat<typename Derived1::Scalar> qpp::comm (const Eigen::MatrixBase< Derived1 > & A, const Eigen::MatrixBase< Derived2 > & B)`

Here is the call graph for this function:



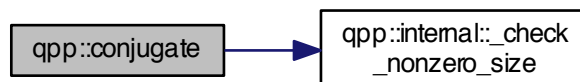
5.1.1.9 `std::vector<size_t> qpp::compperm (const std::vector< size_t > & perm, const std::vector< size_t > & sigma)`

Here is the call graph for this function:



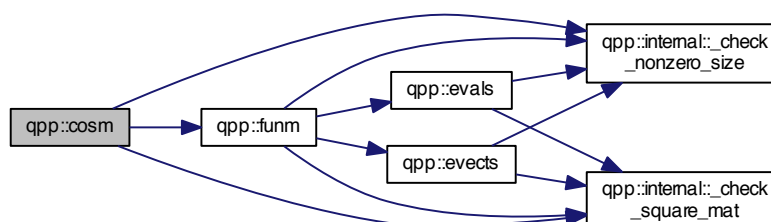
5.1.1.10 `template<typename Derived > types::DynMat<typename Derived::Scalar> qpp::conjugate (const Eigen::MatrixBase< Derived > & A)`

Here is the call graph for this function:



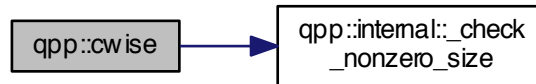
5.1.1.11 `template<typename Derived > types::cmat qpp::cosm (const Eigen::MatrixBase< Derived > & A)`

Here is the call graph for this function:



5.1.1.12 `template<typename OutputScalar , typename Derived > types::DynMat<OutputScalar> qpp::cwise (const Eigen::MatrixBase< Derived > & A, OutputScalar*)(const typename Derived::Scalar &) f)`

Here is the call graph for this function:



5.1.1.13 `template<typename Derived > Derived::Scalar qpp::det (const Eigen::MatrixBase< Derived > & A)`

Here is the call graph for this function:



5.1.1.14 `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)`

5.1.1.15 `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)`

5.1.1.16 `template<typename Derived > void qpp::disp (const Eigen::MatrixBase< Derived > & A, double chop = ct::chop, std::ostream & os = std::cout)`

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

Here is the call graph for this function:



5.1.1.18 `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:



5.1.1.19 `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:



5.1.1.20 `template<typename Derived> void qpp::displn (const Eigen::MatrixBase< Derived > & A, double chop = ct::chop, std::ostream & os = std::cout)`

Here is the call graph for this function:



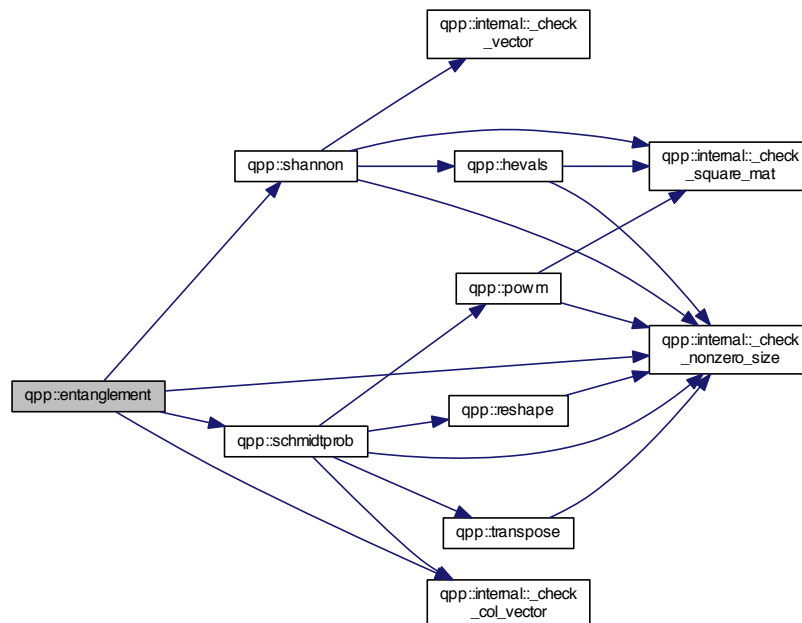
5.1.1.21 `void qpp::displn (const types::cplx c, double chop = ct:::chop, std::ostream & os = std:::cout)`

Here is the call graph for this function:



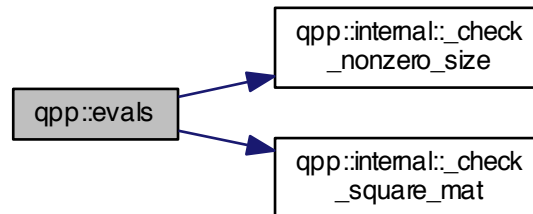
5.1.1.22 `template<typename Derived> double qpp::entanglement (const Eigen::MatrixBase< Derived > & A, const std::vector< size_t > & dims)`

Here is the call graph for this function:



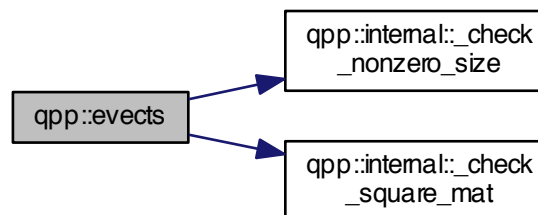
5.1.1.23 `template<typename Derived> types::cmat qpp::evals (const Eigen::MatrixBase< Derived > & A)`

Here is the call graph for this function:



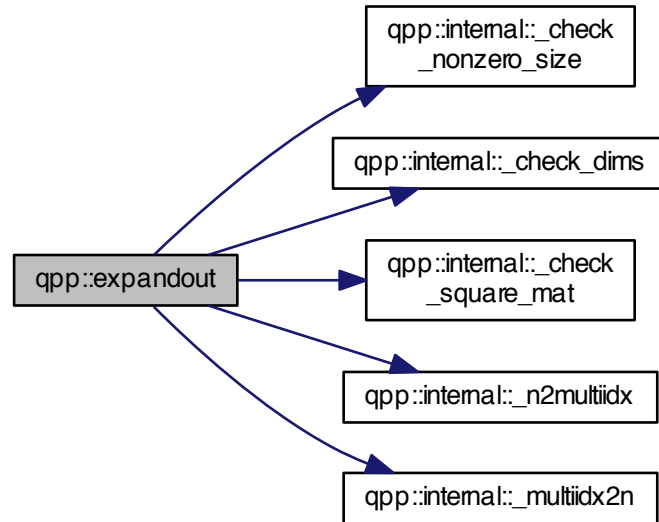
5.1.1.24 `template<typename Derived> types::cmat qpp::evecs (const Eigen::MatrixBase< Derived > & A)`

Here is the call graph for this function:



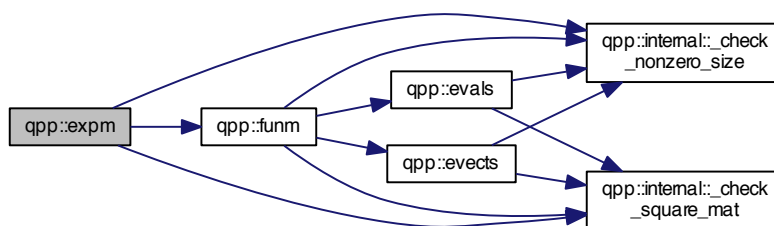
5.1.1.25 `template<typename Derived> types::DynMat<typename Derived::Scalar> qpp::expandout (const Eigen::MatrixBase< Derived> & A, size_t pos, const std::vector< size_t> & dims)`

Here is the call graph for this function:



5.1.1.26 `template<typename Derived> types::cmat qpp::expm (const Eigen::MatrixBase< Derived> & A)`

Here is the call graph for this function:



5.1.1.27 `template<typename Derived> types::cmat qpp::funm (const Eigen::MatrixBase< Derived> & A, types::cplx*)(const types::cplx &) f)`

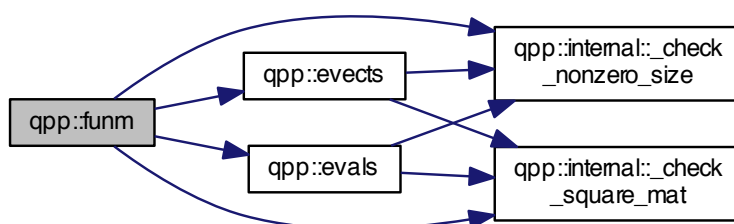
Parameters

A	input matrix
f	function pointer

Returns

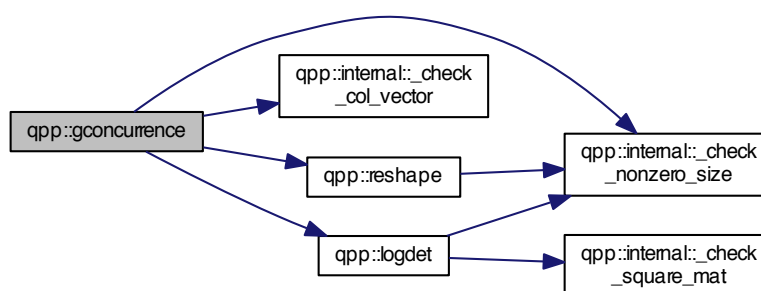
[types::cmat](#)

Here is the call graph for this function:



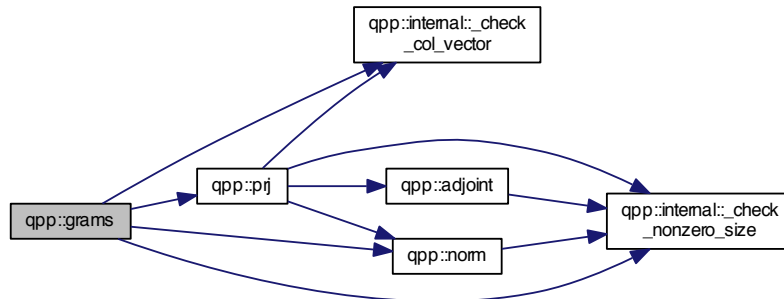
5.1.1.28 `template<typename Derived> double qpp::gconcurrency (const Eigen::MatrixBase< Derived> & A)`

Here is the call graph for this function:



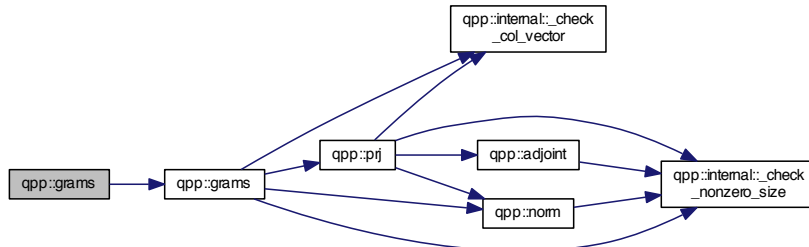
5.1.1.29 `template<typename Derived > types::DynMat<typename Derived::Scalar> qpp::grams (const std::vector< Derived > & Vs)`

Here is the call graph for this function:



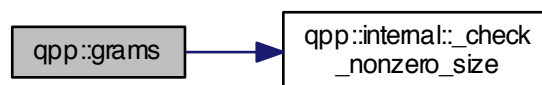
5.1.1.30 `template<typename Derived > types::DynMat<typename Derived::Scalar> qpp::grams (const std::initializer_list< Derived > & Vs)`

Here is the call graph for this function:



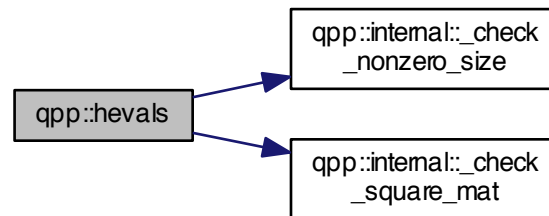
5.1.1.31 `template<typename Derived > types::DynMat<typename Derived::Scalar> qpp::grams (const Eigen::MatrixBase< Derived > & A)`

Here is the call graph for this function:



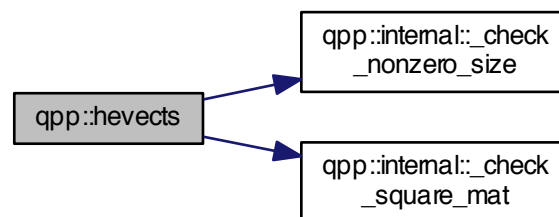
5.1.1.32 `template<typename Derived> types::dmat qpp::hevals (const Eigen::MatrixBase< Derived> & A)`

Here is the call graph for this function:



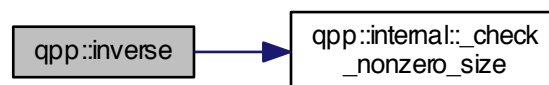
5.1.1.33 `template<typename Derived> types::cmat qpp::hevects (const Eigen::MatrixBase< Derived> & A)`

Here is the call graph for this function:



5.1.1.34 `template<typename Derived> types::DynMat<typename Derived::Scalar> qpp::inverse (const Eigen::MatrixBase< Derived> & A)`

Here is the call graph for this function:



5.1.1.35 `std::vector<size_t> qpp::invperm (const std::vector< size_t > & perm)`

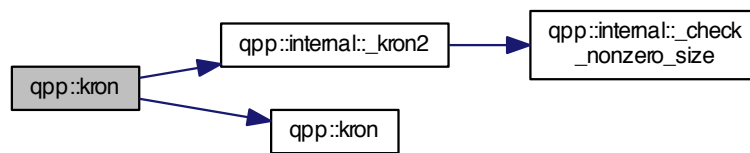
Here is the call graph for this function:



5.1.1.36 `template<typename T> types::DynMat<typename T::Scalar> qpp::kron (const T & head)`

5.1.1.37 `template<typename T, typename... Args> types::DynMat<typename T::Scalar> qpp::kron (const T & head, const Args &... tail)`

Here is the call graph for this function:



5.1.1.38 `template<typename Derived> types::DynMat<typename Derived::Scalar> qpp::kron (const std::vector< Derived > & As)`

Here is the call graph for this function:



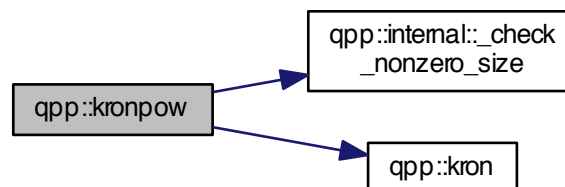
5.1.1.39 `template<typename Derived> types::DynMat<typename Derived::Scalar> qpp::kron (const std::initializer_list<Derived> & As)`

Here is the call graph for this function:



5.1.1.40 `template<typename Derived> types::DynMat<typename Derived::Scalar> qpp::kronpow (const Eigen::MatrixBase<Derived> & A, size_t n)`

Here is the call graph for this function:



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

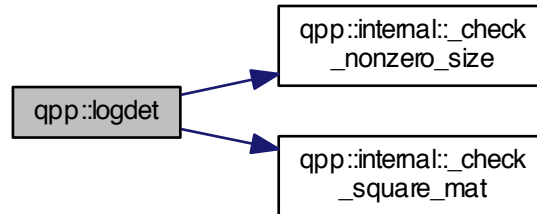
5.1.1.42 `template<typename Derived> Derived qpp::loadMATLABmatrix (const std::string & mat_file, const std::string & var_name)`

5.1.1.43 `template<> types::dmat qpp::loadMATLABmatrix (const std::string & mat_file, const std::string & var_name)`

5.1.1.44 `template<> types::cmat qpp::loadMATLABmatrix (const std::string & mat_file, const std::string & var_name)`

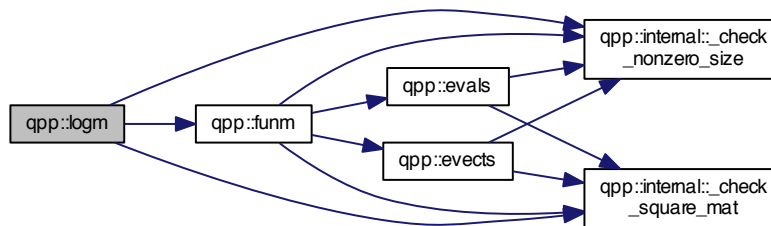
5.1.1.45 `template<typename Derived> Derived::Scalar qpp::logdet (const Eigen::MatrixBase< Derived> & A)`

Here is the call graph for this function:



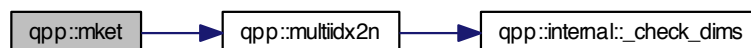
5.1.1.46 `template<typename Derived> types::cmat qpp::logm (const Eigen::MatrixBase< Derived> & A)`

Here is the call graph for this function:



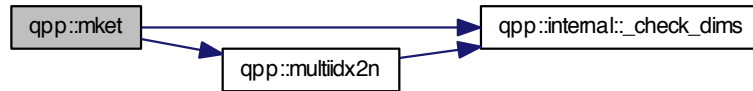
5.1.1.47 `types::ket qpp::mket (const std::vector< size_t> & mask)`

Here is the call graph for this function:

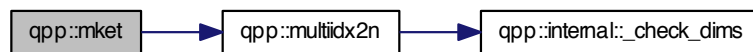


5.1.1.48 `types::ket qpp::mket (const std::vector< size_t > & mask, const std::vector< size_t > & dims)`

Here is the call graph for this function:

**5.1.1.49** `types::ket qpp::mket (const std::vector< size_t > & mask, size_t d)`

Here is the call graph for this function:

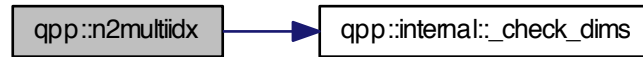
**5.1.1.50** `size_t qpp::multiidx2n (const std::vector< size_t > & midx, const std::vector< size_t > & dims)`

Here is the call graph for this function:



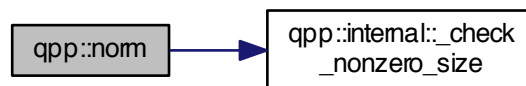
5.1.1.51 `std::vector<size_t> qpp::n2multiidx (size_t n, const std::vector< size_t > & dims)`

Here is the call graph for this function:



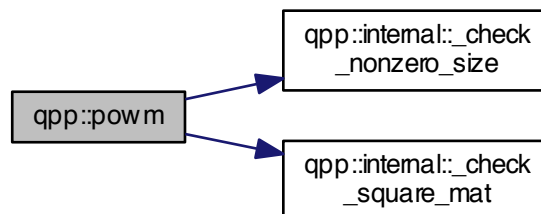
5.1.1.52 `template<typename Derived > double qpp::norm (const Eigen::MatrixBase< Derived > & A)`

Here is the call graph for this function:



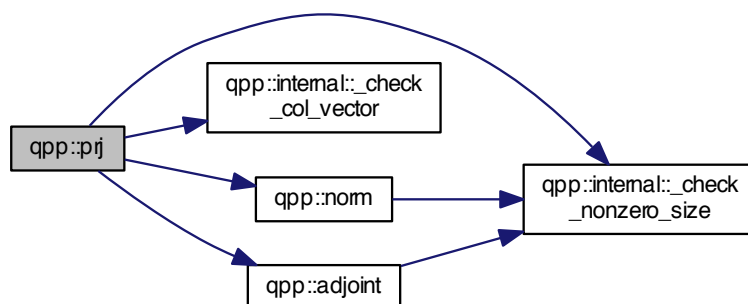
5.1.1.53 `template<typename Derived > types::DynMat<typename Derived::Scalar> qpp::powm (const Eigen::MatrixBase< Derived > & A, size_t n)`

Here is the call graph for this function:



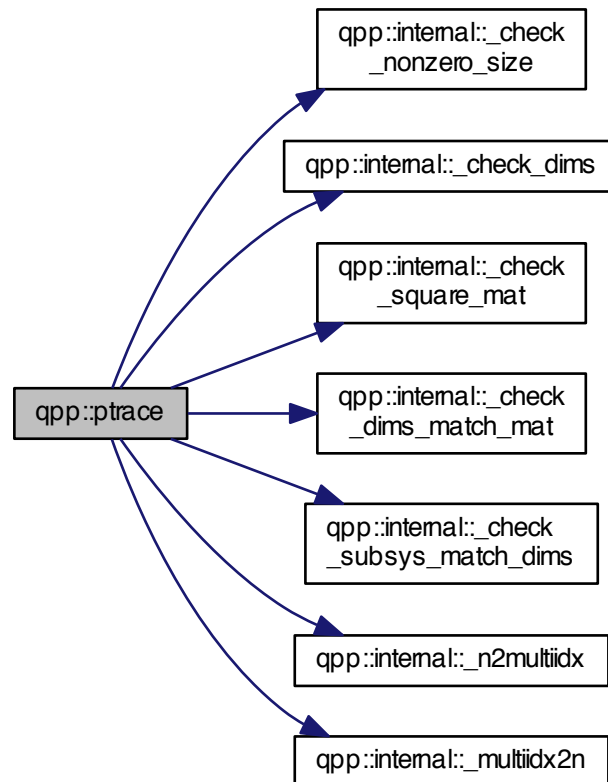
5.1.1.54 `template<typename Derived> types::DynMat<typename Derived::Scalar> qpp::prj (const Eigen::MatrixBase<Derived> & V)`

Here is the call graph for this function:



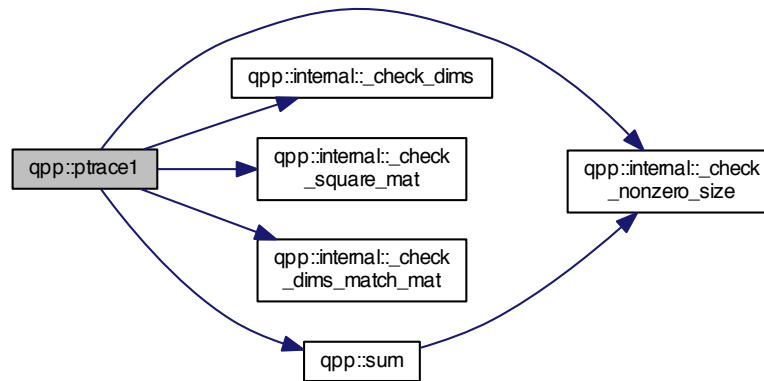
5.1.1.55 `template<typename Derived> types::DynMat<typename Derived::Scalar> qpp::ptrace (const Eigen::MatrixBase< Derived> & A, const std::vector< size_t> & subsys, const std::vector< size_t> & dims)`

Here is the call graph for this function:



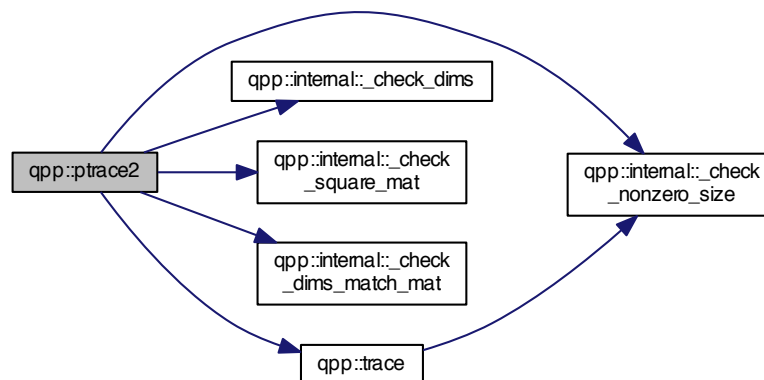
5.1.1.56 `template<typename Derived> types::DynMat<typename Derived::Scalar> qpp::ptrace1 (const Eigen::MatrixBase< Derived> & A, const std::vector< size_t> & dims)`

Here is the call graph for this function:



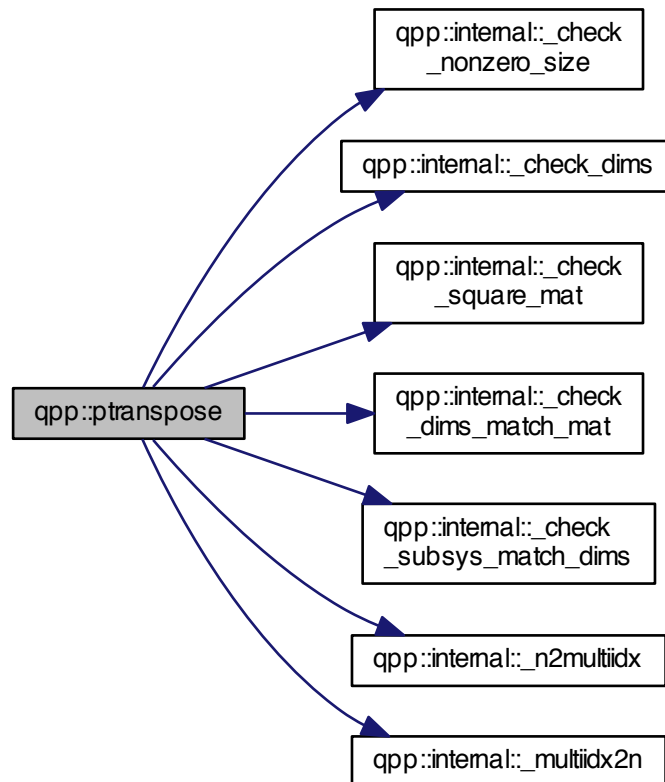
5.1.1.57 `template<typename Derived> types::DynMat<typename Derived::Scalar> qpp::ptrace2 (const Eigen::MatrixBase< Derived> & A, const std::vector< size_t> & dims)`

Here is the call graph for this function:



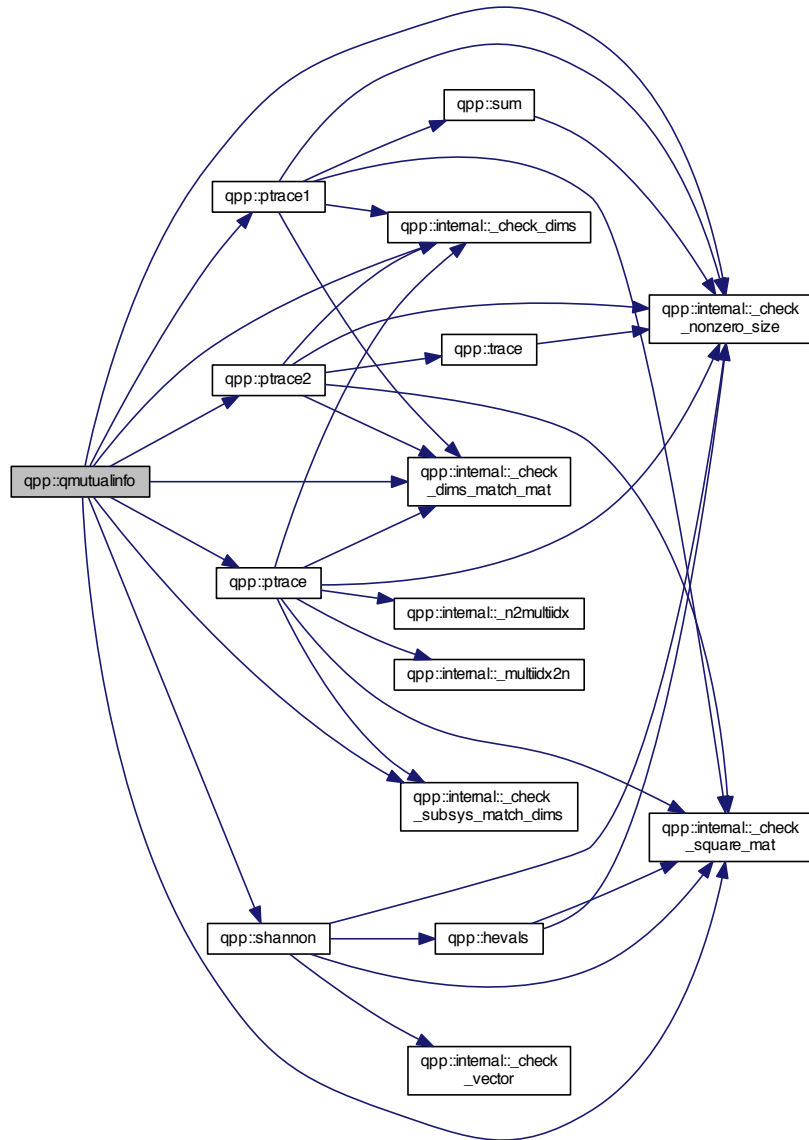
5.1.1.58 `template<typename Derived> types::DynMat<typename Derived::Scalar> qpp::ptranpose (const Eigen::MatrixBase< Derived> & A, const std::vector< size_t> & subsys, const std::vector< size_t> & dims)`

Here is the call graph for this function:



5.1.1.59 `template<typename Derived > double qpp::qmutualinfo (const Eigen::MatrixBase< Derived > & A, const std::vector< size_t > & subsys, const std::vector< size_t > & dims)`

Here is the call graph for this function:



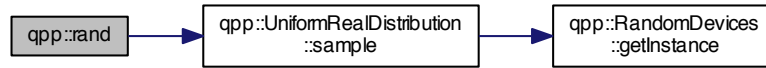
5.1.1.60 `template<typename Derived > Derived qpp::rand (size_t rows, size_t cols, double a = 0, double b = 1)`

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

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

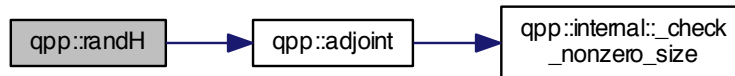
5.1.1.63 `double qpp::rand (double a = 0, double b = 1)`

Here is the call graph for this function:



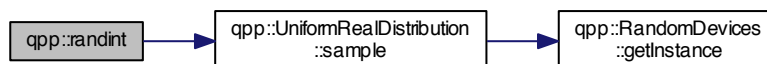
5.1.1.64 `types::cmat qpp::randH (size_t D)`

Here is the call graph for this function:



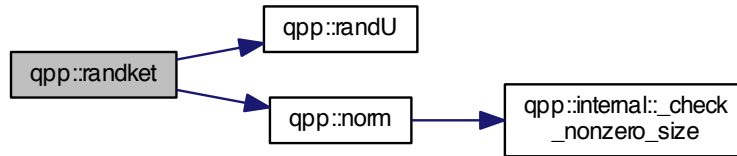
5.1.1.65 `long long qpp::randint (long long a, long long b)`

Here is the call graph for this function:

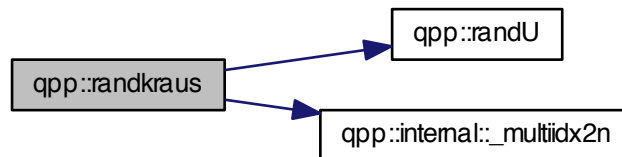


5.1.1.66 `types::ket qpp::randket (size_t D)`

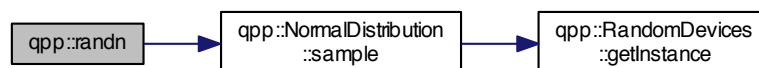
Here is the call graph for this function:

5.1.1.67 `std::vector<types::cmat> qpp::randkraus (size_t n, size_t D)`

Here is the call graph for this function:

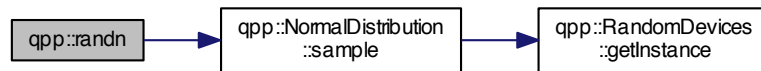
5.1.1.68 `template<typename Derived > Derived qpp::randn (size_t rows, size_t cols, double mean = 0, double sigma = 1)`5.1.1.69 `template<> types::dmat qpp::randn (size_t rows, size_t cols, double mean, double sigma)`

Here is the call graph for this function:

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

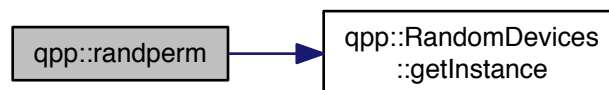
5.1.1.71 `double qpp::randn (double mean = 0, double sigma = 1)`

Here is the call graph for this function:



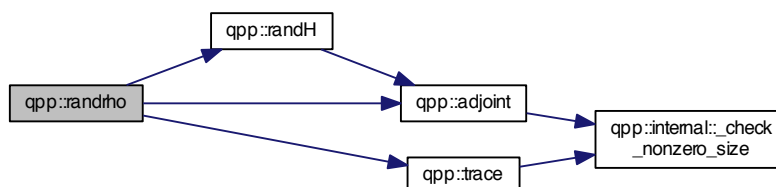
5.1.1.72 `std::vector<size_t> qpp::randperm (size_t n)`

Here is the call graph for this function:



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

Here is the call graph for this function:



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

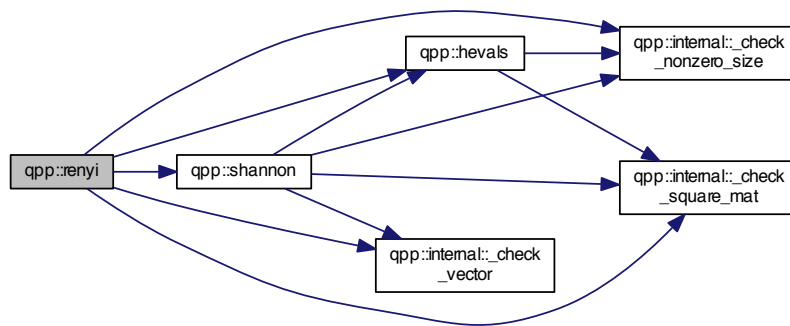
5.1.1.75 types::cmat qpp::randV (size_t Din, size_t Dout)

Here is the call graph for this function:



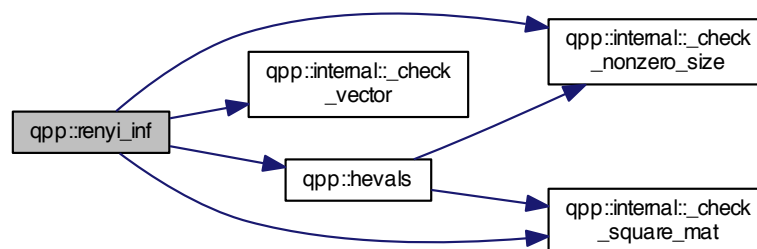
5.1.1.76 template<typename Derived> double qpp::renyi (const double alpha, const Eigen::MatrixBase< Derived > & A)

Here is the call graph for this function:



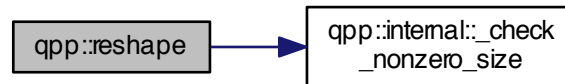
5.1.1.77 template<typename Derived> double qpp::renyi_inf (const Eigen::MatrixBase< Derived > & A)

Here is the call graph for this function:



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

Here is the call graph for this function:

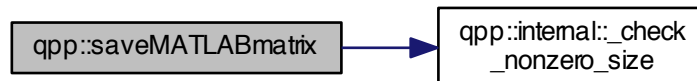


5.1.1.79 `template<typename Derived> void qpp::save (const Eigen::MatrixBase< Derived> & A, const std::string & fname)`

5.1.1.80 `template<typename Derived> void qpp::saveMATLABmatrix (const Eigen::MatrixBase< Derived> & A, const std::string & mat_file, const std::string & var_name, const std::string & mode)`

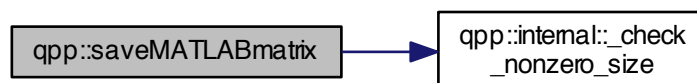
5.1.1.81 `template<> void qpp::saveMATLABmatrix (const Eigen::MatrixBase< typename types::dmat> & A, const std::string & mat_file, const std::string & var_name, const std::string & mode)`

Here is the call graph for this function:



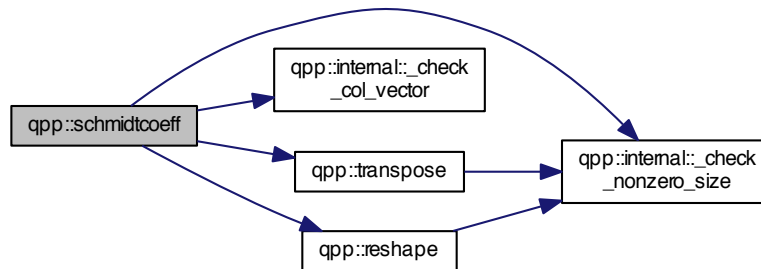
5.1.1.82 `template<> void qpp::saveMATLABmatrix (const Eigen::MatrixBase< typename types::cmat> & A, const std::string & mat_file, const std::string & var_name, const std::string & mode)`

Here is the call graph for this function:



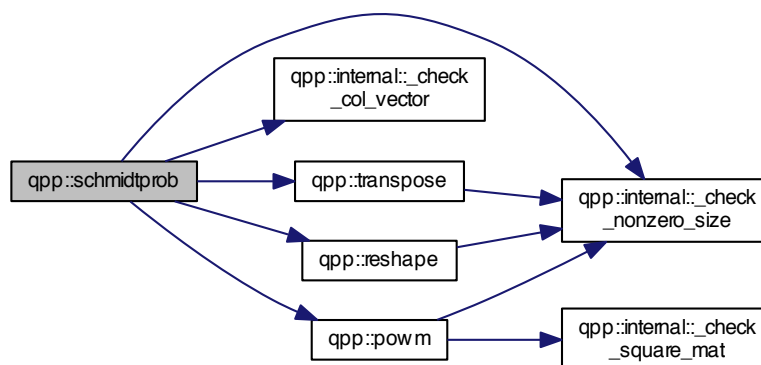
5.1.1.83 `template<typename Derived> types::cmat qpp::schmidtcoeff (const Eigen::MatrixBase< Derived> & A, const std::vector< size_t> & dims)`

Here is the call graph for this function:



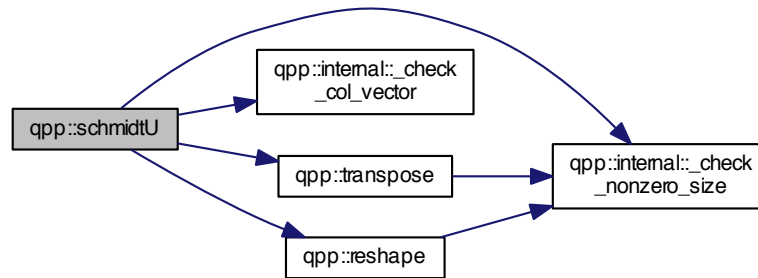
5.1.1.84 `template<typename Derived> types::cmat qpp::schmidtprob (const Eigen::MatrixBase< Derived> & A, const std::vector< size_t> & dims)`

Here is the call graph for this function:



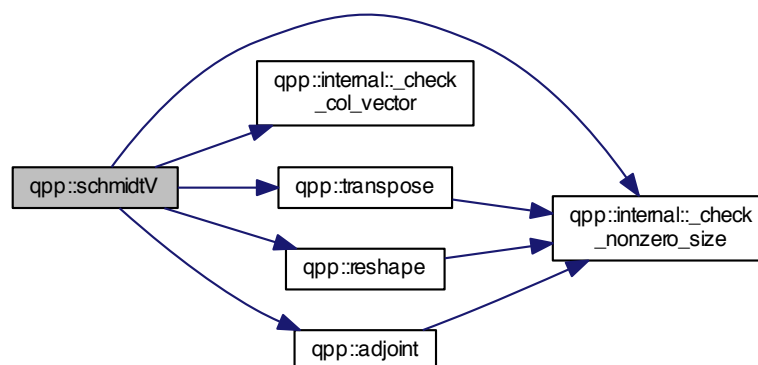
5.1.1.85 `template<typename Derived> types::cmat qpp::schmidtU (const Eigen::MatrixBase< Derived > & A, const std::vector< size_t > & dims)`

Here is the call graph for this function:



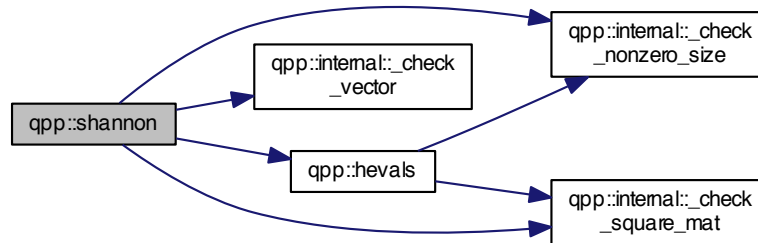
5.1.1.86 `template<typename Derived> types::cmat qpp::schmidtV (const Eigen::MatrixBase< Derived > & A, const std::vector< size_t > & dims)`

Here is the call graph for this function:



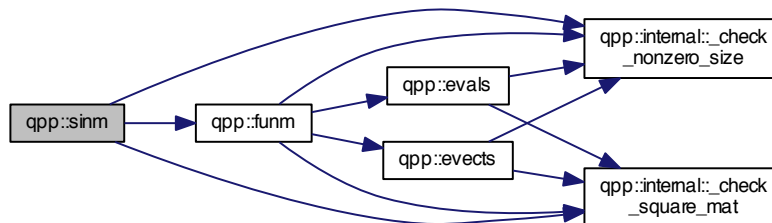
5.1.1.87 `template<typename Derived> double qpp::shannon (const Eigen::MatrixBase< Derived > & A)`

Here is the call graph for this function:



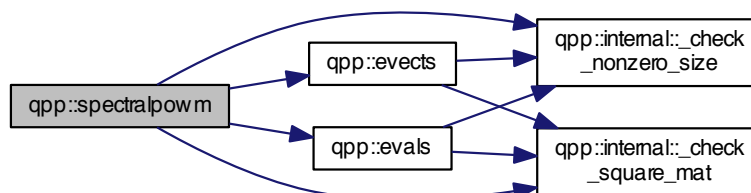
5.1.1.88 `template<typename Derived> types::cmat qpp::sinm (const Eigen::MatrixBase< Derived > & A)`

Here is the call graph for this function:



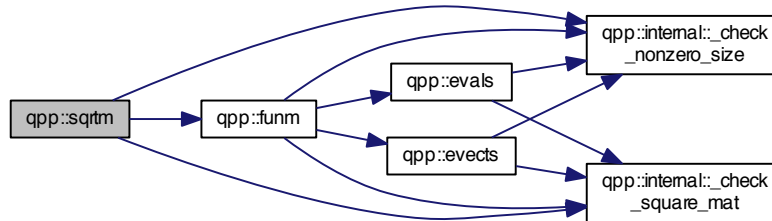
5.1.1.89 `template<typename Derived> types::cmat qpp::spectralpowm (const Eigen::MatrixBase< Derived > & A, const types::cplx z)`

Here is the call graph for this function:



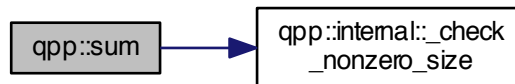
5.1.1.90 `template<typename Derived> types::cmat qpp::sqrtm (const Eigen::MatrixBase< Derived > & A)`

Here is the call graph for this function:



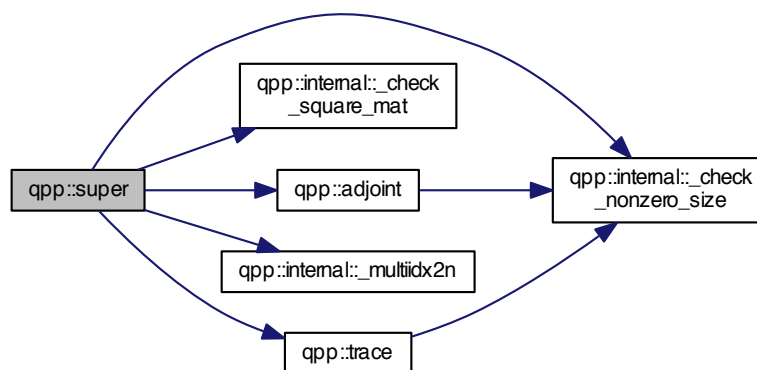
5.1.1.91 `template<typename Derived> Derived::Scalar qpp::sum (const Eigen::MatrixBase< Derived > & A)`

Here is the call graph for this function:



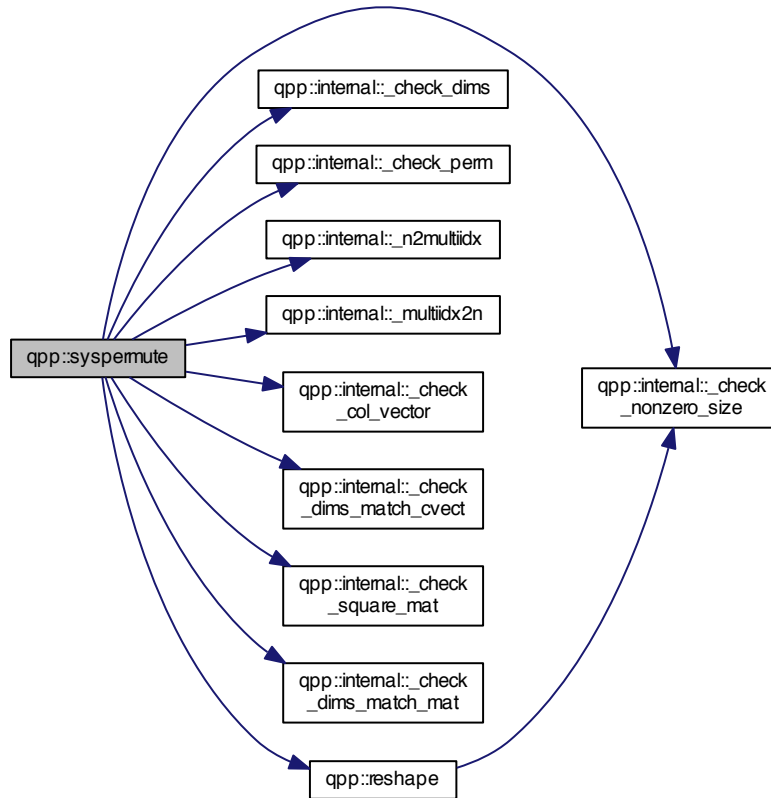
5.1.1.92 `types::cmat qpp::super (const std::vector< types::cmat > & Ks)`

Here is the call graph for this function:



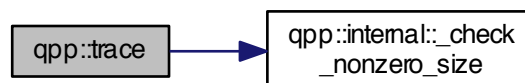
5.1.1.93 `template<typename Derived> types::DynMat<typename Derived::Scalar> qpp::syspermute (const Eigen::MatrixBase< Derived> & A, const std::vector< size_t> & perm, const std::vector< size_t> & dims)`

Here is the call graph for this function:



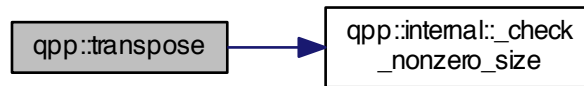
5.1.1.94 `template<typename Derived> Derived::Scalar qpp::trace (const Eigen::MatrixBase< Derived> & A)`

Here is the call graph for this function:



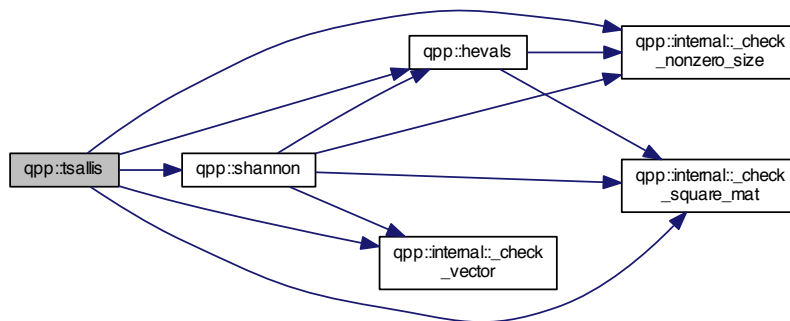
5.1.1.95 `template<typename Derived> types::DynMat<typename Derived::Scalar> qpp::transpose (const Eigen::MatrixBase< Derived> & A)`

Here is the call graph for this function:



5.1.1.96 `template<typename Derived> double qpp::tsallis (const double alpha, const Eigen::MatrixBase< Derived> & 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()`

5.1.2.3 `const States& qpp::st = States::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-12
- const size_t [maxn](#) = 64
- 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-12`

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

5.2.2.5 `const size_t qpp::ct::maxn = 64`

5.2.2.6 `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 Derived >
bool [_check_square_mat](#) (const Eigen::MatrixBase< Derived > &A)
- template<typename Derived >
bool [_check_vector](#) (const Eigen::MatrixBase< Derived > &A)
- template<typename Derived >
bool [_check_row_vector](#) (const Eigen::MatrixBase< Derived > &A)
- template<typename Derived >
bool [_check_col_vector](#) (const Eigen::MatrixBase< Derived > &A)
- template<typename T >
bool [_check_nonzero_size](#) (const T &x)
- bool [_check_dims](#) (const std::vector< size_t > &dims)
- template<typename Derived >
bool [_check_dims_match_mat](#) (const std::vector< size_t > &dims, const Eigen::MatrixBase< Derived > &A)
- template<typename Derived >
bool [_check_dims_match_cvect](#) (const std::vector< size_t > &dims, const Eigen::MatrixBase< Derived > &V)
- template<typename Derived >
bool [_check_dims_match_rvect](#) (const std::vector< size_t > &dims, const Eigen::MatrixBase< Derived > &V)
- bool [_check_eq_dims](#) (const std::vector< size_t > &dims, size_t dim)
- bool [_check_subsys_match_dims](#) (const std::vector< size_t > &subsys, const std::vector< size_t > &dims)
- bool [_check_perm](#) (const std::vector< size_t > &perm)

- `template<typename Derived1 , typename Derived2 >`
`types::DynMat< typename`
`Derived1::Scalar > _kron2 (const Eigen::MatrixBase< Derived1 > &A, const Eigen::MatrixBase< Derived2`
`> &B)`
- `template<typename T >`
`void variadic_vector_emplace (std::vector< T > &)`
- `template<typename T , typename First , typename... Args>`
`void variadic_vector_emplace (std::vector< T > &v, First &&first, Args &&...args)`

5.3.1 Function Documentation

5.3.1.1 `template<typename Derived > bool qpp::internal::_check_col_vector (const Eigen::MatrixBase< Derived > & A)`

5.3.1.2 `bool qpp::internal::_check_dims (const std::vector< size_t > & dims)`

5.3.1.3 `template<typename Derived > bool qpp::internal::_check_dims_match_cvect (const std::vector< size_t > & dims,`
`const Eigen::MatrixBase< Derived > & V)`

5.3.1.4 `template<typename Derived > bool qpp::internal::_check_dims_match_mat (const std::vector< size_t > & dims,`
`const Eigen::MatrixBase< Derived > & A)`

5.3.1.5 `template<typename Derived > bool qpp::internal::_check_dims_match_rvect (const std::vector< size_t > & dims,`
`const Eigen::MatrixBase< Derived > & V)`

5.3.1.6 `bool qpp::internal::_check_eq_dims (const std::vector< size_t > & dims, size_t dim)`

5.3.1.7 `template<typename T > bool qpp::internal::_check_nonzero_size (const T & x)`

5.3.1.8 `bool qpp::internal::_check_perm (const std::vector< size_t > & perm)`

5.3.1.9 `template<typename Derived > bool qpp::internal::_check_row_vector (const Eigen::MatrixBase< Derived > & A)`

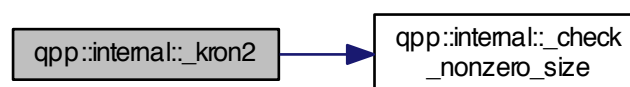
5.3.1.10 `template<typename Derived > bool qpp::internal::_check_square_mat (const Eigen::MatrixBase< Derived > & A)`

5.3.1.11 `bool qpp::internal::_check_subsys_match_dims (const std::vector< size_t > & subsys, const std::vector< size_t >`
`& dims)`

5.3.1.12 `template<typename Derived > bool qpp::internal::_check_vector (const Eigen::MatrixBase< Derived > & A)`

5.3.1.13 `template<typename Derived1 , typename Derived2 > types::DynMat<typename Derived1::Scalar>`
`qpp::internal::_kron2 (const Eigen::MatrixBase< Derived1 > & A, const Eigen::MatrixBase< Derived2 > & B)`

Here is the call graph for this function:



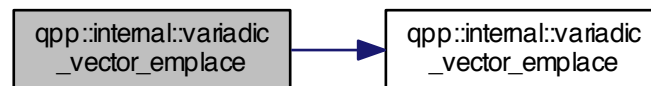
5.3.1.14 `size_t qpp::internal::_multiidx2n (const size_t * midx, size_t numdims, const size_t * dims)`

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

5.3.1.16 `template<typename T> void qpp::internal::variadic_vector_emplace (std::vector< T> &)`

5.3.1.17 `template<typename T, typename First, typename... Args> void qpp::internal::variadic_vector_emplace (std::vector< T> & v, First && first, Args &&... args)`

Here is the call graph for this function:



5.4 qpp::types Namespace Reference

Typedefs

- using `cplx` = `std::complex< double >`
- using `cmat` = `Eigen::MatrixXcd`
- using `dmat` = `Eigen::MatrixXd`
- using `ket` = `Eigen::Matrix< cplx, Eigen::Dynamic, 1 >`
- using `bra` = `Eigen::Matrix< cplx, 1, Eigen::Dynamic >`
- template<typename Scalar>
using `DynMat` = `Eigen::Matrix< Scalar, Eigen::Dynamic, Eigen::Dynamic >`

5.4.1 Typedef Documentation

5.4.1.1 using `qpp::types::bra` = typedef `Eigen::Matrix<cplx, 1, Eigen::Dynamic>`

5.4.1.2 using `qpp::types::cmat` = typedef `Eigen::MatrixXcd`

5.4.1.3 using `qpp::types::cplx` = typedef `std::complex<double>`

5.4.1.4 using `qpp::types::dmat` = typedef `Eigen::MatrixXd`

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

5.4.1.6 using `qpp::types::ket` = typedef `Eigen::Matrix<cplx, Eigen::Dynamic, 1>`

Chapter 6

Class Documentation

6.1 qpp::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::DiscreteDistribution::DiscreteDistribution (InputIterator first, InputIterator last)` [inline]

6.1.1.2 `qpp::DiscreteDistribution::DiscreteDistribution (std::initializer_list< double > weights)` [inline]

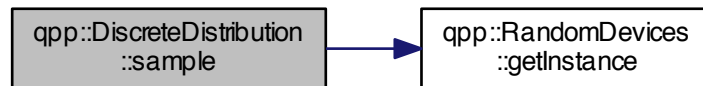
6.1.1.3 `qpp::DiscreteDistribution::DiscreteDistribution (std::vector< double > weights)` [inline]

6.1.2 Member Function Documentation

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

6.1.2.2 `size_t qpp::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::DiscreteDistribution::_d [protected]`

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

- [include/classes/stat.h](#)

6.2 `qpp::DiscreteDistributionAbsSquare` Class Reference

```
#include <stat.h>
```

Public Member Functions

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

Protected Member Functions

- `template<typename InputIterator >`
`std::vector< double > cplx2weights` (InputIterator first, InputIterator last)

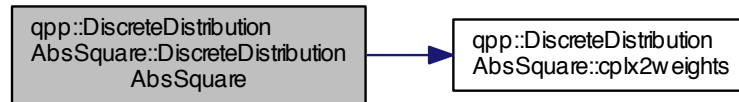
Protected Attributes

- `std::discrete_distribution`
`< size_t > _d`

6.2.1 Constructor & Destructor Documentation

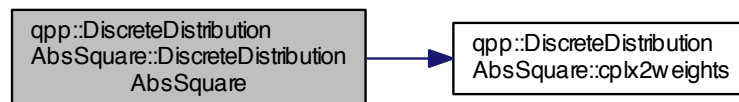
6.2.1.1 `template<typename InputIterator> qpp::DiscreteDistributionAbsSquare::DiscreteDistributionAbsSquare (InputIterator first, InputIterator last) [inline]`

Here is the call graph for this function:



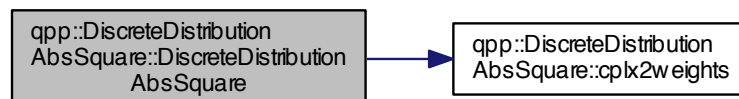
6.2.1.2 `qpp::DiscreteDistributionAbsSquare::DiscreteDistributionAbsSquare (std::initializer_list< types::cplx > amplitudes) [inline]`

Here is the call graph for this function:



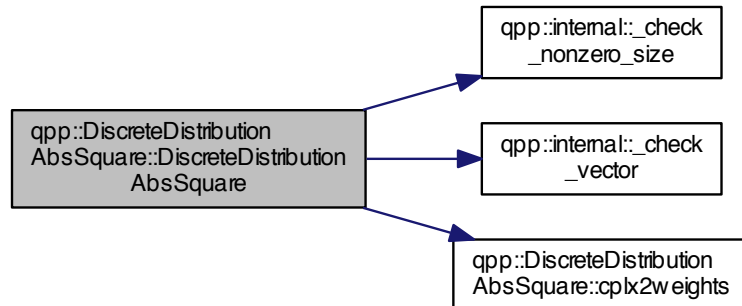
6.2.1.3 `qpp::DiscreteDistributionAbsSquare::DiscreteDistributionAbsSquare (std::vector< types::cplx > amplitudes) [inline]`

Here is the call graph for this function:



6.2.1.4 `qpp::DiscreteDistributionAbsSquare::DiscreteDistributionAbsSquare (const types::cmat & V) [inline]`

Here is the call graph for this function:



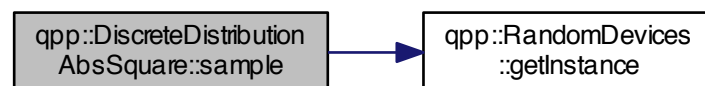
6.2.2 Member Function Documentation

6.2.2.1 `template<typename InputIterator> std::vector<double> qpp::DiscreteDistributionAbsSquare::cplx2weights (InputIterator first, InputIterator last) [inline],[protected]`

6.2.2.2 `std::vector<double> qpp::DiscreteDistributionAbsSquare::probabilities () [inline]`

6.2.2.3 `size_t qpp::DiscreteDistributionAbsSquare::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::DiscreteDistributionAbsSquare::_d [protected]`

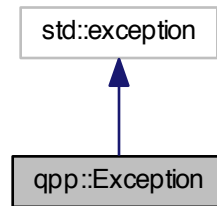
The documentation for this class was generated from the following file:

- [include/classes/stat.h](#)

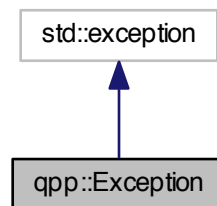
6.3 qpp::Exception Class Reference

```
#include <exception.h>
```

Inheritance diagram for qpp::Exception:



Collaboration diagram for qpp::Exception:



Public Types

- enum `Type` {
`Type::UNKNOWN_EXCEPTION = 1`, `Type::ZERO_SIZE`, `Type::MATRIX_NOT_SQUARE`, `Type::MATRIX_NOT_CVECTOR`,
`Type::MATRIX_NOT_RVECTOR`, `Type::MATRIX_NOT_VECTOR`, `Type::MATRIX_NOT_SQUARE_OR_CVECTOR`, `Type::MATRIX_NOT_SQUARE_OR_RVECTOR`,
`Type::MATRIX_NOT_SQUARE_OR_VECTOR`, `Type::DIMS_INVALID`, `Type::DIMS_NOT_EQUAL`, `Type::DIMS_MISMATCH_MATRIX`,
`Type::DIMS_MISMATCH_CVECTOR`, `Type::DIMS_MISMATCH_RVECTOR`, `Type::DIMS_MISMATCH_VECTOR`, `Type::SUBSYS_MISMATCH_DIMS`,
`Type::PERM_INVALID`, `Type::NOT_QUBIT_GATE`, `Type::NOT_QUBIT_SUBSYS`, `Type::NOT_BIPARTITE`,
`Type::OUT_OF_RANGE`, `Type::TYPE_MISMATCH`, `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]`

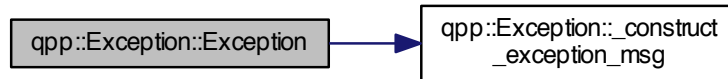
Enumerator

UNKNOWN_EXCEPTION
ZERO_SIZE
MATRIX_NOT_SQUARE
MATRIX_NOT_CVECTOR
MATRIX_NOT_RVECTOR
MATRIX_NOT_VECTOR
MATRIX_NOT_SQUARE_OR_CVECTOR
MATRIX_NOT_SQUARE_OR_RVECTOR
MATRIX_NOT_SQUARE_OR_VECTOR
DIMS_INVALID
DIMS_NOT_EQUAL
DIMS_MISMATCH_MATRIX
DIMS_MISMATCH_CVECTOR
DIMS_MISMATCH_RVECTOR
DIMS_MISMATCH_VECTOR
SUBSYS_MISMATCH_DIMS
PERM_INVALID
NOT_QUBIT_GATE
NOT_QUBIT_SUBSYS
NOT_BIPARTITE
OUT_OF_RANGE
TYPE_MISMATCH
UNDEFINED_TYPE
CUSTOM_EXCEPTION

6.3.2 Constructor & Destructor Documentation

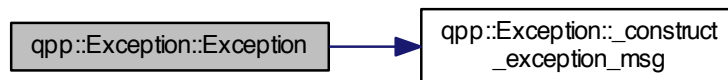
6.3.2.1 `qpp::Exception::Exception (const std::string & where, const Type & type)` `[inline]`

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/classes/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 Rn](#) (double theta, std::vector< double > n) const
- [types::cmat Zd](#) (size_t D) const
- [types::cmat Fd](#) (size_t D) const
- [types::cmat Xd](#) (size_t D) const
- template<typename Derived = Eigen::MatrixXcd>
Derived [ld](#) (size_t D) const
- template<typename Derived1 , typename Derived2 >
[types::DynMat](#)< typename
Derived1::Scalar > [apply](#) (const Eigen::MatrixBase< Derived1 > &state, const Eigen::MatrixBase< Derived2 > &A, const std::vector< size_t > &subsys, const std::vector< size_t > &dims) const
- template<typename Derived >
[types::DynMat](#)< typename
Derived::Scalar > [CTRL](#) (const Eigen::MatrixBase< Derived > &A, const std::vector< size_t > &ctrl, const
std::vector< size_t > &subsys, 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 CNOTba](#)
- [types::cmat SWAP](#)
- [types::cmat TOF](#)
- [types::cmat FRED](#)

Private Member Functions

- [~Gates](#) ()
- [Gates](#) ()

6.4.1 Constructor & Destructor Documentation

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

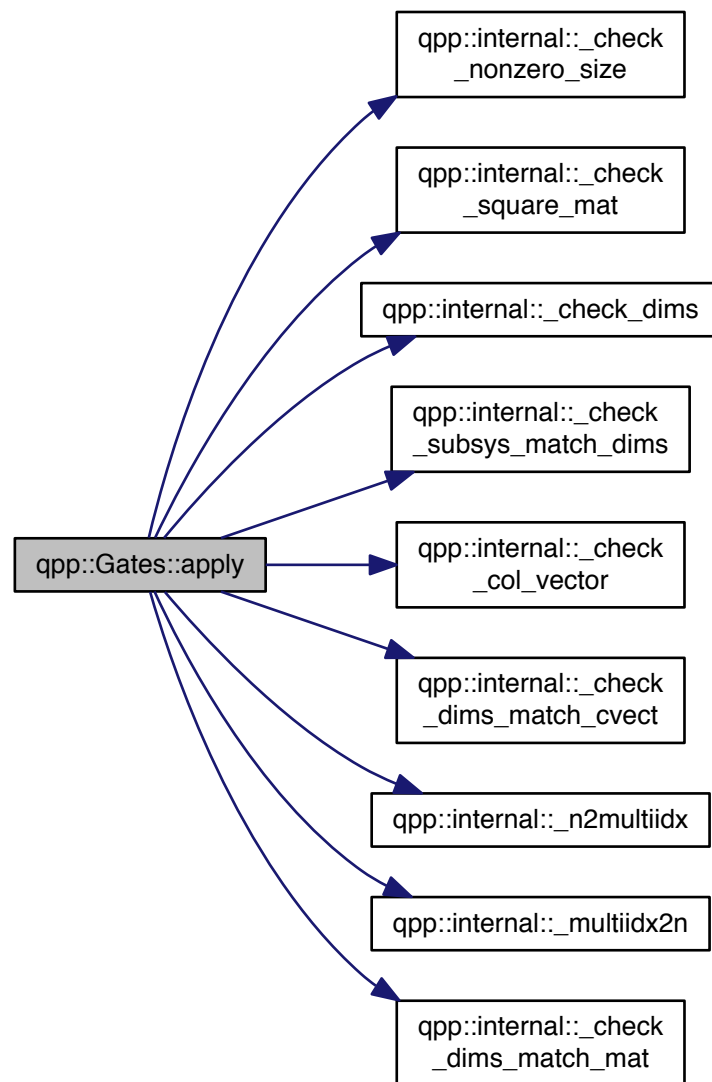
6.4.1.2 `qpp::Gates::Gates (const Gates &) [delete]`

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

6.4.2 Member Function Documentation

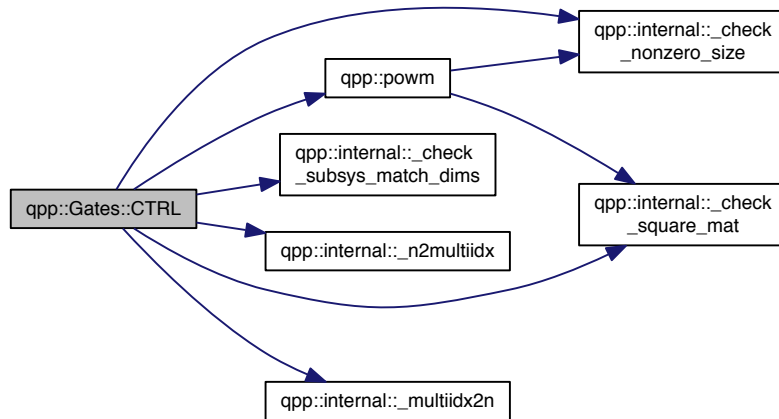
6.4.2.1 `template<typename Derived1 , typename Derived2 > types::DynMat<typename Derived1::Scalar>
qpp::Gates::apply (const Eigen::MatrixBase< Derived1 > & state, const Eigen::MatrixBase< Derived2 > & A, const
std::vector< size_t > & subsys, const std::vector< size_t > & dims) const [inline]`

Here is the call graph for this function:



6.4.2.2 `template<typename Derived > types::DynMat<typename Derived::Scalar> qpp::Gates::CTRL (const Eigen::MatrixBase< Derived > & A, const std::vector< size_t > & ctrl, const std::vector< size_t > & subsys, 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]`

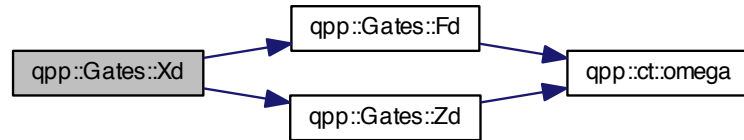
6.4.2.5 `template<typename Derived = Eigen::MatrixXcd> Derived qpp::Gates::Id (size_t D) const [inline]`

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

6.4.2.7 `types::cmat qpp::Gates::Rn (double theta, std::vector< double > n) 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::CNOTab`

6.4.3.2 `types::cmat qpp::Gates::CNOTba`

6.4.3.3 `types::cmat qpp::Gates::CZ`

6.4.3.4 `types::cmat qpp::Gates::FRED`

6.4.3.5 `types::cmat qpp::Gates::H`

6.4.3.6 `types::cmat qpp::Gates::Id2`

6.4.3.7 `types::cmat qpp::Gates::S`

6.4.3.8 `types::cmat qpp::Gates::SWAP`

6.4.3.9 `types::cmat qpp::Gates::T`

6.4.3.10 `types::cmat qpp::Gates::TOF`

6.4.3.11 `types::cmat qpp::Gates::X`

6.4.3.12 `types::cmat qpp::Gates::Y`

6.4.3.13 `types::cmat qpp::Gates::Z`

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

- `include/classes/gates.h`

6.5 `qpp::NormalDistribution` Class Reference

```
#include <stat.h>
```

Public Member Functions

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

Protected Attributes

- `std::normal_distribution _d`

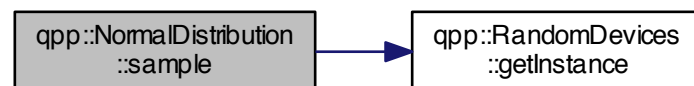
6.5.1 Constructor & Destructor Documentation

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

6.5.2 Member Function Documentation

6.5.2.1 `double qpp::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::NormalDistribution::_d` `[protected]`

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

- `include/classes/stat.h`

6.6 qpp::Qudit Class Reference

```
#include <qudit.h>
```

Public Member Functions

- [Qudit](#) (const [types::cmat](#) &rho=[States::getInstance\(\)](#).pz0)
- [size_t measure](#) (const [types::cmat](#) &U, bool destructive=false)
- [size_t measure](#) (bool destructive=false)
- [types::cmat getRho](#) () const
- [size_t getD](#) () const
- virtual [~Qudit](#) ()=default

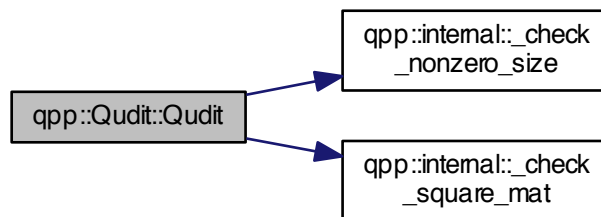
Private Attributes

- [types::cmat _rho](#)
- [size_t _D](#)

6.6.1 Constructor & Destructor Documentation

6.6.1.1 `qpp::Qudit::Qudit (const types::cmat & rho = States::getInstance\(\) .pz0) [inline]`

Here is the call graph for this function:



6.6.1.2 `virtual qpp::Qudit::~~Qudit () [virtual],[default]`

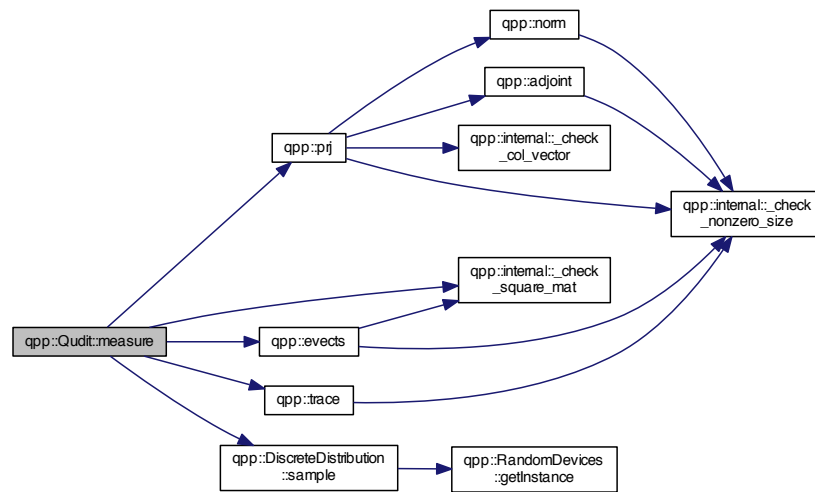
6.6.2 Member Function Documentation

6.6.2.1 `size_t qpp::Qudit::getD () const [inline]`

6.6.2.2 `types::cmat qpp::Qudit::getRho () const [inline]`

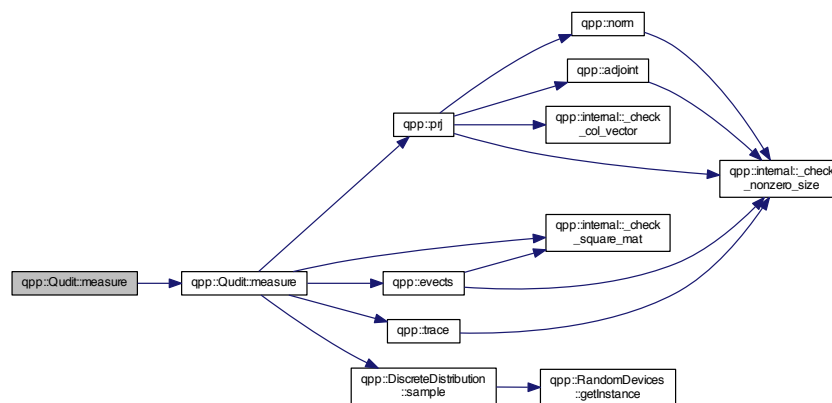
6.6.2.3 `size_t qpp::Qudit::measure (const types::cmat & U, bool destructive = false) [inline]`

Here is the call graph for this function:



6.6.2.4 `size_t qpp::Qudit::measure (bool destructive = false) [inline]`

Here is the call graph for this function:



6.6.3 Member Data Documentation

6.6.3.1 `size_t qpp::Qudit::_D [private]`

6.6.3.2 `types::cmat qpp::Qudit::_rho [private]`

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

- [include/classes/qudit.h](#)

6.7 qpp::RandomDevices Class Reference

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

Public Member Functions

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

Static Public Member Functions

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

Public Attributes

- std::random_device [_rd](#)
- std::mt19937 [_rng](#)

Private Member Functions

- [~RandomDevices](#) ()
- [RandomDevices](#) ()

6.7.1 Constructor & Destructor Documentation

6.7.1.1 `qpp::RandomDevices::~~RandomDevices () [inline],[private]`

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

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

6.7.2 Member Function Documentation

6.7.2.1 `static RandomDevices& qpp::RandomDevices::getInstance () [inline],[static]`

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

6.7.3 Member Data Documentation

6.7.3.1 `std::random_device qpp::RandomDevices::_rd`

6.7.3.2 `std::mt19937 qpp::RandomDevices::_rng`

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

- include/classes/[randevs.h](#)

6.8 qpp::States Class Reference

```
#include <states.h>
```

Public Member Functions

- [States](#) (const [States](#) &)=delete
- [States](#) & [operator=](#) (const [States](#) &)=delete

Static Public Member Functions

- static const [States](#) & [getInstance](#) ()

Public Attributes

- [types::ket x0](#)
- [types::ket x1](#)
- [types::ket y0](#)
- [types::ket y1](#)
- [types::ket z0](#)
- [types::ket z1](#)
- [types::cmat px0](#)
- [types::cmat px1](#)
- [types::cmat py0](#)
- [types::cmat py1](#)
- [types::cmat pz0](#)
- [types::cmat pz1](#)
- [types::ket b00](#)
- [types::ket b01](#)
- [types::ket b10](#)
- [types::ket b11](#)
- [types::cmat pb00](#)
- [types::cmat pb01](#)
- [types::cmat pb10](#)
- [types::cmat pb11](#)
- [types::ket GHZ](#)
- [types::ket W](#)
- [types::cmat pGHZ](#)
- [types::cmat pW](#)

Private Member Functions

- [~States](#) ()
- [States](#) ()

6.8.1 Constructor & Destructor Documentation

6.8.1.1 `qpp::States::~~States ()` `[inline],[private]`

6.8.1.2 `qpp::States::States (const States &)` `[delete]`

6.8.1.3 `qpp::States::States ()` `[inline],[private]`

6.8.2 Member Function Documentation

6.8.2.1 `static const States& qpp::States::getInstance ()` `[inline],[static]`

6.8.2.2 `States& qpp::States::operator= (const States &) [delete]`

6.8.3 Member Data Documentation

6.8.3.1 `types::ket qpp::States::b00`

6.8.3.2 `types::ket qpp::States::b01`

6.8.3.3 `types::ket qpp::States::b10`

6.8.3.4 `types::ket qpp::States::b11`

6.8.3.5 `types::ket qpp::States::GHZ`

6.8.3.6 `types::cmat qpp::States::pb00`

6.8.3.7 `types::cmat qpp::States::pb01`

6.8.3.8 `types::cmat qpp::States::pb10`

6.8.3.9 `types::cmat qpp::States::pb11`

6.8.3.10 `types::cmat qpp::States::pGHZ`

6.8.3.11 `types::cmat qpp::States::pW`

6.8.3.12 `types::cmat qpp::States::px0`

6.8.3.13 `types::cmat qpp::States::px1`

6.8.3.14 `types::cmat qpp::States::py0`

6.8.3.15 `types::cmat qpp::States::py1`

6.8.3.16 `types::cmat qpp::States::pz0`

6.8.3.17 `types::cmat qpp::States::pz1`

6.8.3.18 `types::ket qpp::States::W`

6.8.3.19 `types::ket qpp::States::x0`

6.8.3.20 `types::ket qpp::States::x1`

6.8.3.21 `types::ket qpp::States::y0`

6.8.3.22 `types::ket qpp::States::y1`

6.8.3.23 `types::ket qpp::States::z0`

6.8.3.24 `types::ket qpp::States::z1`

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

- `include/classes/states.h`

6.9 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::steady_clock::time_point [_start](#)
- std::chrono::steady_clock::time_point [_end](#)

Friends

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

6.9.1 Constructor & Destructor Documentation

6.9.1.1 [qpp::Timer::Timer](#) () [\[inline\]](#)

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

6.9.2 Member Function Documentation

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

6.9.2.2 [void qpp::Timer::tic](#) () [\[inline\]](#)

6.9.2.3 [void qpp::Timer::toc](#) () [\[inline\]](#)

6.9.3 Friends And Related Function Documentation

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

6.9.4 Member Data Documentation

6.9.4.1 [std::chrono::steady_clock::time_point qpp::Timer::_end](#) [\[protected\]](#)

6.9.4.2 [std::chrono::steady_clock::time_point qpp::Timer::_start](#) [\[protected\]](#)

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

- [include/classes/timer.h](#)

6.10 qpp::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](#)

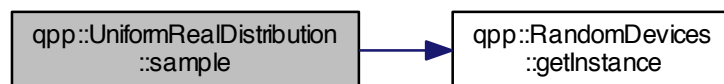
6.10.1 Constructor & Destructor Documentation

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

6.10.2 Member Function Documentation

6.10.2.1 `double qpp::UniformRealDistribution::sample ()` `[inline]`

Here is the call graph for this function:



6.10.3 Member Data Documentation

6.10.3.1 `std::uniform_real_distribution qpp::UniformRealDistribution::_d` `[protected]`

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

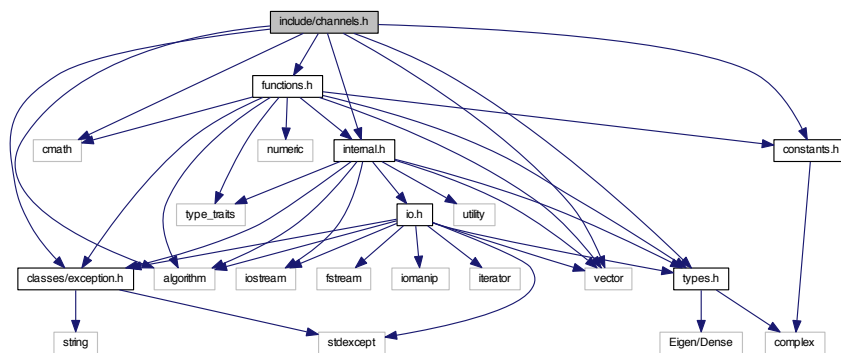
- `include/classes/stat.h`

Chapter 7

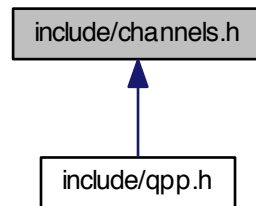
File Documentation

7.1 include/channels.h File Reference

```
#include <algorithm>
#include <cmath>
#include <vector>
#include "constants.h"
#include "functions.h"
#include "internal.h"
#include "types.h"
#include "classes/exception.h"
Include dependency graph for channels.h:
```



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



Namespaces

- [qpp](#)

Functions

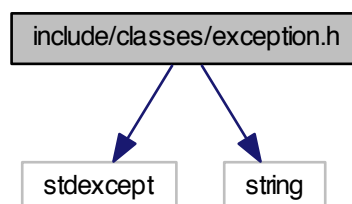
- `types::cmat qpp::super (const std::vector< types::cmat > &Ks)`
- `types::cmat qpp::choi (const std::vector< types::cmat > &Ks)`
- `std::vector< types::cmat > qpp::choi2kraus (const types::cmat &A)`
- `template<typename Derived >
types::cmat qpp::channel (const Eigen::MatrixBase< Derived > &rho, const std::vector< types::cmat > &Ks)`
- `template<typename Derived >
types::cmat qpp::channel (const Eigen::MatrixBase< Derived > &rho, const std::vector< types::cmat > &Ks,
const std::vector< size_t > &subsys, const std::vector< size_t > &dims)`

7.2 include/classes/exception.h File Reference

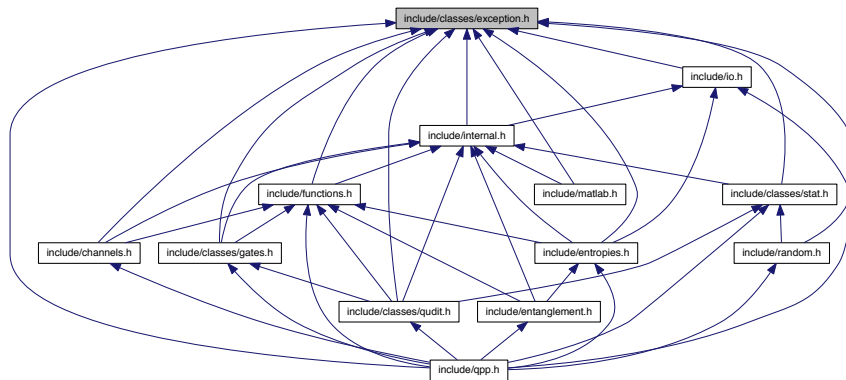
```
#include <stdexcept>
```

```
#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](#)

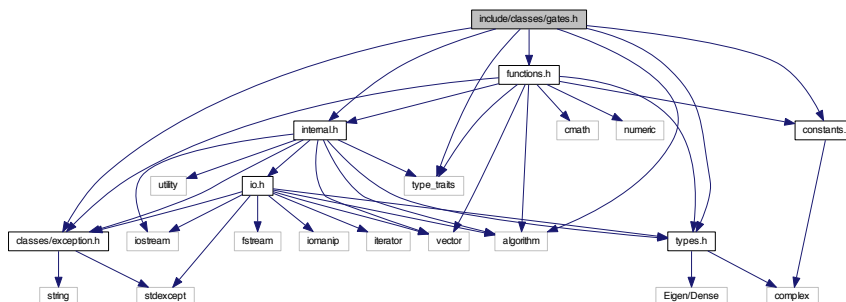
7.3 include/classes/gates.h File Reference

```

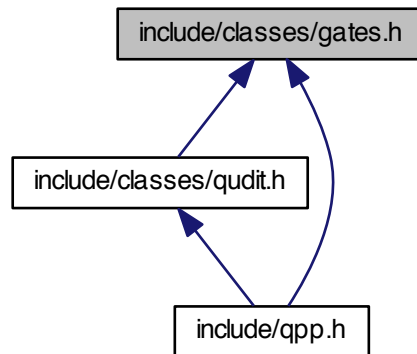
#include <algorithm>
#include <type_traits>
#include "constants.h"
#include "functions.h"
#include "exception.h"
#include "internal.h"
#include "types.h"

```

Include dependency graph for gates.h:



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



Classes

- class `qpp::Gates`

Namespaces

- `qpp`

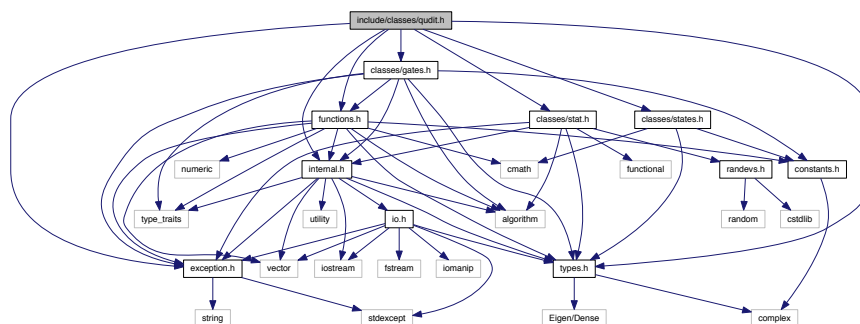
7.4 include/classes/qudit.h File Reference

```

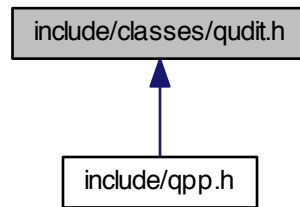
#include "exception.h"
#include "functions.h"
#include "internal.h"
#include "types.h"
#include "classes/gates.h"
#include "classes/stat.h"
#include "classes/states.h"

```

Include dependency graph for qudit.h:



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



Classes

- class `qpp::Qudit`

Namespaces

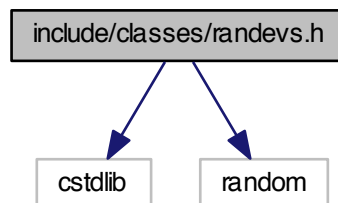
- `qpp`

7.5 include/classes/randevs.h File Reference

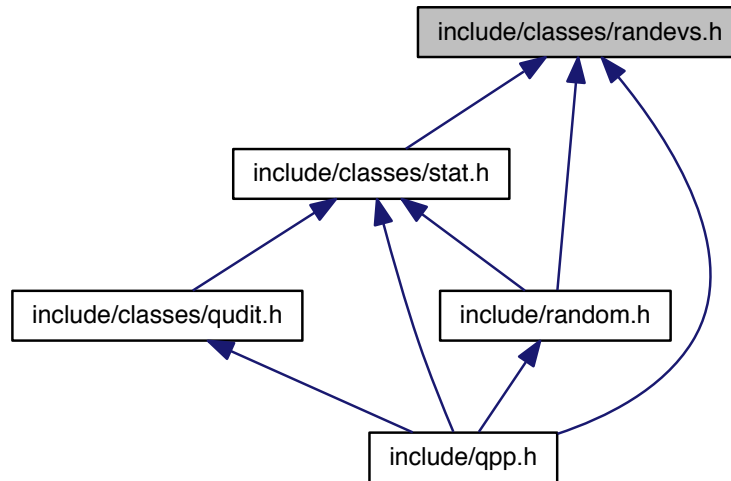
```
#include <cstdlib>
```

```
#include <random>
```

Include dependency graph for randevs.h:



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



Classes

- class [qpp::RandomDevices](#)

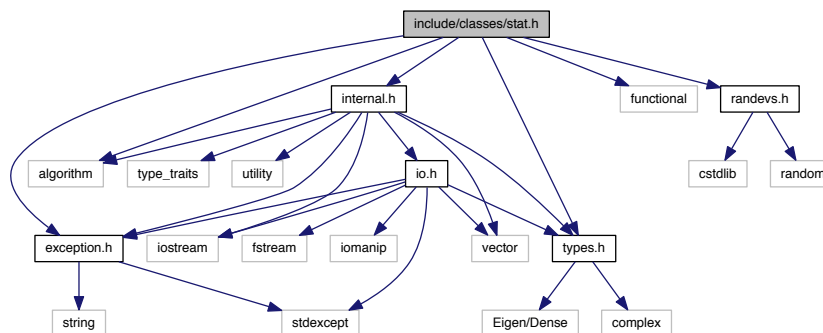
Namespaces

- [qpp](#)

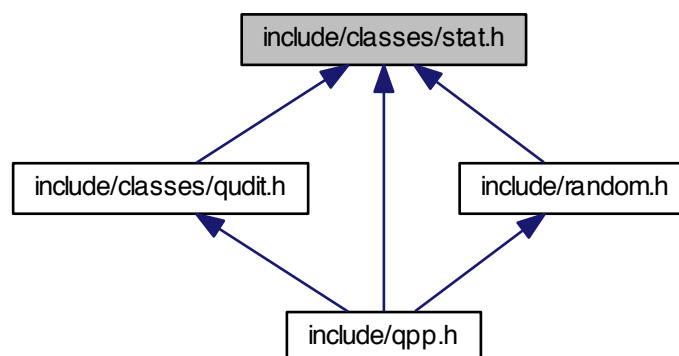
7.6 include/classes/stat.h File Reference

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


Include dependency graph for stat.h:



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



Classes

- class [qpp::NormalDistribution](#)
- class [qpp::UniformRealDistribution](#)
- class [qpp::DiscreteDistribution](#)
- class [qpp::DiscreteDistributionAbsSquare](#)

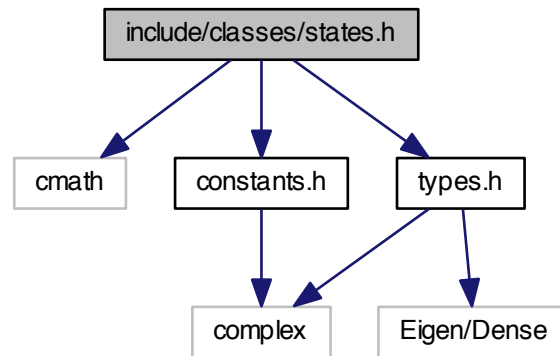
Namespaces

- [qpp](#)

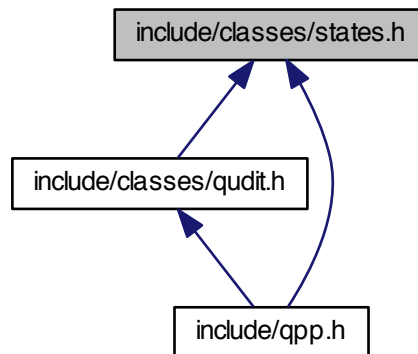
7.7 include/classes/stat.h File Reference

```
#include <cmath>
```

```
#include "constants.h"  
#include "types.h"  
Include dependency graph for states.h:
```



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



Classes

- class `qpp::States`

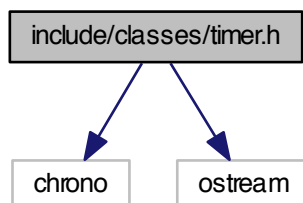
Namespaces

- `qpp`

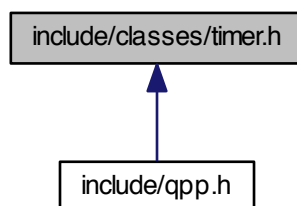
7.8 include/classes/timer.h File Reference

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

Include dependency graph for timer.h:



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



Classes

- class [qpp::Timer](#)

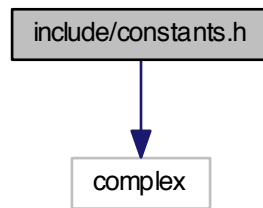
Namespaces

- [qpp](#)

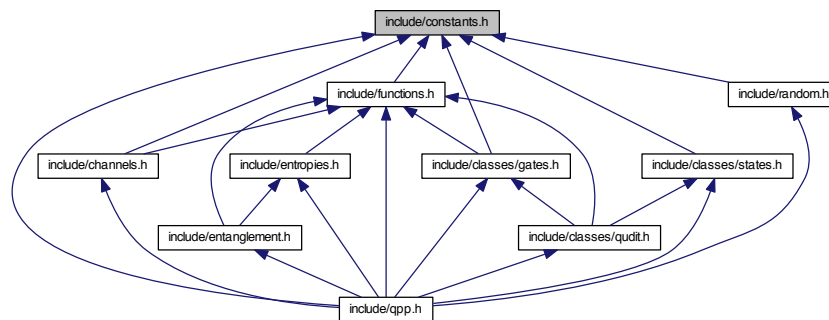
7.9 include/constants.h File Reference

```
#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)`

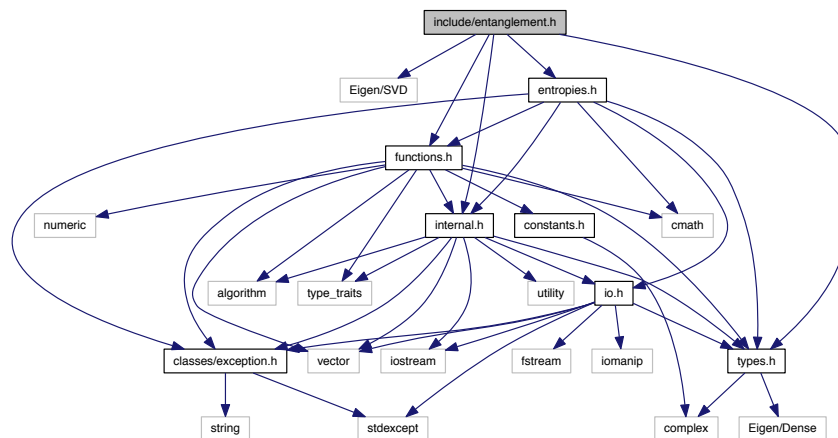
Variables

- `const double qpp::ct::chop = 1e-10`
- `const double qpp::ct::eps = 1e-12`
- `const size_t qpp::ct::maxn = 64`
- `const std::complex< double > qpp::ct::ii = { 0, 1 }`
- `const double qpp::ct::pi = 3.141592653589793238462643383279502884`
- `const double qpp::ct::ee = 2.718281828459045235360287471352662497`

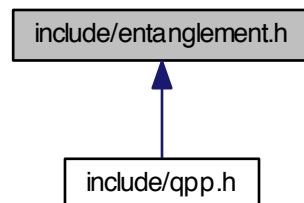
7.10 include/entanglement.h File Reference

```
#include <Eigen/SVD>
#include "entropies.h"
#include "functions.h"
#include "internal.h"
#include "types.h"
```

Include dependency graph for entanglement.h:



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



Namespaces

- [qpp](#)

Functions

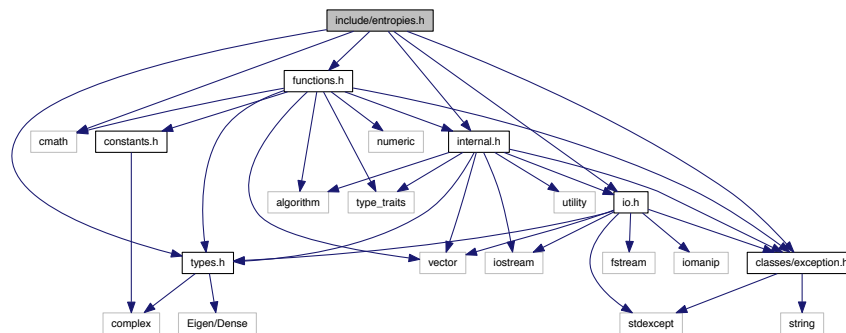
- `template<typename Derived >`
`types::cmat qpp::schmidtcoeff (const Eigen::MatrixBase< Derived > &A, const std::vector< size_t > &dims)`
- `template<typename Derived >`
`types::cmat qpp::schmidtU (const Eigen::MatrixBase< Derived > &A, const std::vector< size_t > &dims)`
- `template<typename Derived >`
`types::cmat qpp::schmidtV (const Eigen::MatrixBase< Derived > &A, const std::vector< size_t > &dims)`

- `template<typename Derived >`
`types::cmat qpp::schmidtprob (const Eigen::MatrixBase< Derived > &A, const std::vector< size_t > &dims)`
- `template<typename Derived >`
`double qpp::entanglement (const Eigen::MatrixBase< Derived > &A, const std::vector< size_t > &dims)`
- `template<typename Derived >`
`double qpp::gconcurrency (const Eigen::MatrixBase< Derived > &A)`

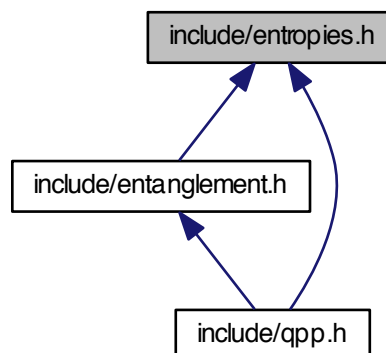
7.11 include/entropies.h File Reference

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

Include dependency graph for entropies.h:



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



Namespaces

- [qpp](#)

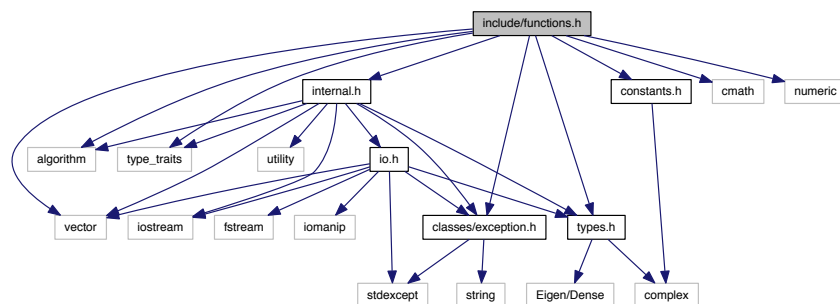
Functions

- `template<typename Derived >`
double [qpp::shannon](#) (const Eigen::MatrixBase< Derived > &A)
- `template<typename Derived >`
double [qpp::renyi](#) (const double alpha, const Eigen::MatrixBase< Derived > &A)
- `template<typename Derived >`
double [qpp::renyi_inf](#) (const Eigen::MatrixBase< Derived > &A)
- `template<typename Derived >`
double [qpp::tsallis](#) (const double alpha, const Eigen::MatrixBase< Derived > &A)
- `template<typename Derived >`
double [qpp::qmutualinfo](#) (const Eigen::MatrixBase< Derived > &A, const std::vector< size_t > &subsys, const std::vector< size_t > &dims)

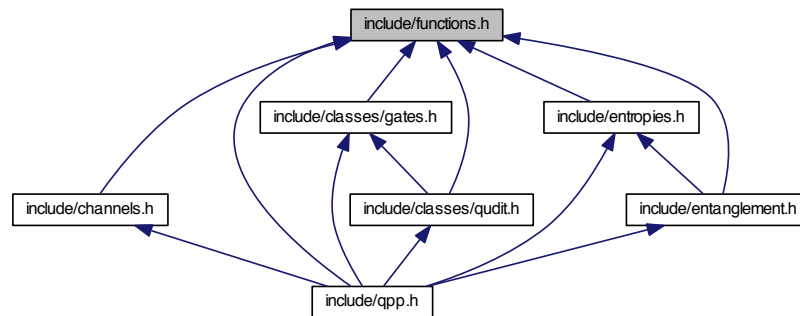
7.12 include/functions.h File Reference

```
#include <algorithm>
#include <cmath>
#include <numeric>
#include <type_traits>
#include <vector>
#include "constants.h"
#include "internal.h"
#include "types.h"
#include "classes/exception.h"
```

Include dependency graph for functions.h:



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



Namespaces

- [qpp](#)

Functions

- `template<typename Derived >`
`types::DynMat< typename`
`Derived::Scalar > qpp::transpose (const Eigen::MatrixBase< Derived > &A)`
- `template<typename Derived >`
`types::DynMat< typename`
`Derived::Scalar > qpp::conjugate (const Eigen::MatrixBase< Derived > &A)`
- `template<typename Derived >`
`types::DynMat< typename`
`Derived::Scalar > qpp::adjoint (const Eigen::MatrixBase< Derived > &A)`
- `template<typename Derived >`
`types::DynMat< typename`
`Derived::Scalar > qpp::inverse (const Eigen::MatrixBase< Derived > &A)`
- `template<typename Derived >`
`Derived::Scalar qpp::trace (const Eigen::MatrixBase< Derived > &A)`
- `template<typename Derived >`
`Derived::Scalar qpp::det (const Eigen::MatrixBase< Derived > &A)`
- `template<typename Derived >`
`Derived::Scalar qpp::logdet (const Eigen::MatrixBase< Derived > &A)`
- `template<typename Derived >`
`Derived::Scalar qpp::sum (const Eigen::MatrixBase< Derived > &A)`
- `template<typename Derived >`
`double qpp::norm (const Eigen::MatrixBase< Derived > &A)`
- `template<typename Derived >`
`types::cmat qpp::evals (const Eigen::MatrixBase< Derived > &A)`
- `template<typename Derived >`
`types::cmat qpp::evecs (const Eigen::MatrixBase< Derived > &A)`
- `template<typename Derived >`
`types::dmat qpp::hevals (const Eigen::MatrixBase< Derived > &A)`
- `template<typename Derived >`
`types::cmat qpp::hevecs (const Eigen::MatrixBase< Derived > &A)`
- `template<typename Derived >`
`types::cmat qpp::funm (const Eigen::MatrixBase< Derived > &A, types::cplx(*f)(const types::cplx &))`

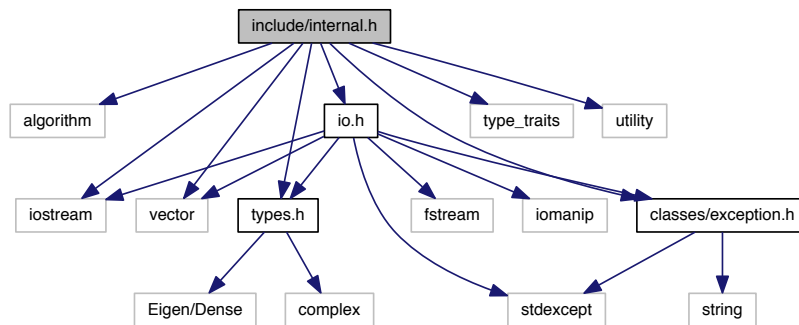
- `template<typename Derived >`
`types::cmat qpp::sqrtm (const Eigen::MatrixBase< Derived > &A)`
- `template<typename Derived >`
`types::cmat qpp::absm (const Eigen::MatrixBase< Derived > &A)`
- `template<typename Derived >`
`types::cmat qpp::expm (const Eigen::MatrixBase< Derived > &A)`
- `template<typename Derived >`
`types::cmat qpp::logm (const Eigen::MatrixBase< Derived > &A)`
- `template<typename Derived >`
`types::cmat qpp::sinm (const Eigen::MatrixBase< Derived > &A)`
- `template<typename Derived >`
`types::cmat qpp::cosm (const Eigen::MatrixBase< Derived > &A)`
- `template<typename Derived >`
`types::cmat qpp::spectralpwm (const Eigen::MatrixBase< Derived > &A, const types::cplx z)`
- `template<typename Derived >`
`types::DynMat< typename`
`Derived::Scalar > qpp::pwm (const Eigen::MatrixBase< Derived > &A, size_t n)`
- `template<typename OutputScalar, typename Derived >`
`types::DynMat< OutputScalar > qpp::cwise (const Eigen::MatrixBase< Derived > &A, Output-`
`Scalar(*f)(const typename Derived::Scalar &))`
- `template<typename T >`
`types::DynMat< typename T::Scalar > qpp::kron (const T &head)`
- `template<typename T, typename... Args>`
`types::DynMat< typename T::Scalar > qpp::kron (const T &head, const Args &...tail)`
- `template<typename Derived >`
`types::DynMat< typename`
`Derived::Scalar > qpp::kron (const std::vector< Derived > &As)`
- `template<typename Derived >`
`types::DynMat< typename`
`Derived::Scalar > qpp::kron (const std::initializer_list< Derived > &As)`
- `template<typename Derived >`
`types::DynMat< typename`
`Derived::Scalar > qpp::kronpow (const Eigen::MatrixBase< Derived > &A, size_t n)`
- `template<typename Derived >`
`types::DynMat< typename`
`Derived::Scalar > qpp::reshape (const Eigen::MatrixBase< Derived > &A, size_t rows, size_t cols)`
- `template<typename Derived >`
`types::DynMat< typename`
`Derived::Scalar > qpp::syspermute (const Eigen::MatrixBase< Derived > &A, const std::vector< size_t >`
`&perm, const std::vector< size_t > &dims)`
- `template<typename Derived >`
`types::DynMat< typename`
`Derived::Scalar > qpp::ptrace1 (const Eigen::MatrixBase< Derived > &A, const std::vector< size_t >`
`&dims)`
- `template<typename Derived >`
`types::DynMat< typename`
`Derived::Scalar > qpp::ptrace2 (const Eigen::MatrixBase< Derived > &A, const std::vector< size_t >`
`&dims)`
- `template<typename Derived >`
`types::DynMat< typename`
`Derived::Scalar > qpp::ptrace (const Eigen::MatrixBase< Derived > &A, const std::vector< size_t > &sub-`
`sys, const std::vector< size_t > &dims)`
- `template<typename Derived >`
`types::DynMat< typename`
`Derived::Scalar > qpp::ptranspose (const Eigen::MatrixBase< Derived > &A, const std::vector< size_t >`
`&subsys, const std::vector< size_t > &dims)`

- `template<typename Derived1 , typename Derived2 >`
`types::DynMat< typename`
`Derived1::Scalar > qpp::comm (const Eigen::MatrixBase< Derived1 > &A, const Eigen::MatrixBase< Derived2 > &B)`
- `template<typename Derived1 , typename Derived2 >`
`types::DynMat< typename`
`Derived1::Scalar > qpp::anticomm (const Eigen::MatrixBase< Derived1 > &A, const Eigen::MatrixBase< Derived2 > &B)`
- `template<typename Derived >`
`types::DynMat< typename`
`Derived::Scalar > qpp::prj (const Eigen::MatrixBase< Derived > &V)`
- `template<typename Derived >`
`types::DynMat< typename`
`Derived::Scalar > qpp::expandout (const Eigen::MatrixBase< Derived > &A, size_t pos, const std::vector< size_t > &dims)`
- `template<typename Derived >`
`types::DynMat< typename`
`Derived::Scalar > qpp::grams (const std::vector< Derived > &Vs)`
- `template<typename Derived >`
`types::DynMat< typename`
`Derived::Scalar > qpp::grams (const std::initializer_list< Derived > &Vs)`
- `template<typename Derived >`
`types::DynMat< typename`
`Derived::Scalar > qpp::grams (const Eigen::MatrixBase< Derived > &A)`
- `std::vector< size_t > qpp::n2multiidx (size_t n, const std::vector< size_t > &dims)`
- `size_t qpp::multiidx2n (const std::vector< size_t > &midx, const std::vector< size_t > &dims)`
- `types::ket qpp::mket (const std::vector< size_t > &mask)`
- `types::ket qpp::mket (const std::vector< size_t > &mask, const std::vector< size_t > &dims)`
- `types::ket qpp::mket (const std::vector< size_t > &mask, size_t d)`
- `std::vector< size_t > qpp::invperm (const std::vector< size_t > &perm)`
- `std::vector< size_t > qpp::compperm (const std::vector< size_t > &perm, const std::vector< size_t > &sigma)`

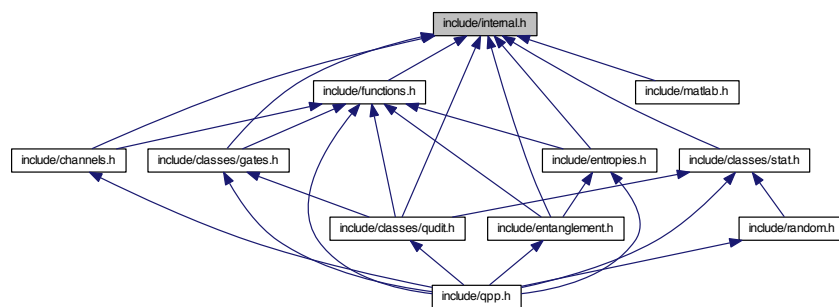
7.13 include/internal.h File Reference

```
#include <algorithm>
#include <iostream>
#include <type_traits>
#include <utility>
#include <vector>
#include "types.h"
#include "classes/exception.h"
#include "io.h"
```

Include dependency graph for internal.h:



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



Namespaces

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

Functions

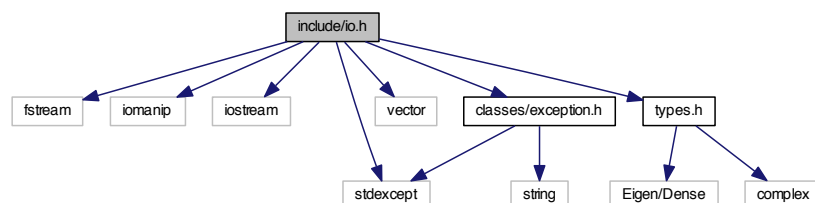
- void [qpp::internal::_n2multiidx](#) (size_t n, size_t numdims, const size_t *dims, size_t *result)
- size_t [qpp::internal::_multiidx2n](#) (const size_t *midx, size_t numdims, const size_t *dims)
- template<typename Derived >
bool [qpp::internal::_check_square_mat](#) (const Eigen::MatrixBase< Derived > &A)
- template<typename Derived >
bool [qpp::internal::_check_vector](#) (const Eigen::MatrixBase< Derived > &A)
- template<typename Derived >
bool [qpp::internal::_check_row_vector](#) (const Eigen::MatrixBase< Derived > &A)
- template<typename Derived >
bool [qpp::internal::_check_col_vector](#) (const Eigen::MatrixBase< Derived > &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 Derived >`
`bool qpp::internal::_check_dims_match_mat (const std::vector< size_t > &dims, const Eigen::MatrixBase< Derived > &A)`
- `template<typename Derived >`
`bool qpp::internal::_check_dims_match_cvect (const std::vector< size_t > &dims, const Eigen::MatrixBase< Derived > &V)`
- `template<typename Derived >`
`bool qpp::internal::_check_dims_match_rvect (const std::vector< size_t > &dims, const Eigen::MatrixBase< Derived > &V)`
- `bool qpp::internal::_check_eq_dims (const std::vector< size_t > &dims, size_t dim)`
- `bool qpp::internal::_check_subsys_match_dims (const std::vector< size_t > &subsys, const std::vector< size_t > &dims)`
- `bool qpp::internal::_check_perm (const std::vector< size_t > &perm)`
- `template<typename Derived1 , typename Derived2 >`
`types::DynMat< typename`
`Derived1::Scalar > qpp::internal::_kron2 (const Eigen::MatrixBase< Derived1 > &A, const Eigen::MatrixBase< Derived2 > &B)`
- `template<typename T >`
`void qpp::internal::variadic_vector_emplace (std::vector< T > &)`
- `template<typename T , typename First , typename... Args>`
`void qpp::internal::variadic_vector_emplace (std::vector< T > &v, First &&first, Args &&...args)`

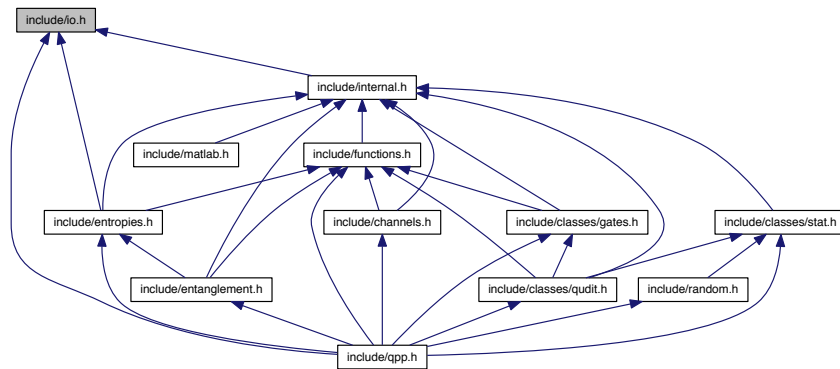
7.14 include/io.h File Reference

```
#include <algorithm>
#include <fstream>
#include <iomanip>
#include <iostream>
#include <iterator>
#include <stdexcept>
#include <vector>
#include "types.h"
#include "classes/exception.h"
```

Include dependency graph for io.h:



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



Namespaces

- [qpp](#)

Functions

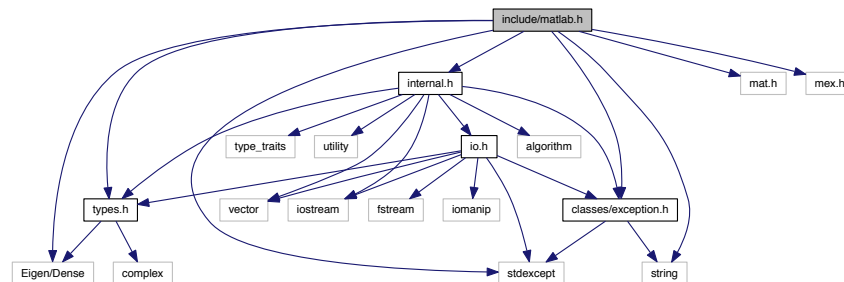
- `template<typename T >`
`void qpp::disp (const T &x, const std::string &separator, const std::string &start="[" , const std::string &end="]", std::ostream &os=std::cout)`
- `template<typename T >`
`void qpp::displn (const T &x, const std::string &separator, const std::string &start="[" , const std::string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

7.15 include/matlab.h File Reference

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

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

Include dependency graph for matlab.h:



Namespaces

- [qpp](#)

Functions

- `template<typename Derived >`
`Derived qpp::loadMATLABmatrix (const std::string &mat_file, const std::string &var_name)`
- `template<>`
`types::dmat qpp::loadMATLABmatrix (const std::string &mat_file, const std::string &var_name)`
- `template<>`
`types::cmat qpp::loadMATLABmatrix (const std::string &mat_file, const std::string &var_name)`
- `template<typename Derived >`
`void qpp::saveMATLABmatrix (const Eigen::MatrixBase< Derived > &A, const std::string &mat_file, const std::string &var_name, const std::string &mode)`
- `template<>`
`void qpp::saveMATLABmatrix (const Eigen::MatrixBase< typename types::dmat > &A, const std::string &mat_file, const std::string &var_name, const std::string &mode)`
- `template<>`
`void qpp::saveMATLABmatrix (const Eigen::MatrixBase< typename types::cmat > &A, const std::string &mat_file, const std::string &var_name, const std::string &mode)`

7.16 include/qpp.h File Reference

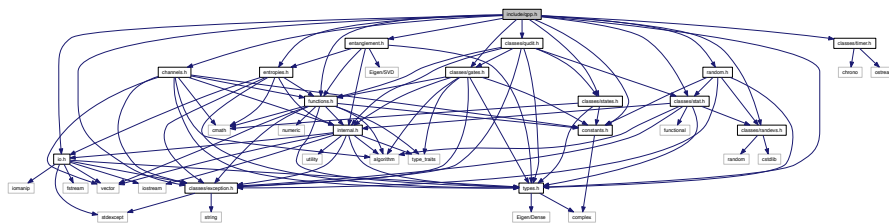
```
#include "channels.h"
```

```

#include "constants.h"
#include "entanglement.h"
#include "entropies.h"
#include "functions.h"
#include "io.h"
#include "random.h"
#include "types.h"
#include "classes/exception.h"
#include "classes/gates.h"
#include "classes/qudit.h"
#include "classes/randevs.h"
#include "classes/stat.h"
#include "classes/states.h"
#include "classes/timer.h"

```

Include dependency graph for qpp.h:



Namespaces

- [qpp](#)

Variables

- RandomDevices & [qpp::rdevs](#) = RandomDevices::getInstance()
- const Gates & [qpp::gt](#) = Gates::getInstance()
- const States & [qpp::st](#) = States::getInstance()

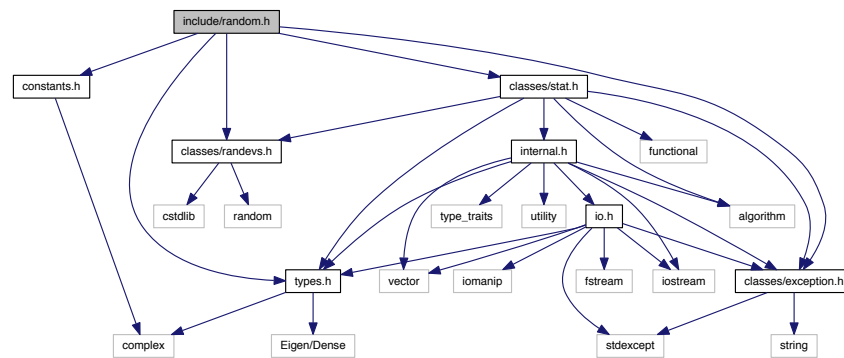
7.17 include/random.h File Reference

```

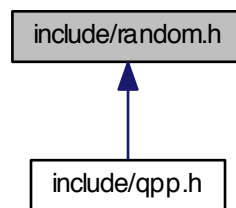
#include "constants.h"
#include "types.h"
#include "classes/exception.h"
#include "classes/randevs.h"
#include "classes/stat.h"

```

Include dependency graph for random.h:



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



Namespaces

- [qpp](#)

Functions

- `template<typename Derived >`
Derived [qpp::rand](#) (size_t rows, size_t cols, double a=0, double b=1)
- `template<>`
`types::dmat` [qpp::rand](#) (size_t rows, size_t cols, double a, double b)
- `template<>`
`types::cmat` [qpp::rand](#) (size_t rows, size_t cols, double a, double b)
- `double` [qpp::rand](#) (double a=0, double b=1)
- `long long` [qpp::randint](#) (long long a, long long b)
- `template<typename Derived >`
Derived [qpp::randn](#) (size_t rows, size_t cols, double mean=0, double sigma=1)
- `template<>`
`types::dmat` [qpp::randn](#) (size_t rows, size_t cols, double mean, double sigma)
- `template<>`
`types::cmat` [qpp::randn](#) (size_t rows, size_t cols, double mean, double sigma)
- `double` [qpp::randn](#) (double mean=0, double sigma=1)

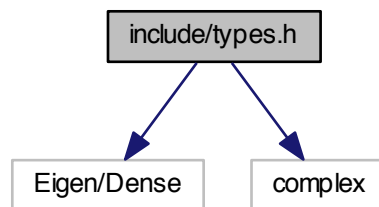
- `types::cmat` [qpp::randU](#) (size_t D)
- `types::cmat` [qpp::randV](#) (size_t Din, size_t Dout)
- `std::vector< types::cmat >` [qpp::randkraus](#) (size_t n, size_t D)
- `types::cmat` [qpp::randH](#) (size_t D)
- `types::ket` [qpp::randket](#) (size_t D)
- `types::cmat` [qpp::randrho](#) (size_t D)
- `std::vector< size_t >` [qpp::randperm](#) (size_t n)

7.18 include/types.h File Reference

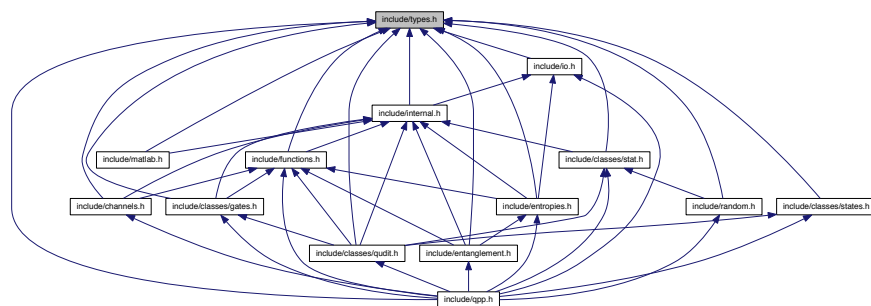
```
#include <Eigen/Dense>
```

```
#include <complex>
```

Include dependency graph for types.h:



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



Namespaces

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

Typedefs

- using [qpp::types::cplx](#) = `std::complex< double >`
- using [qpp::types::cmat](#) = `Eigen::MatrixXcd`

- using `qpp::types::dmat` = `Eigen::MatrixXd`
- using `qpp::types::ket` = `Eigen::Matrix< cplx, Eigen::Dynamic, 1 >`
- using `qpp::types::bra` = `Eigen::Matrix< cplx, 1, Eigen::Dynamic >`
- `template<typename Scalar >`
using `qpp::types::DynMat` = `Eigen::Matrix< Scalar, Eigen::Dynamic, Eigen::Dynamic >`