qpp

0.1

Generated by Doxygen 1.8.5

Sun Apr 20 2014 14:27:41

Contents

1	Nam	nespace	Index				1
	1.1	Names	space List				. 1
2	Hier	archica	Index				3
	2.1	Class I	Hierarchy		 		. 3
3	Clas	ss Index					5
	3.1	Class I	_ist		 		. 5
4	File	Index					7
	4.1	File Lis	st		 		. 7
5	Nam	nespace	Documer	ntation			9
	5.1	qpp Na	amespace	Reference	 		. 9
		5.1.1	Function	Documentation	 		. 13
			5.1.1.1	absm	 		. 13
			5.1.1.2	adjoint	 		. 13
			5.1.1.3	anticomm	 		. 14
			5.1.1.4	channel	 		. 14
			5.1.1.5	choi	 		. 15
			5.1.1.6	choi2kraus	 		. 15
			5.1.1.7	comm	 		. 16
			5.1.1.8	conjugate	 		. 16
			5.1.1.9	cosm	 		. 16
			5.1.1.10	cwise	 		. 17
			5.1.1.11	det	 		. 17
			5.1.1.12	disp	 		. 17
			5.1.1.13	disp	 		. 17
			5.1.1.14	disp			. 17
			5.1.1.15	disp			. 17
			5.1.1.16				
			5.1.1.17	displn	 		. 18
			5 1 1 18	dienla			18

iv CONTENTS

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

CONTENTS

	5.1.1.59	randkraus	35
	5.1.1.60	randn	35
	5.1.1.61	randn	35
	5.1.1.62	randn	35
	5.1.1.63	randn	35
	5.1.1.64	randrho	36
	5.1.1.65	randU	36
	5.1.1.66	randV	36
	5.1.1.67	renyi	36
	5.1.1.68	renyi_inf	37
	5.1.1.69	reshape	37
	5.1.1.70	save	37
	5.1.1.71	saveMATLABmatrix	37
	5.1.1.72	saveMATLABmatrix	38
	5.1.1.73	saveMATLABmatrix	38
	5.1.1.74	schmidtcoeff	38
	5.1.1.75	schmidtprob	39
	5.1.1.76	schmidtU	39
	5.1.1.77	schmidtV	40
	5.1.1.78	shannon	40
	5.1.1.79	sinm	41
	5.1.1.80	spectralpowm	41
	5.1.1.81	sqrtm	41
	5.1.1.82	sum	42
	5.1.1.83	super	42
	5.1.1.84	syspermute	43
	5.1.1.85	trace	43
	5.1.1.86	transpose	44
	5.1.1.87	tsallis	44
5.1.2	Variable I	Documentation	44
	5.1.2.1	gt	44
	5.1.2.2	rdevs	44
	5.1.2.3	st	44
qpp::ct	Namespa	ce Reference	44
5.2.1	Function	Documentation	45
	5.2.1.1	omega	45
5.2.2	Variable I	Documentation	45
	5.2.2.1	chop	45
	5.2.2.2	ee	45
	5.2.2.3	eps	45
	qpp::ct 5.2.1	5.1.1.60 5.1.1.61 5.1.1.62 5.1.1.63 5.1.1.64 5.1.1.65 5.1.1.67 5.1.1.68 5.1.1.69 5.1.1.70 5.1.1.71 5.1.1.72 5.1.1.73 5.1.1.74 5.1.1.75 5.1.1.76 5.1.1.77 5.1.1.78 5.1.1.79 5.1.1.80 5.1.1.81 5.1.1.82 5.1.1.83 5.1.1.84 5.1.1.85 5.1.1.85 5.1.1.86 5.1.1.87 5.1.2 Variable 5.1.2.1 5.1.2.2 5.1.2.3 qpp::ct Namespa 5.2.1 Function 5.2.1.1 5.2.2 5.2.2.1	5.1.1.60 randn 5.1.1.61 randn 5.1.1.62 randn 5.1.1.63 randn 5.1.1.64 randrho 5.1.1.65 randU 5.1.1.66 randV 5.1.1.67 renyi 5.1.1.69 reshape 5.1.1.70 save 5.1.1.71 saveMATLABmatrix 5.1.1.72 saveMATLABmatrix 5.1.1.73 saveMATLABmatrix 5.1.1.74 schmidtcoeff 5.1.1.75 schmidtpob 5.1.1.76 schmidtu 5.1.1.77 schmidtV 5.1.1.78 shannon 5.1.1.79 sinm 5.1.1.80 spectralpowm 5.1.1.81 sqrtm 5.1.1.82 sum 5.1.1.83 super 5.1.1.84 syspermute 5.1.1.85 trace 5.1.1.86 transpose 5.1.1.87 stallis 5.1.2 Variable Documentation 5.1.2.1 qt 5.1.2.2 rdevs 5.1.2.3 st qppictt Namespace Reference 5.2.1 runction Documentation 5.2.2.1 ohop 5.2.2.2 ee

vi CONTENTS

			5.2.2.4	ii	45
			5.2.2.5	maxn	45
			5.2.2.6	pi	45
	5.3	qpp::in	ternal Nan	nespace Reference	45
		5.3.1	Function	Documentation	46
			5.3.1.1	_check_col_vector	46
			5.3.1.2	_check_dims	46
			5.3.1.3	_check_dims_match_cvect	46
			5.3.1.4	_check_dims_match_mat	46
			5.3.1.5	_check_dims_match_rvect	46
			5.3.1.6	_check_eq_dims	46
			5.3.1.7	_check_nonzero_size	46
			5.3.1.8	_check_perm_match_dims	46
			5.3.1.9	_check_row_vector	46
			5.3.1.10	_check_square_mat	46
			5.3.1.11	_check_subsys_match_dims	46
			5.3.1.12	_check_vector	46
			5.3.1.13	_multiidx2n	46
			5.3.1.14	_n2multiidx	46
	5.4	qpp::ty	pes Name	space Reference	46
		5.4.1	Typedef [Documentation	46
			5.4.1.1	bra	46
			5.4.1.2	cmat	46
			5.4.1.3	cplx	47
			5.4.1.4	dmat	47
			5.4.1.5	DynMat	47
			5.4.1.6	ket	47
6	Clas	s Docui	mentation		49
	6.1			ribution Class Reference	_
		6.1.1		tor & Destructor Documentation	
			6.1.1.1	Discrete Distribution	
			6.1.1.2	Discrete Distribution	49
			6.1.1.3	Discrete Distribution	
		6.1.2	Member	Function Documentation	49
			6.1.2.1	probabilities	49
			6.1.2.2	sample	
		6.1.3	Member	Data Documentation	50
			6.1.3.1	_d	50
	6.2	qpp::Di	iscreteDist	ributionAbsSquare Class Reference	50

CONTENTS vii

	6.2.1	Constructor	& Destructor Documentation	 50
		6.2.1.1 D	DiscreteDistributionAbsSquare	 51
		6.2.1.2 D	DiscreteDistributionAbsSquare	 51
		6.2.1.3 D	DiscreteDistributionAbsSquare	 51
		6.2.1.4 D	DiscreteDistributionAbsSquare	 52
	6.2.2	Member Fu	nction Documentation	 52
		6.2.2.1 cp	plx2weights	 52
		6.2.2.2 p	robabilities	 52
		6.2.2.3 sa	ample	 52
	6.2.3	Member Da	ta Documentation	 52
		6.2.3.1 _	d	 52
6.3	qpp::E	xception Clas	ss Reference	 52
	6.3.1	Member En	umeration Documentation	 54
		6.3.1.1 Ty	ype	 54
	6.3.2	Constructor	& Destructor Documentation	 55
		6.3.2.1 E	xception	 55
		6.3.2.2 E	xception	 55
		6.3.2.3 ~	Exception	 55
	6.3.3	Member Fu	nction Documentation	 55
		6.3.3.1	construct_exception_msg	 55
		6.3.3.2 w	/hat	 55
	6.3.4	Member Da	ta Documentation	 55
		6.3.4.1	custom	 55
		6.3.4.2	msg	 55
		6.3.4.3	type	 55
		6.3.4.4	where	 55
6.4	qpp::G	ates Class R	eference	 56
	6.4.1	Constructor	& Destructor Documentation	 56
		6.4.1.1 G	Sates	 56
		6.4.1.2 G	Sates	 56
		6.4.1.3 ~	Gates	 56
	6.4.2	Member Fu	nction Documentation	 56
		6.4.2.1 C	TRL	 57
		6.4.2.2 F	d	 57
		6.4.2.3 g	etInstance	 57
		6.4.2.4 lo	1	 57
		6.4.2.5 o	perator=	 57
		6.4.2.6 R	Riheta	 57
		6.4.2.7 X	d	 58
		6.4.2.8 Z	'd	 58

viii CONTENTS

	6.4.3	Member Data Documentation
		6.4.3.1 CNOTab
		6.4.3.2 CNOTba
		6.4.3.3 CZ
		6.4.3.4 FRED
		6.4.3.5 H
		6.4.3.6 ld2
		6.4.3.7 S
		6.4.3.8 SWAP
		6.4.3.9 T
		6.4.3.10 TOF
		6.4.3.11 X
		6.4.3.12 Y
		6.4.3.13 Z
6.5	qpp::N	ormalDistribution Class Reference
	6.5.1	Constructor & Destructor Documentation
		6.5.1.1 NormalDistribution
	6.5.2	Member Function Documentation
		6.5.2.1 sample
	6.5.3	Member Data Documentation
		6.5.3.1 _d
6.6	qpp::Q	audit Class Reference
	6.6.1	Constructor & Destructor Documentation
		6.6.1.1 Qudit
		6.6.1.2 ~Qudit
	6.6.2	Member Function Documentation
		6.6.2.1 getD
		6.6.2.2 getRho
		6.6.2.3 measure
		6.6.2.4 measure
	6.6.3	Member Data Documentation
		6.6.3.1 _D
		6.6.3.2 _rho
6.7	qpp::R	andomDevices Class Reference
	6.7.1	Constructor & Destructor Documentation
		6.7.1.1 RandomDevices
		6.7.1.2 RandomDevices
		6.7.1.3 ~RandomDevices
	6.7.2	Member Function Documentation
		6.7.2.1 getInstance

CONTENTS

		6.7.2.2 operator=
	6.7.3	Member Data Documentation
		6.7.3.1 _rd
		6.7.3.2 _rng
6.8	qpp::S	tates Class Reference
	6.8.1	Constructor & Destructor Documentation
		6.8.1.1 States
		6.8.1.2 States
		6.8.1.3 ~States
	6.8.2	Member Function Documentation
		6.8.2.1 getInstance
		6.8.2.2 operator=
	6.8.3	Member Data Documentation
		6.8.3.1 b00
		6.8.3.2 b01
		6.8.3.3 b10
		6.8.3.4 b11
		6.8.3.5 GHZ
		6.8.3.6 pb00
		6.8.3.7 pb01
		6.8.3.8 pb10
		6.8.3.9 pb11
		6.8.3.10 pGHZ
		6.8.3.11 pW
		6.8.3.12 px0
		6.8.3.13 px1
		6.8.3.14 py0
		6.8.3.15 py1
		6.8.3.16 pz0
		6.8.3.17 pz1
		6.8.3.18 W
		6.8.3.19 x0
		6.8.3.20 x1
		6.8.3.21 y0
		6.8.3.22 y1
		6.8.3.23 z0
		6.8.3.24 z1
6.9	qpp::Ti	imer Class Reference
	6.9.1	Constructor & Destructor Documentation
		6.9.1.1 Timer

CONTENTS

			6.9.1.2	\sim Timer					 	 	٠.	 	 	65
		6.9.2	Member F	Function	Docume	ntation			 	 		 	 	65
			6.9.2.1	seconds					 	 		 	 	65
			6.9.2.2	tic					 	 		 	 	65
			6.9.2.3	toc					 	 		 	 	65
		6.9.3	Friends A	and Relate	ed Funct	ion Dod	cumen	tation	 	 		 	 	65
			6.9.3.1	operator	<<				 	 		 	 	65
		6.9.4	Member [Data Doc	umentati	ion			 	 		 	 	65
			6.9.4.1	_end .					 	 		 	 	65
			6.9.4.2	_start .					 	 		 	 	65
	6.10	qpp::Ui	niformReal	Distributi	on Class	Refere	ence .		 	 		 	 	65
		6.10.1	Construct	tor & Des	tructor D	ocume	ntation	١	 	 		 	 	66
			6.10.1.1	Uniform	RealDist	ribution	١		 	 		 	 	66
		6.10.2	Member F	Function	Docume	ntation			 	 		 	 	66
			6.10.2.1	sample					 	 		 	 	66
		6.10.3	Member [Data Doc	umentati	ion			 	 		 	 	66
			6.10.3.1	_d					 	 		 	 	66
7	File I	Docume	entation											67
•														٠.
	7.1	include	/channels.	h File Re	erence				 	 		 	 	67
	7.1 7.2		/channels. /classes/ex											67 68
	7.2	include	/classes/ex	xception.l	n File Re	eference	э		 	 		 	 	68
		include	/classes/ex /classes/ga	xception.l	r File Re e Refere	eference	9 		 	 		 	 	
	7.2 7.3	include include include	/classes/ex /classes/ga /classes/qa	xception.l ates.h Fil udit.h File	n File Re e Refere Referer	eference nce . nce .	e 		 	 		 	 	68 69 70
	7.2 7.3 7.4	include include include include	/classes/ex /classes/ga /classes/qa /classes/ra	xception.l ates.h File udit.h File andevs.h	n File Re e Refere Referei File Refe	eference nce . nce . erence	e 		 	 		 	 	68 69 70 71
	7.2 7.3 7.4 7.5	include include include include	/classes/ex/classes/qui/classes/qui/classes/ra/classes/st	xception.l ates.h Fil udit.h File andevs.h tat.h File	n File Re e Refere Referen File Refe Reference	eference nce . nce . erence	e		 	 		 	 	68 69 70 71 72
	7.2 7.3 7.4 7.5 7.6	include include include include include	/classes/ex /classes/ga /classes/qa /classes/ra	xception.l ates.h Fil udit.h File andevs.h tat.h File tates.h Fi	n File Re e Refere Referen File Refe Reference e Refere	eference nce . nce . erence ce	9		 	 		 	 	68 69 70 71
	7.2 7.3 7.4 7.5 7.6 7.7	include include include include include include	/classes/ex/classes/qui/classes/ra/classes/st/classes/st/classes/st/classes/tir/classes/ti	xception.l ates.h File udit.h File andevs.h tat.h File tates.h File mer.h File	n File Re e Refere Referen File Refe Referen e Refere Referen	eference nce . nce . erence ce ence .	9					 	 	68 69 70 71 72 73
	7.2 7.3 7.4 7.5 7.6 7.7 7.8	include include include include include include include	/classes/e/ /classes/qu /classes/ra /classes/st /classes/st	xception.l ates.h File udit.h File andevs.h tat.h File tates.h Fi mer.h File	n File Re e Refere Referen File Refe Referen e Referen Reference	eference nce . erence ce ence .	9			 		 	 	68 69 70 71 72 73 75
	7.2 7.3 7.4 7.5 7.6 7.7 7.8 7.9	include include include include include include include	/classes/ex/classes/qui/classes/qui/classes/sti/classes/sti/classes/tir/constants	xception.l ates.h File udit.h File andevs.h tat.h File tates.h Fi mer.h File s.h File Re	n File Re e Referer Reference Reference Reference e Refere	eference	9					 	 	68 69 70 71 72 73 75 75
	7.2 7.3 7.4 7.5 7.6 7.7 7.8 7.9 7.10 7.11	include include include include include include include include	/classes/e/ /classes/qu /classes/ra /classes/st /classes/st /classes/tir /constants /entanglen	xception.l ates.h File udit.h File andevs.h tat.h File tates.h Fi mer.h File i.h File Re nent.h Fil	n File Re e Referer Reference Reference e Referer ference e Referer ference	eference nce . erence ce . ence .	9							68 69 70 71 72 73 75 75
	7.2 7.3 7.4 7.5 7.6 7.7 7.8 7.9 7.10 7.11 7.12	include	/classes/e/ /classes/q/ /classes/ra /classes/st /classes/st /classes/tir /constants /entanglen /entropies.	xception.l ates.h File udit.h File andevs.h tat.h File tates.h Fi mer.h File s.h File Re nent.h Fil h File Re h File Re	n File Re e Referer Referer File Referer Referer Referer Referer ference Referer e Referer	eference nce nce erence ce nce	9							68 69 70 71 72 73 75 75 77
	7.2 7.3 7.4 7.5 7.6 7.7 7.8 7.9 7.10 7.11 7.12 7.13	include	/classes/ex/classes/qu/classes/qu/classes/st/classes/str/classes/tir/constants/entanglen/entropies./functions.	ates.h File udit.h File andevs.h tat.h File tates.h Fi mer.h File s.h File Re nent.h Fil h File Re h File Re	r File Re e Referer Reference e Reference e Reference de Reference de Reference de rence	eference nce . erence ce . ence . nce .								68 69 70 71 72 73 75 75 77 78 79
	7.2 7.3 7.4 7.5 7.6 7.7 7.8 7.9 7.10 7.11 7.12 7.13 7.14	include	/classes/e/ /classes/q/ /classes/q/ /classes/st /classes/st /classes/tit /constants /entanglen /entropies. /functions. /internal.h	xception.l ates.h File udit.h File andevs.h tat.h File tates.h Fi mer.h File s.h File Re nent.h Fil h File Re File Refe	r File Referer Reference Reference Reference Reference rerence	eference nce . erence ce . ence . nce .								68 69 70 71 72 73 75 75 77 78 79 82
	7.2 7.3 7.4 7.5 7.6 7.7 7.8 7.9 7.10 7.11 7.12 7.13 7.14 7.15	include	/classes/e/ /classes/q/ /classes/ra /classes/st /classes/st /classes/tir /constants /entanglen /entropies. /functions. /internal.h	xception.l ates.h File udit.h File andevs.h tat.h File tates.h File mer.h File h File Re h File Re File Refe Reference File Refer	n File Re e Referer Referer File Refe Reference Referer Referer ference ference ference rence ence	eference nce . erence . ence . nce ence .								68 69 70 71 72 73 75 75 77 78 79 82 84
	7.2 7.3 7.4 7.5 7.6 7.7 7.8 7.9 7.10 7.11 7.12 7.13 7.14 7.15 7.16	include	/classes/ex/classes/qu/classes/ra/classes/st/classes/st/classes/tir/constants/entanglen/entropies./functions./internal.h/io.h File R	ates.h File udit.h File andevs.h tat.h File tates.h Fi mer.h File s.h File Re nent.h Fil h File Re File Refe Reference File Reference	n File Re e Referer Reference e Referer Reference e Referer de Referer e Referer	eference nce erence ence nce								68 69 70 71 72 73 75 77 78 79 82 84 85

Chapter 1

Namespace Index

1.1 Namespace List

Here is a list of all namespaces with brief descriptions:

qpp	
qpp::ct	44
qpp::internal	45
qpp::types	46

2 Namespace Index

Chapter 2

Hierarchical Index

2.1 Class Hierarchy

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

n::DiscreteDistribution	49
o::DiscreteDistributionAbsSquare	50
eption	
qpp::Exception	52
o::Gates	56
::NormalDistribution	59
o::Qudit	60
::RandomDevices	62
o::States	
o::Timer	65
::UniformRealDistribution	65

Hierarchical Index

Chapter 3

Class Index

3.1 Class List

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

qpp::DiscreteDistribution	49
qpp::DiscreteDistributionAbsSquare	50
qpp::Exception	52
qpp::Gates	56
qpp::NormalDistribution	59
qpp::Qudit	
qpp::RandomDevices	
qpp::States	
qpp::Timer	
qpp::UniformRealDistribution	35

6 Class Index

Chapter 4

File Index

4.1 File List

Here is a list of all files with brief descriptions:

include/channels.h
include/constants.h
include/entanglement.h
include/entropies.h
include/functions.h
include/internal.h
include/io.h
include/matlab.h
$include/qpp.h \qquad . \qquad$
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

8 File Index

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 channel (const types::cmat &rho, const std::vector< types::cmat > &Ks)
- types::cmat super (const std::vector< types::cmat > &Ks)
- types::cmat choi (const std::vector< types::cmat > &Ks)
- std::vector < types::cmat > choi2kraus (const types::cmat &A)
- template<typename 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 gconcurrence (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 gmutualinfo (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 >

  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 evects (const Eigen::MatrixBase< Derived > &A)
• template<typename Derived >
  types::dmat hevals (const Eigen::MatrixBase< Derived > &A)

    template<typename Derived >

  types::cmat hevects (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)
 \bullet \ \ \mathsf{template} \mathord{<} \mathsf{typename} \ \mathsf{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(*f)(const
  typename Derived::Scalar &))

    template<typename Derived1 , typename Derived2 >

  types::DynMat< typename
  Derived1::Scalar > kron (const Eigen::MatrixBase< Derived1 > &A, const Eigen::MatrixBase< Derived2 >
  &B)

    template<typename Derived >

  types::DynMat< typename
  Derived::Scalar > kronlist (const std::vector < types::DynMat < typename Derived::Scalar > > &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
  \label{eq:const_state} \mbox{Derived::Scalar} > \mbox{syspermute (const Eigen::MatrixBase} < \mbox{Derived} > \&\mbox{A, const std::vector} < \mbox{size } \mbox{$t > \&$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 > &subsys,
  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-
  sys, 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< types::DynMat< typename Derived::Scalar > > &Vs)

    template<typename Derived >

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

- **Namespace Documentation** 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) 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) 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) types::cmat rand (size t rows, size t cols, double a, double b) • double rand (double a=0, double b=1)
- template<> types::dmat randn (size_t rows, size_t cols, double mean, double sigma) types::cmat randn (size t rows, size t cols, double mean, double sigma)

Derived randn (size t rows, size t cols, double mean=0, double sigma=1)

template<typename Derived >

- 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)

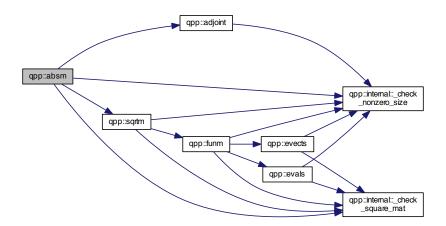
Variables

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

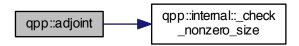
5.1.1 Function Documentation

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)

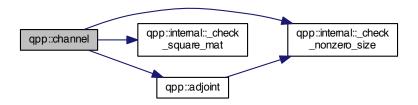


5.1.1.3 template<typename Derived1 , typename Derived2 > types::DynMat<typename Derived1::Scalar> qpp::anticomm (const Eigen::MatrixBase< Derived1 > & A, const Eigen::MatrixBase< Derived2 > & B)

Here is the call graph for this function:

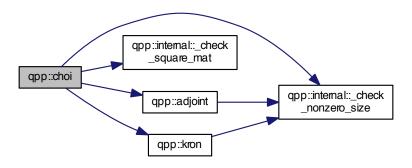


5.1.1.4 types::cmat qpp::channel (const types::cmat & $\it rho$, const std::vector< types::cmat > & $\it Ks$)

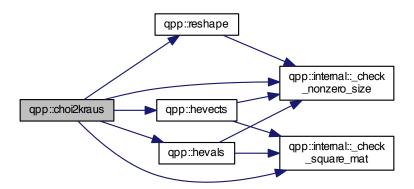


5.1.1.5 types::cmat qpp::choi (const std::vector< types::cmat > & Ks)

Here is the call graph for this function:

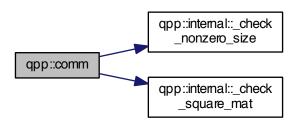


5.1.1.6 std::vector<types::cmat> qpp::choi2kraus (const types::cmat & A)



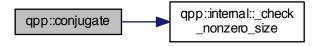
5.1.1.7 template<typename Derived1 , typename Derived2 > types::DynMat<typename Derived1::Scalar> qpp::comm (const Eigen::MatrixBase< Derived1 > & A, const Eigen::MatrixBase< Derived2 > & B)

Here is the call graph for this function:

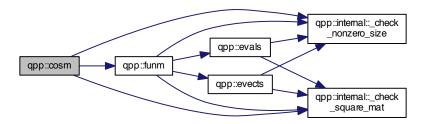


5.1.1.8 template<typename Derived > types::DynMat<typename Derived::Scalar> qpp::conjugate (const Eigen::MatrixBase< Derived > & A)

Here is the call graph for this function:

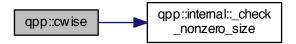


5.1.1.9 template<typename Derived > types::cmat qpp::cosm (const Eigen::MatrixBase< Derived > & A)



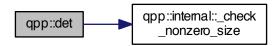
5.1.1.10 template<typename OutputScalar , typename Derived > types::DynMat<OutputScalar> qpp::cwise (const Eigen::MatrixBase< Derived > & A, OutputScalar(*)(const typename Derived::Scalar &) f)

Here is the call graph for this function:



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

Here is the call graph for this function:



- 5.1.1.12 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)
- 5.1.1.13 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)
- 5.1.1.14 template<typename Derived > void qpp::disp (const Eigen::MatrixBase< Derived > & A, double chop = ct::chop, std::ostream & os = std::cout)
- 5.1.1.15 void qpp::disp (const types::cplx c, double chop = ct : :chop, std::ostream & os = std: :cout)



5.1.1.16 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:



5.1.1.17 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:



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

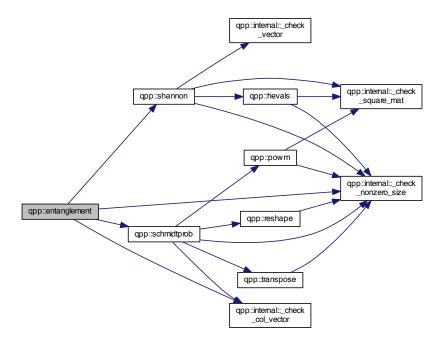


5.1.1.19 void qpp::displn (const types::cplx c, double chop = ct : :chop, std::ostream & os = std::cout)

Here is the call graph for this function:



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

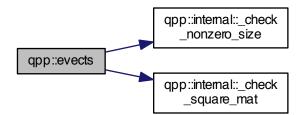


5.1.1.21 template < typename Derived > types::cmat qpp::evals (const Eigen::MatrixBase < Derived > & A)

Here is the call graph for this function:

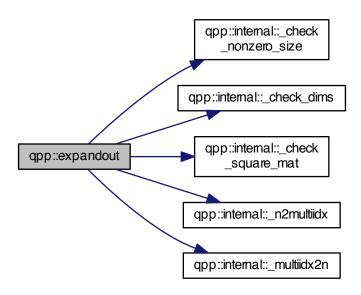


5.1.1.22 template < typename Derived > types::cmat qpp::evects (const Eigen::MatrixBase < Derived > & A)



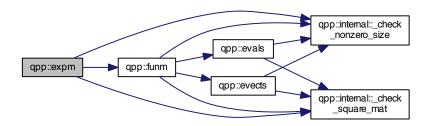
5.1.1.23 template<typename Derived > types::DynMat<typename Derived::Scalar> qpp::expandout (const Eigen::MatrixBase< Derived > & A, size_t pos, const std::vector< size_t > & dims)

Here is the call graph for this function:



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

Here is the call graph for this function:



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

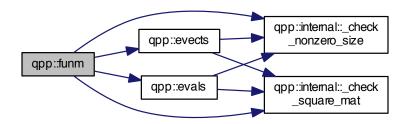
Parameters

Α	input matrix
f	function pointer

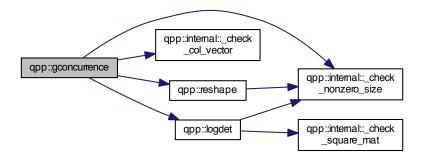
Returns

types::cmat

Here is the call graph for this function:

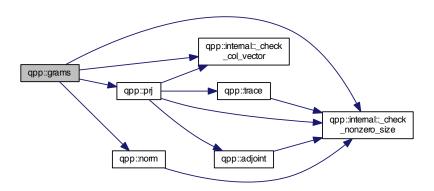


5.1.1.26 template < typename Derived > double qpp::gconcurrence (const Eigen::MatrixBase < Derived > & A)



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

Here is the call graph for this function:

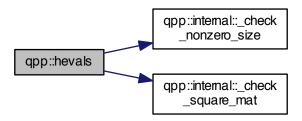


5.1.1.28 template < typename Derived > types::DynMat < typename Derived::Scalar > qpp::grams (const Eigen::MatrixBase < Derived > & A)



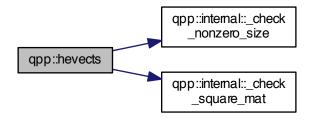
5.1.1.29 template < typename Derived > types::dmat qpp::hevals (const Eigen::MatrixBase < Derived > & A)

Here is the call graph for this function:

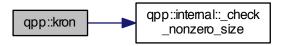


5.1.1.30 template<typename Derived > types::cmat qpp::hevects (const Eigen::MatrixBase< Derived > & A)

Here is the call graph for this function:



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



5.1.1.32 template<typename Derived > types::DynMat<typename Derived::Scalar> qpp::kronlist (const std::vector< types::DynMat< typename Derived::Scalar > > & As)

Here is the call graph for this function:



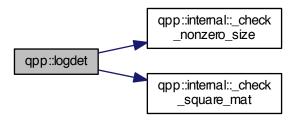
5.1.1.33 template < typename Derived > types::DynMat < typename Derived::Scalar > qpp::kronpow (const Eigen::MatrixBase < Derived > & A, size_t n)



- $5.1.1.34 \quad template < typename \ Derived > types:: DynMat < typename \ Derived:: Scalar > qpp:: load (\ const \ std:: string \ \& \ \textit{fname}$)
- 5.1.1.35 template<typename Derived > Derived qpp::loadMATLABmatrix (const std::string & mat_file, const std::string & var_name)
- 5.1.1.36 template <> types::dmat qpp::loadMATLABmatrix (const std::string & mat_file, const std::string & var_name)
- 5.1.1.37 template <> types::cmat qpp::loadMATLABmatrix (const std::string & mat_file, const std::string & var_name)

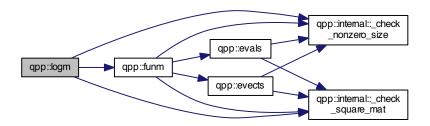
5.1.1.38 template<typename Derived > Derived::Scalar qpp::logdet (const Eigen::MatrixBase< Derived > & A)

Here is the call graph for this function:

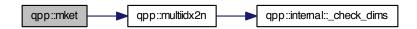


5.1.1.39 template<typename Derived > types::cmat qpp::logm (const Eigen::MatrixBase< Derived > & A)

Here is the call graph for this function:



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



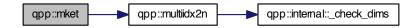
 $5.1.1.41 \quad types:: ket \; qpp:: mket \; (\; const \; std:: vector < \; size_t > \& \; mask, \; const \; std:: vector < \; size_t > \& \; dims \;)$

Here is the call graph for this function:



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

Here is the call graph for this function:



5.1.1.43 size_t qpp::multiidx2n (const std::vector < size_t > & midx, const std::vector < size_t > & dims)



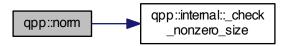
5.1.1.44 std::vector<size_t> qpp::n2multiidx (size_t n, const std::vector< size_t > & dims)

Here is the call graph for this function:

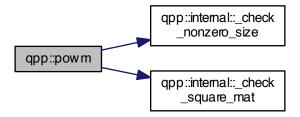


5.1.1.45 template<typename Derived > double qpp::norm (const Eigen::MatrixBase< Derived > & A)

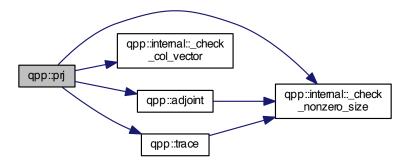
Here is the call graph for this function:



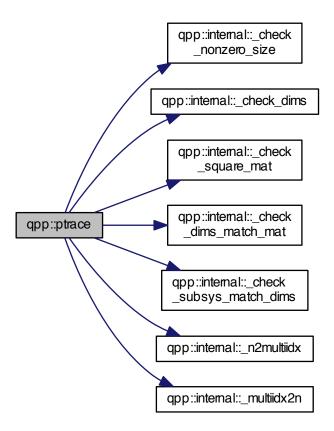
5.1.1.46 template<typename Derived > types::DynMat<typename Derived::Scalar> qpp::powm (const Eigen::MatrixBase< Derived > & A, size_t n)



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

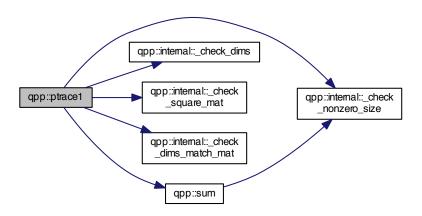


5.1.1.48 template<typename Derived > types::DynMat<typename Derived::Scalar> qpp::ptrace (const Eigen::MatrixBase< Derived > & A, const std::vector< size_t > & subsys, const std::vector< size_t > & dims)

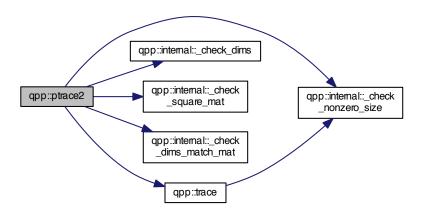


5.1.1.49 template<typename Derived > types::DynMat<typename Derived::Scalar> qpp::ptrace1 (const Eigen::MatrixBase< Derived > & A, const std::vector< size_t > & dims)

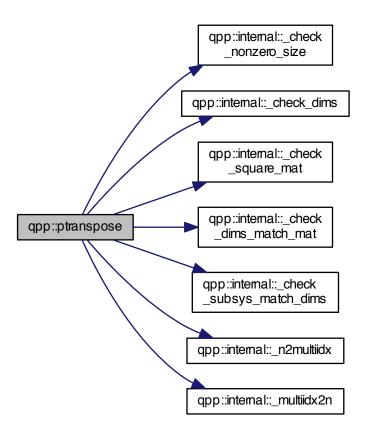
Here is the call graph for this function:



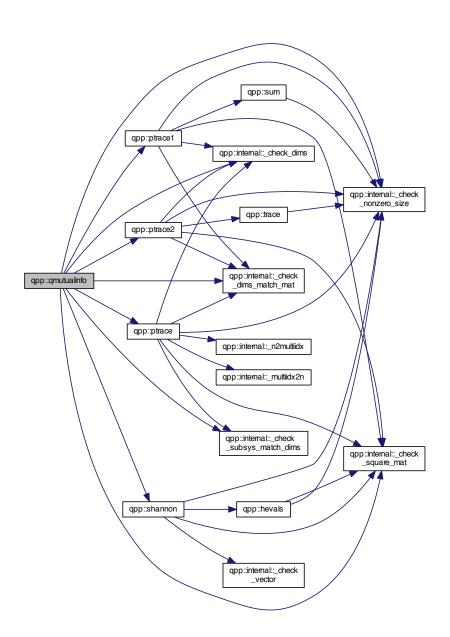
5.1.1.50 template<typename Derived > types::DynMat<typename Derived::Scalar> qpp::ptrace2 (const Eigen::MatrixBase< Derived > & A, const std::vector< size_t > & dims)



5.1.1.51 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)



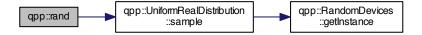
5.1.1.52 template<typename Derived > double qpp::qmutualinfo (const Eigen::MatrixBase< Derived > & A, const std::vector< size_t > & subsys, const std::vector< size_t > & dims)



- 5.1.1.53 template < typename Derived > Derived qpp::rand (size_t rows, size_t cols, double a = 0, double b = 1)
- 5.1.1.54 template <> types::dmat qpp::rand (size_t rows, size_t cols, double a, double b)
- 5.1.1.55 template <> types::cmat qpp::rand (size_t rows, size_t cols, double a, double b)

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

Here is the call graph for this function:

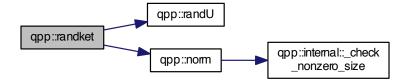


5.1.1.57 types::cmat qpp::randH (size_t D)

Here is the call graph for this function:

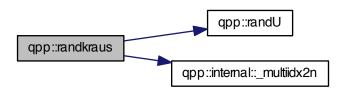


5.1.1.58 types::ket qpp::randket (size_t D)



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

Here is the call graph for this function:

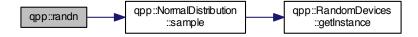


- 5.1.1.60 template < typename Derived > Derived qpp::randn (size_t rows, size_t cols, double mean = 0, double sigma = 1)
- 5.1.1.61 template<> types::dmat qpp::randn (size_t rows, size_t cols, double mean, double sigma)

Here is the call graph for this function:

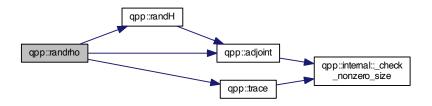


- 5.1.1.62 template<> types::cmat qpp::randn (size_t rows, size_t cols, double mean, double sigma)
- 5.1.1.63 double qpp::randn (double mean = 0, double sigma = 1)



5.1.1.64 types::cmat qpp::randrho (size_t D)

Here is the call graph for this function:



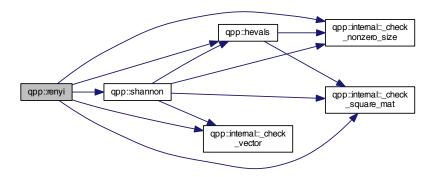
5.1.1.65 types::cmat qpp::randU (size_t D)

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

Here is the call graph for this function:

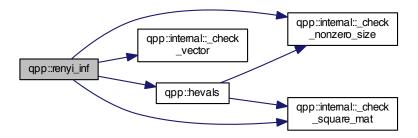


$\textbf{5.1.1.67} \quad \textbf{template} < \textbf{typename Derived} > \textbf{double qpp::renyi (const double } \textbf{alpha}, \ \textbf{const Eigen::MatrixBase} < \textbf{Derived} > \textbf{\& A)}$



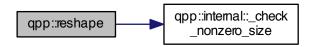
5.1.1.68 template < typename Derived > double qpp::renyi_inf (const Eigen::MatrixBase < Derived > & A)

Here is the call graph for this function:



5.1.1.69 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:



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

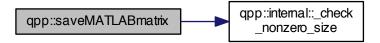
Here is the call graph for this function:



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

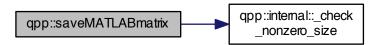
5.1.1.72 template<> void qpp::saveMATLABmatrix (const Eigen::MatrixBase< typename types::dmat > & A, const std::string & mat_file, const std::string & var_name, const std::string & mode)

Here is the call graph for this function:

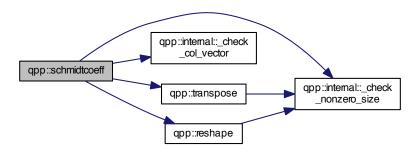


5.1.1.73 template<> void qpp::saveMATLABmatrix (const Eigen::MatrixBase< typename types::cmat > & A, const std::string & mat_file, const std::string & var_name, const std::string & mode)

Here is the call graph for this function:

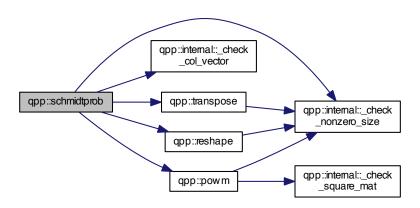


5.1.1.74 template<typename Derived > types::cmat qpp::schmidtcoeff (const Eigen::MatrixBase< Derived > & A, const std::vector< size_t > & dims)

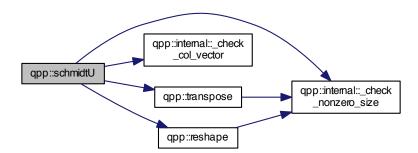


5.1.1.75 template < typename Derived > types::cmat qpp::schmidtprob (const Eigen::MatrixBase < Derived > & A, const std::vector < size_t > & dims)

Here is the call graph for this function:

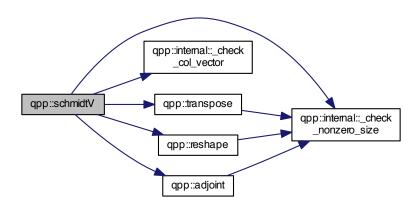


5.1.1.76 template < typename Derived > types::cmat qpp::schmidtU (const Eigen::MatrixBase < Derived > & A, const std::vector < size_t > & dims)

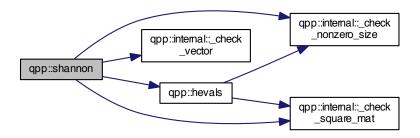


5.1.1.77 template < typename Derived > types::cmat qpp::schmidtV (const Eigen::MatrixBase < Derived > & A, const std::vector < size_t > & dims)

Here is the call graph for this function:

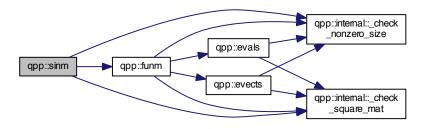


5.1.1.78 template<typename Derived > double qpp::shannon (const Eigen::MatrixBase< Derived > & A)



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

Here is the call graph for this function:

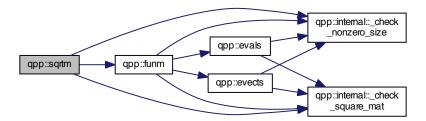


5.1.1.80 template<typename Derived > types::cmat qpp::spectralpowm (const Eigen::MatrixBase< Derived > & A, const types::cplx z)

Here is the call graph for this function:

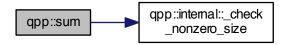


5.1.1.81 template < typename Derived > types::cmat qpp::sqrtm (const Eigen::MatrixBase < Derived > & A)

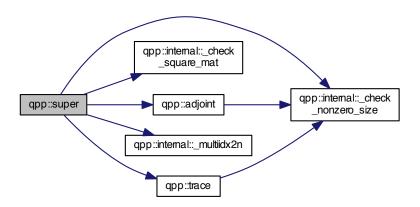


5.1.1.82 template < typename Derived > Derived::Scalar qpp::sum (const Eigen::MatrixBase < Derived > & A)

Here is the call graph for this function:

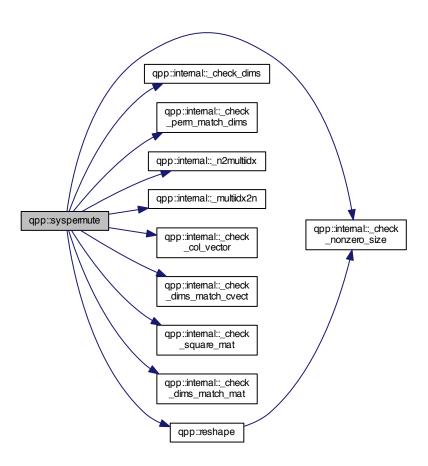


5.1.1.83 types::cmat qpp::super (const std::vector< types::cmat > & Ks)

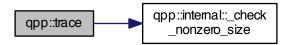


5.1.1.84 template<typename Derived > types::DynMat<typename Derived::Scalar> qpp::syspermute (const Eigen::MatrixBase< Derived > & A, const std::vector< size_t > & perm, const std::vector< size_t > & dims)

Here is the call graph for this function:

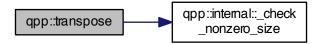


5.1.1.85 template < typename Derived > Derived::Scalar qpp::trace (const Eigen::MatrixBase < Derived > & A)



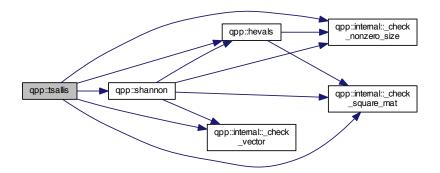
5.1.1.86 template<typename Derived > types::DynMat<typename Derived::Scalar> qpp::transpose (const Eigen::MatrixBase< Derived > & A)

Here is the call graph for this function:



5.1.1.87 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

```
5.3 qpp::internal Namespace Reference

 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

       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 gpp::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 <u>_check_square_mat</u> (const Eigen::MatrixBase< Derived > &A)
• template<typename Derived >
 bool <u>_check_vector</u> (const Eigen::MatrixBase< Derived > &A)

    template<typename Derived >

  bool check row vector (const Eigen::MatrixBase< Derived > &A)

    template<typename Derived >

 bool <u>_check_col_vector</u> (const Eigen::MatrixBase< Derived > &A)

    template<tvpename T >

 bool <u>_check_nonzero_size</u> (const T &x)

    bool <u>_check_dims</u> (const std::vector< size_t > &dims)

    template<typename Derived >

 bool <u>check_dims_match_mat</u> (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 >

    template<typename Derived >

  bool _check_dims_match_rvect (const std::vector< size_t > &dims, const Eigen::MatrixBase< Derived >

    bool <u>_check_eq_dims</u> (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 <u>_check_perm_match_dims</u> (const std::vector< size_t > &perm, const std::vector< size_t > &dims)

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_match_dims (const std::vector < size_t > & perm, const std::vector < size_t > & dims)
- 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 size_t qpp::internal::_multiidx2n (const size_t * midx, size_t numdims, const size_t * dims)
- 5.3.1.14 void qpp::internal::_n2multiidx (size_t n, size_t numdims, const size_t * dims, size_t * result)

5.4 qpp::types Namespace Reference

Typedefs

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

5.4.1 Typedef Documentation

- 5.4.1.1 typedef Eigen::Matrix<cplx, 1, Eigen::Dynamic> qpp::types::bra
- 5.4.1.2 typedef Eigen::MatrixXcd qpp::types::cmat

- 5.4.1.3 typedef std::complex<double> qpp::types::cplx
- 5.4.1.4 typedef Eigen::MatrixXd qpp::types::dmat
- 5.4.1.5 template<typename Scalar > using qpp::types::DynMat = typedef Eigen::Matrix<Scalar, Eigen::Dynamic, Eigen::Dynamic>
- $5.4.1.6 \quad typedef \ Eigen:: Matrix < \textbf{cplx}, \ Eigen:: Dynamic, 1 > \textbf{qpp}:: types:: ket$

Names	pace	Docur	nentation

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)
- Discrete Distribution (std::vector< double > weights)
- size_t sample ()
- std::vector< double > probabilities ()

Protected Attributes

```
std::discrete_distributionsize_t > _d
```

6.1.1 Constructor & Destructor Documentation

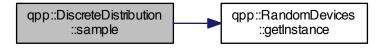
- 6.1.1.1 template<typename InputIterator > qpp::DiscreteDistribution::DiscreteDistribution (InputIterator first, InputIterator last) [inline]
- **6.1.1.2** qpp::DiscreteDistribution::DiscreteDistribution (std::initializer_list < double > weights) [inline]
- 6.1.1.3 qpp::DiscreteDistribution::DiscreteDistribution (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)

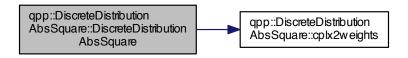
Protected Attributes

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:

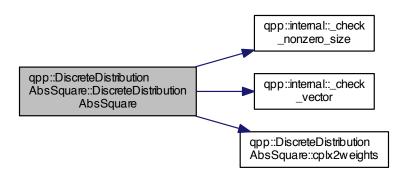


 $\textbf{6.2.1.3} \quad \textbf{qpp::DiscreteDistributionAbsSquare::DiscreteDistributionAbsSquare (\ \textbf{std::vector} < \textbf{types::cplx} > \textbf{amplitudes} \ \textbf{)} \\ \text{[inline]}$



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]
- $\textbf{6.2.2.2} \quad \textbf{std::vector} < \textbf{double} > \textbf{qpp::DiscreteDistributionAbsSquare::probabilities ()} \quad [\texttt{inline}]$
- $\textbf{6.2.2.3} \quad \textbf{size_t qpp::DiscreteDistributionAbsSquare::sample ()} \quad \texttt{[inline]}$

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]

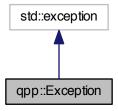
The documentation for this class was generated from the following file:

• include/classes/stat.h

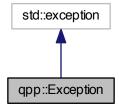
6.3 qpp::Exception Class Reference

#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_CV-ECTOR, 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_MISMATCH_DIMS, Type::NOT_QUBIT_GATE, Type::NOT_QUBIT_SUBSYS, Type::NOT_BI-PARTITE.

Type::OUT_OF_RANGE, Type::UNDEFINED_TYPE, Type::TYPE_MISMATCH, Type::CUSTOM_EXCEPTION }

Public Member Functions

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

Private Member Functions

• std::string _construct_exception_msg ()

Private Attributes

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

6.3.1 Member Enumeration Documentation

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

Enumerator

UNKNOWN_EXCEPTION

ZERO_SIZE

MATRIX_NOT_SQUARE

MATRIX_NOT_CVECTOR

MATRIX_NOT_RVECTOR

MATRIX_NOT_VECTOR

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

 ${\it DIMS_MISMATCH_VECTOR}$

SUBSYS_MISMATCH_DIMS

PERM_MISMATCH_DIMS

NOT_QUBIT_GATE

 NOT_QUBIT_SUBSYS

NOT_BIPARTITE

OUT_OF_RANGE

UNDEFINED_TYPE

TYPE_MISMATCH

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::** \sim **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
- virtual ∼Gates ()=default
- types::cmat Rtheta (double theta) const
- types::cmat ld (size_t D) const
- types::cmat Zd (size_t D) const
- types::cmat Fd (size_t D) const
- types::cmat Xd (size_t D) const
- types::cmat CTRL (const types::cmat &A, const std::vector< size_t > &ctrl, const std::vector< size_t > &gate, size_t n, size_t d=2) const

Static Public Member Functions

• static const Gates & getInstance ()

Public Attributes

- types::cmat ld2
- types::cmat H
- types::cmat X
- types::cmat Y
- types::cmat Z
- types::cmat S
- · types::cmat T
- types::cmat CNOTab
- types::cmat CZ
- types::cmat CNOTba
- · types::cmat SWAP
- types::cmat TOF
- types::cmat FRED

Private Member Functions

• Gates ()

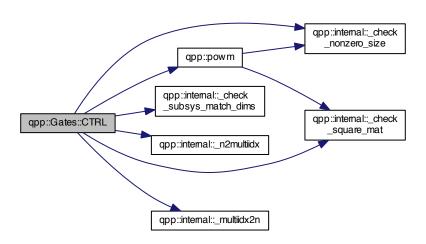
6.4.1 Constructor & Destructor Documentation

```
6.4.1.1 qpp::Gates::Gates( ) [inline],[private]
6.4.1.2 qpp::Gates::Gates( const Gates & ) [delete]
6.4.1.3 virtual qpp::Gates::~Gates( ) [virtual],[default]
```

6.4.2 Member Function Documentation

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

Here is the call graph for this function:



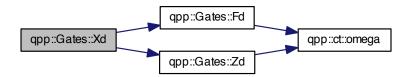
6.4.2.2 types::cmat qpp::Gates::Fd (size_t D) const [inline]



- 6.4.2.3 static const Gates& qpp::Gates::getInstance() [inline], [static]
- 6.4.2.4 types::cmat qpp::Gates::ld (size_t D) const [inline]
- 6.4.2.5 Gates& qpp::Gates::operator=(const Gates &) [delete]
- 6.4.2.6 types::cmat qpp::Gates::Rtheta (double theta) const [inline]

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

Here is the call graph for this function:



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



- 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::ld2
- 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

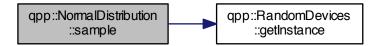
6.5.1 Constructor & Destructor Documentation

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

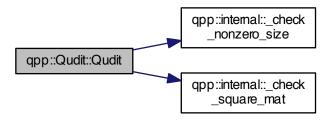
- Qudit (const types::cmat &rho=States::getInstance().pz0)
- size_t measure (const types::cmat &U, bool destructive=false)
- size_t measure (bool destructive=false)
- types::cmat getRho () const
- size_t getD () const
- virtual \sim Qudit ()=default

Private Attributes

- · types::cmat _rho
- size_t _D

6.6.1 Constructor & Destructor Documentation

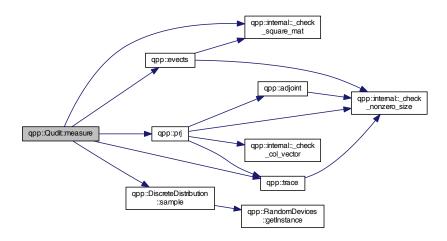
6.6.1.1 qpp::Qudit::Qudit (const types::cmat & rho = States::getInstance () .pz0) [inline]



- 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]

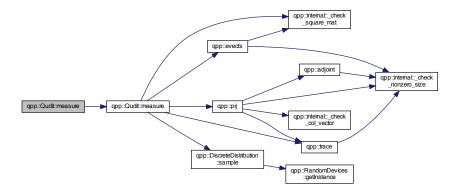
6.6.2.3 size_t qpp::Qudit::measure (const types::cmat & U, bool destructive = false) [inline]

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
- virtual ∼RandomDevices ()=default

Static Public Member Functions

• static RandomDevices & getInstance ()

Public Attributes

- std::random device rd
- std::mt19937 _rng

Private Member Functions

· 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** virtual qpp::RandomDevices::~RandomDevices() [virtual], [default]
- 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
- virtual ∼States ()=default

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 GHZtypes::ket W
- types::cmat pGHZ
- types::cmat pW

Private Member Functions

• 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 virtual qpp::States::∼States()** [virtual], [default]
- 6.8.2 Member Function Documentation
- **6.8.2.1** static const States& qpp::States::getInstance() [inline], [static]

64 Class Documentation

```
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::high_resolution_clock::time_point _start
- std::chrono::high resolution clock::time point end

Friends

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

6.9.1 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]
```

```
\textbf{6.9.2.2} \quad \textbf{void qpp::Timer::tic()} \quad \texttt{[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::high_resolution_clock::time_point qpp::Timer::_end [protected]
```

6.9.4.2 std::chrono::high_resolution_clock::time_point qpp::Timer::_start [protected]

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

• include/classes/timer.h

6.10 qpp::UniformRealDistribution Class Reference

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

66 Class Documentation

Public Member Functions

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

Protected Attributes

• std::uniform_real_distribution_d

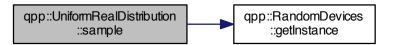
6.10.1 Constructor & Destructor Documentation

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:

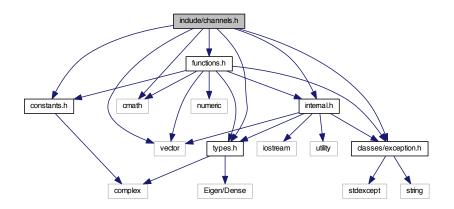
• include/classes/stat.h

Chapter 7

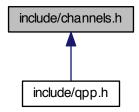
File Documentation

7.1 include/channels.h File Reference

```
#include <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

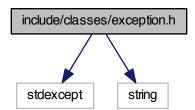
Functions

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

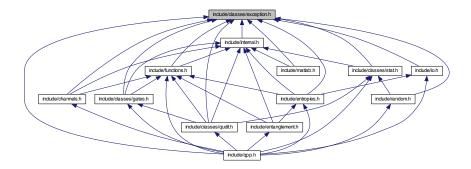
7.2 include/classes/exception.h File Reference

#include <stdexcept>
#include <string>

Include dependency graph for exception.h:



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



Classes

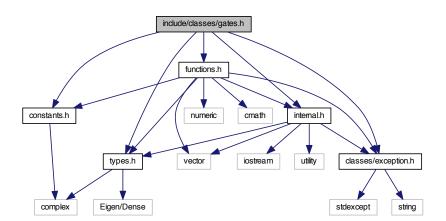
· class qpp::Exception

Namespaces

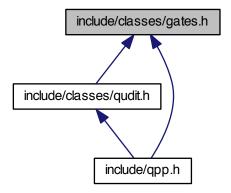
• qpp

7.3 include/classes/gates.h File Reference

```
#include "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

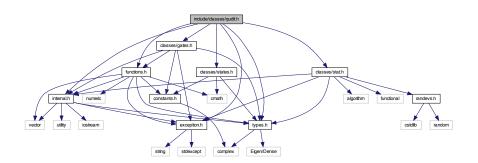
class qpp::Gates

Namespaces

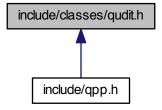
• qpp

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 dependency graph for qudit.h:
```



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



Classes

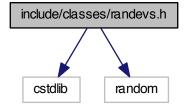
class qpp::Qudit

Namespaces

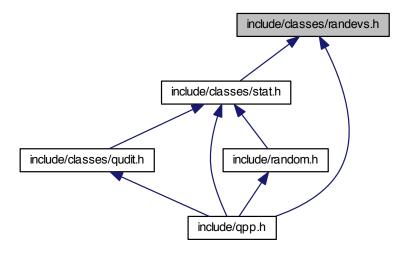
qpp

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

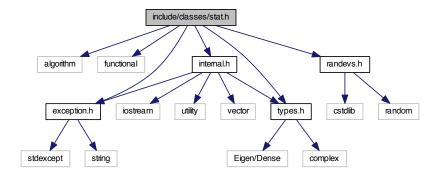
Namespaces

• qpp

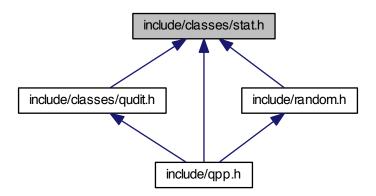
7.6 include/classes/stat.h File Reference

```
#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

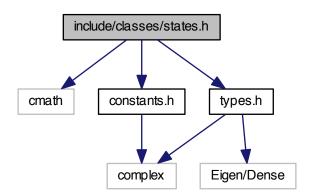
Namespaces

• qpp

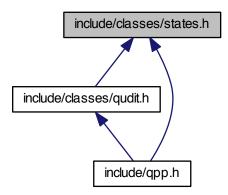
7.7 include/classes/states.h File Reference

#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

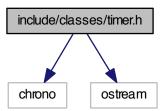
Namespaces

qpp

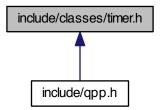
7.8 include/classes/timer.h File Reference

#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

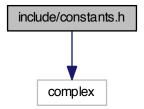
Namespaces

• qpp

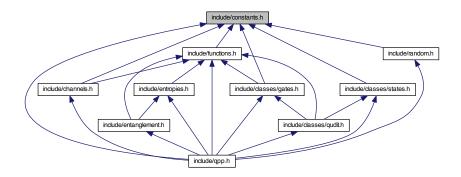
7.9 include/constants.h File Reference

#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)

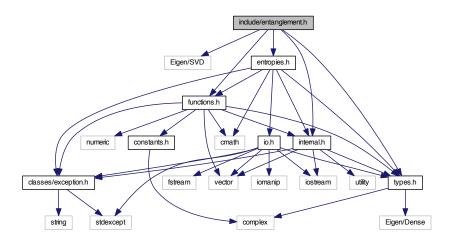
Variables

- 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

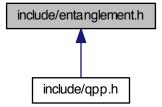
7.10 include/entanglement.h File Reference

```
#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

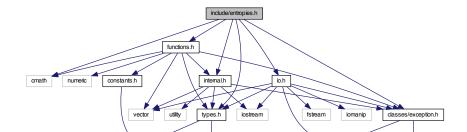
Functions

- 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::gconcurrence (const Eigen::MatrixBase< Derived > &A)

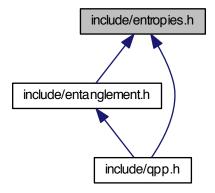
7.11 include/entropies.h File Reference

```
#include <cmath>
#include "functions.h"
#include "internal.h"
#include "types.h"
#include "classes/exception.h"
#include dependency graph for entropies.h:
```



Eigen/Dense

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



string

Namespaces

• qpp

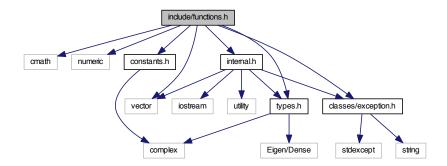
Functions

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

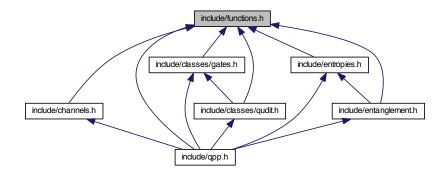
- template<typename Derived >
 double qpp::renyi (const double alpha, const Eigen::MatrixBase< Derived > &A)
- template<typename Derived >
 double qpp::renyi_inf (const Eigen::MatrixBase< Derived > &A)
- template<typename Derived >
 double qpp::tsallis (const double alpha, const Eigen::MatrixBase< Derived > &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 <cmath>
#include <numeric>
#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 >
 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::evects (const Eigen::MatrixBase< Derived > &A)
- template<typename Derived >
 types::dmat qpp::hevals (const Eigen::MatrixBase< Derived > &A)
- template<typename Derived >
 types::cmat qpp::hevects (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::spectralpowm (const Eigen::MatrixBase< Derived > &A, const types::cplx z)

    template<typename Derived >

   types::DynMat< typename
   Derived::Scalar > qpp::powm (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 Derived1, typename Derived2 >

   types::DynMat< typename
   Derived1::Scalar > qpp::kron (const Eigen::MatrixBase< Derived1 > &A, const Eigen::MatrixBase< De-
   rived2 > &B)

    template<typename Derived >

   types::DynMat< typename
   Derived::Scalar > qpp::kronlist (const std::vector < types::DynMat < typename Derived::Scalar > > &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
   {\tt Derived::Scalar} > {\tt qpp::ptranspose} \; ({\tt const} \; {\tt Eigen::MatrixBase} < \; {\tt Derived} > \& {\tt A}, \; {\tt const} \; {\tt std::vector} < \; {\tt size\_t} > \; {\tt Const} \; {\tt Co
   &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< De-
   rived2 > &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)

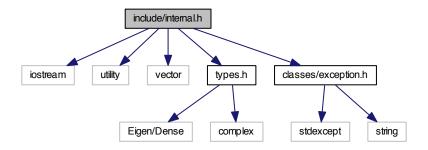
template<typename Derived >
 types::DynMat< typename
 Derived::Scalar > qpp::grams (const std::vector< types::DynMat< typename Derived::Scalar >> &Vs)

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

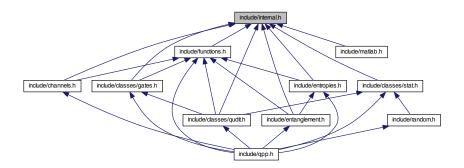
- std::vector< size_t > qpp::n2multiidx (size_t n, const std::vector< size_t > &dims)
- size_t qpp::multiidx2n (const std::vector < size_t > &midx, const std::vector < size_t > &dims)
- types::ket qpp::mket (const std::vector< size_t > &mask)
- types::ket qpp::mket (const std::vector < size_t > &mask, const std::vector < size_t > &dims)
- types::ket qpp::mket (const std::vector< size_t > &mask, size_t d)

7.13 include/internal.h File Reference

```
#include <iostream>
#include <utility>
#include <vector>
#include "types.h"
#include "classes/exception.h"
Include dependency graph for internal.h:
```



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



Namespaces

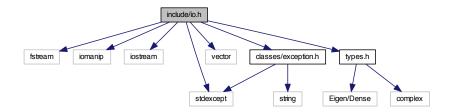
- qpp
- · qpp::internal

Functions

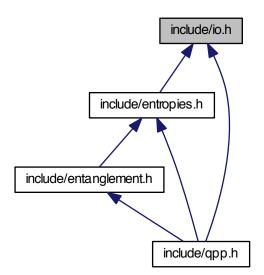
- void qpp::internal::_n2multiidx (size_t n, size_t numdims, const size_t *dims, size_t *result)
- size t qpp::internal:: multiidx2n (const size t *midx, size t numdims, const size t *dims)
- template<typename Derived >
 bool qpp::internal::_check_square_mat (const Eigen::MatrixBase< Derived > &A)
- 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_match_dims (const std::vector< size_t > &perm, const std::vector< size_t > &dims)

7.14 include/io.h File Reference

```
#include <fstream>
#include <iomanip>
#include <iostream>
#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 >

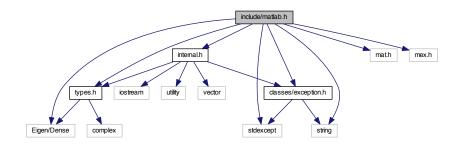
void qpp::disp (const T &x, const std::string &separator, const std::string &start="[", const std::string &end="]", std::ostream &os=std::cout)

- 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

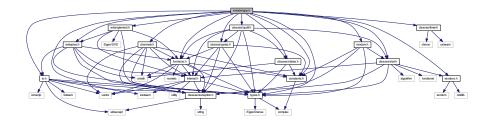
qpp

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

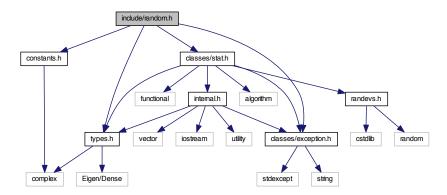
Variables

• RandomDevices & qpp::rdevs = RandomDevices::getInstance()

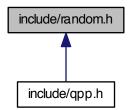
```
const Gates & qpp::gt = Gates::getInstance()const States & qpp::st = States::getInstance()
```

7.17 include/random.h File Reference

```
#include "constants.h"
#include "types.h"
#include "classes/exception.h"
#include "classes/stat.h"
Include dependency graph for random.h:
```



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



Namespaces

• qpp

Functions

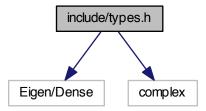
```
    template<typename Derived >
        Derived qpp::rand (size_t rows, size_t cols, double a=0, double b=1)
    template<>
        types::dmat qpp::rand (size_t rows, size_t cols, double a, double b)
```

- template<>
 - types::cmat qpp::rand (size_t rows, size_t cols, double a, double b)
- double qpp::rand (double a=0, double b=1)
- 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)

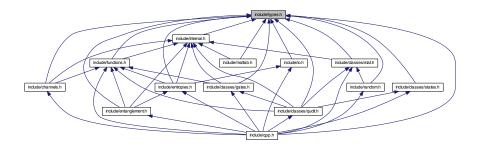
7.18 include/types.h File Reference

#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

- $\bullet \ \ \mathsf{typedef} \ \mathsf{std} \text{::complex} < \mathsf{double} > \mathsf{qpp} \text{::types} \text{::cplx} \\$
- typedef Eigen::MatrixXcd qpp::types::cmat
- typedef Eigen::MatrixXd qpp::types::dmat
- typedef Eigen::Matrix < cplx,
 Eigen::Dynamic, 1 > qpp::types::ket
- typedef Eigen::Matrix< cplx,
 - 1, Eigen::Dynamic > qpp::types::bra
- template<typename Scalar >

using qpp::types::DynMat = Eigen::Matrix< Scalar, Eigen::Dynamic, Eigen::Dynamic >