Octave C++ Classes

Edition 1.0 for Octave version 2.0.5
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John W. Eaton

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2 A Brief Introduction to Octave

This manual documents how to run, install and port Octave's C++ classes, and how to report bugs.

3 Arrays

3.1 Constructors and Assignment

Array<T>::Array (`void`) Constructor

Create an array with no elements.

Array<T>::Array (`int` *n* [`, const T &`*val*]) Constructor

Create an array with *n* elements. If the optional argument *val* is supplied, the elements are initialized to *val*; otherwise, they are left uninitialized. If *n* is less than zero, the current error handler is invoked (see Chapter 13 [Error Handling], page 45).

Array<T>::Array (`const Array<T> &`*a*) Constructor

Create a copy of the *Array*<*T*> object *a*. Memory for the *Array*<*T*> class is managed using a reference counting scheme, so the cost of this operation is independent of the size of the array.

`Array<T>&` **Array<T>::operator =** (`const Array<T> &`*a*) Operator

Assignment operator. Memory for the *Array*<*T*> class is managed using a reference counting scheme, so the cost of this operation is independent of the size of the array.

`int` **Array<T>::capacity** (`void`) `const` Method
`int` **Array<T>::length** (`void`) `const` Method

Return the length of the array.

`T&` **Array<T>::elem** (`int` *n*) Method
`T&` **Array<T>::checkelem** (`int` *n*) Method
`T&` **Array<T>::operator** () (`int` *n*) Method

If *n* is within the bounds of the array, return a reference to the element indexed by *n*; otherwise, the current error handler is invoked (see Chapter 13 [Error Handling], page 45).

`T` **Array<T>::elem** (`int` *n*) `const` Method
`T` **Array<T>::checkelem** (`int` *n*) `const` Method
`T` **Array<T>::operator** () (`int` *n*) `const` Method

If *n* is within the bounds of the array, return the value indexed by *n*; otherwise, call the current error handler. See Chapter 13 [Error Handling], page 45.

`T&` **Array<T>::xelem** (`int` *n*) Method
`T` **Array<T>::xelem** (`int` *n*) `const` Method

Return a reference to, or the value of, the element indexed by *n*. These methods never perform bounds checking.

`void` **Array<T>::resize** (`int` *n* [, `const T &`*val*]) Method

Change the size of the array to be *n* elements. All elements are unchanged, except that if *n* is greater than the current size and the optional argument *val* is provided, the additional elements are initialized to *val*; otherwise, any additional elements are left uninitialized. In the current implementation, if *n* is less than the current size, the length is updated but no memory is released.

`const T*` **Array<T>::data** (`void`) `const` Method

Array2 (`void`)
Array2 (`int` *n*, `int` *m*)
Array2 (`int` *n*, `int` *m*, `const T &`*val*)
Array2 (`const Array2<T> &`*a*)
Array2 (`const DiagArray<T> &`*a*)

`Array2<T>&` **operator =** (`const Array2<T> &`*a*)

`int` **dim1** (`void`) `const`
`int` **rows** (`void`) `const`

`int` **dim2** (`void`) `const`
`int` **cols** (`void`) `const`
`int` **columns** (`void`) `const`

`T&` **elem** (`int` *i*, `int` *j*)
`T&` **checkelem** (`int` *i*, `int` *j*)
`T&` **operator** () (`int` *i*, `int` *j*)

`void` **resize** (`int` *n*, `int` *m*)
`void` **resize** (`int` *n*, `int` *m*, `const T &`*val*)

`Array3` (**void**)
`Array3` (**int** *n*, `int` *m*, `int` *k*)
`Array3` (**int** *n*, `int` *m*, `int` *k*, `const T &`*val*)
`Array3` (**const** `Array3<T> &`*a*)

`Array3<T>&` **operator =** (`const Array3<T> &`*a*)

`int` **dim1** (`void`) `const`
`int` **dim2** (`void`) `const`
`int` **dim3** (`void`) `const`

`T&` **elem** (`int` *i*, `int` *j*, `int` *k*)
`T&` **checkelem** (`int` *i*, `int` *j*, `int` *k*)
`T&` **operator** () (`int` *i*, `int` *j*, `int` *k*)

`void` **resize** (`int` *n*, `int` *m*, `int` *k*)
`void` **resize** (`int` *n*, `int` *m*, `int` *k*, `const T &`*val*)

(void)
(int *n*)
(int *n*, `const T &`*val*)
(int *r*, `int` *c*)
(int *r*, `int` *c*, `const T &`*val*)
(const `Array<T> &`*a*)
(const `DiagArray<T> &`*a*)

`DiagArray<T>&` **operator =** (`const DiagArray<T> &`*a*)

`int` **dim1** (`void`) `const`
`int` **rows** (`void`) `const`

`int` **dim2** (`void`) `const`
`int` **cols** (`void`) `const`
`int` **columns** (`void`) `const`

`T&` **elem** (`int` *r*, `int` *c*)
`T&` **checkelem** (`int` *r*, `int` *c*)
`T&` **operator ()** (`int` *r*, `int` *c*)

`void` **resize** (`int` *n*, `int` *m*)
`void` **resize** (`int` *n*, `int` *m*, `const T &`*val*)

The real and complex `ColumnVector` and `RowVector` classes all have the following functions. These will eventually be part of an `MArray<T>` class, derived from the `Array<T>` class. Then the `ColumnVector` and `RowVector` classes will be derived from the `MArray<T>` class.

Element by element vector by scalar ops.

`RowVector` **operator +** (`const RowVector &`*a*, `const double &`*s*)
`RowVector` **operator -** (`const RowVector &`*a*, `const double &`*s*)
`RowVector` **operator *** (`const RowVector &`*a*, `const double &`*s*)
`RowVector` **operator /** (`const RowVector &`*a*, `const double &`*s*)

Element by element scalar by vector ops.

`RowVector` **operator +** (`const double &`*s*, `const RowVector &`*a*)
`RowVector` **operator -** (`const double &`*s*, `const RowVector &`*a*)
`RowVector` **operator *** (`const double &`*s*, `const RowVector &`*a*)
`RowVector` **operator /** (`const double &`*s*, `const RowVector &`*a*)

Element by element vector by vector ops.

`RowVector` **operator +** (`const RowVector &`*a*, `const RowVector &`*b*)
`RowVector` **operator -** (`const RowVector &`*a*, `const RowVector &`*b*)

`RowVector` **product** (`const RowVector &`*a*, `const RowVector &`*b*)
`RowVector` **quotient** (`const RowVector &`*a*, `const RowVector &`*b*)

Unary MArray ops.

`RowVector` **operator -** (`const RowVector &`*a*)

The `Matrix` classes share the following functions. These will eventually be part of an `MArray2<T>` class, derived from the `Array2<T>` class. Then the `Matrix` class will be derived from the `MArray<T>` class.

Element by element matrix by scalar ops.

`Matrix` **operator +** (`const Matrix &`*a*, `const double &`*s*)
`Matrix` **operator -** (`const Matrix &`*a*, `const double &`*s*)
`Matrix` **operator *** (`const Matrix &`*a*, `const double &`*s*)
`Matrix` **operator /** (`const Matrix &`*a*, `const double &`*s*)

Element by element scalar by matrix ops.

`Matrix` **operator +** (`const double &`*s*, `const Matrix &`*a*)
`Matrix` **operator -** (`const double &`*s*, `const Matrix &`*a*)
`Matrix` **operator *** (`const double &`*s*, `const Matrix &`*a*)
`Matrix` **operator /** (`const double &`*s*, `const Matrix &`*a*)

Element by element matrix by matrix ops.

`Matrix` **operator +** (`const Matrix &`*a*, `const Matrix &`*b*)
`Matrix` **operator -** (`const Matrix &`*a*, `const Matrix &`*b*)

`Matrix` **product** (`const Matrix &`*a*, `const Matrix &`*b*)
`Matrix` **quotient** (`const Matrix &`*a*, `const Matrix &`*b*)

Unary matrix ops.

`Matrix` **operator -** (`const Matrix &`*a*)

The `DiagMatrix` classes share the following functions. These will eventually be part of an `MDiagArray<T>` class, derived from the `DiagArray<T>` class. Then the `DiagMatrix` class will be derived from the `MDiagArray<T>` class.

Element by element MDiagArray by scalar ops.

`DiagMatrix` **operator *** (`const DiagMatrix &`*a*, `const double &`*s*)
`DiagMatrix` **operator /** (`const DiagMatrix &`*a*, `const double &`*s*)

Element by element scalar by MDiagArray ops.

`DiagMatrix` **operator *** (`const double &`*s*, `const DiagMatrix &`*a*)

Element by element MDiagArray by MDiagArray ops.

`DiagMatrix` **operator +** (`const DiagMatrix &`*a*, `const DiagMatrix &`*b*)
`DiagMatrix` **operator -** (`const DiagMatrix &`*a*, `const DiagMatrix &`*b*)

`DiagMatrix` **product** (`const DiagMatrix &`*a*, `const DiagMatrix &`*b*)

Unary MDiagArray ops.

`DiagMatrix` **operator -** (`const DiagMatrix &`*a*)

4 Matrix and Vector Operations

(**void**)
(**int** *r*, int *c*)
(**int** *r*, int *c*, double *val*)
(**const** Array2<double> &*a*)
(**const** Matrix &*a*)
(**const** DiagArray<double> &*a*)
(**const** DiagMatrix &*a*)

Matrix& **operator** = (const Matrix &*a*)

int **operator** == (const Matrix &*a*) const
int **operator** != (const Matrix &*a*) const

Matrix& **insert** (const Matrix &*a*, int *r*, int *c*)
Matrix& **insert** (const RowVector &*a*, int *r*, int *c*)
Matrix& **insert** (const ColumnVector &*a*, int *r*, int *c*)
Matrix& **insert** (const DiagMatrix &*a*, int *r*, int *c*)

Matrix& **fill** (double *val*)
Matrix& **fill** (double *val*, int r1, int c1, int r2, int c2)

Matrix **append** (const Matrix &*a*) const
Matrix **append** (const RowVector &*a*) const
Matrix **append** (const ColumnVector &*a*) const
Matrix **append** (const DiagMatrix &*a*) const

Matrix **stack** (const Matrix &*a*) const
Matrix **stack** (const RowVector &*a*) const
Matrix **stack** (const ColumnVector &*a*) const
Matrix **stack** (const DiagMatrix &*a*) const

Matrix **transpose** (void) const

Matrix **extract** (int r1, int c1, int r2, int c2) const

RowVector **row** (int *i*) const
RowVector **row** (char *s) const

ColumnVector **column** (int *i*) const
ColumnVector **column** (char *s) const

Matrix **inverse** (void) const
Matrix **inverse** (int &*info*) const
Matrix **inverse** (int &*info*, double &*rcond*) const

ComplexMatrix **fourier** (void) const
ComplexMatrix **ifourier** (void) const

DET **determinant** (void) const
DET **determinant** (int &*info*) const
DET **determinant** (int &*info*, double &*rcond*) const

Matrix **solve** (const Matrix &*b*) const
Matrix **solve** (const Matrix &*b*, int &*info*) const
Matrix **solve** (const Matrix &*b*, int &*info*, double &*rcond*) const

ComplexMatrix **solve** (const ComplexMatrix &*b*) const
ComplexMatrix **solve** (const ComplexMatrix &*b*, int &*info*) const
ComplexMatrix **solve** (const ComplexMatrix &*b*, int &*info*, double &*rcond*) const

ColumnVector **solve** (const ColumnVector &*b*) const
ColumnVector **solve** (const ColumnVector &*b*, int &*info*) const
ColumnVector **solve** (const ColumnVector &*b*, int &*info*, double &*rcond*) const

ComplexColumnVector **solve** (const ComplexColumnVector &*b*) const
ComplexColumnVector **solve** (const ComplexColumnVector &*b*, int &*info*) const
ComplexColumnVector **solve** (const ComplexColumnVector &*b*, int &*info*, double &*rcond*) const

Matrix **lssolve** (const Matrix &*b*) const
Matrix **lssolve** (const Matrix &*b*, int &*info*) const
Matrix **lssolve** (const Matrix &*b*, int &*info*, int &*rank*) const

ComplexMatrix **lssolve** (const ComplexMatrix &*b*) const
ComplexMatrix **lssolve** (const ComplexMatrix &*b*, int &*info*) const
ComplexMatrix **lssolve** (const ComplexMatrix &*b*, int &*info*, int &*rank*) const

ColumnVector **lssolve** (const ColumnVector &*b*) const
ColumnVector **lssolve** (const ColumnVector &*b*, int &*info*) const
ColumnVector **lssolve** (const ColumnVector &*b*, int &*info*, int &*rank*) const

ComplexColumnVector **lssolve** (const ComplexColumnVector &*b*) const
ComplexColumnVector **lssolve** (const ComplexColumnVector &*b*, int &*info*) const
ComplexColumnVector **lssolve** (const ComplexColumnVector &*b*, int &*info*, int &*rank*) const

Matrix& **operator +=** (const Matrix &*a*)
Matrix& **operator -=** (const Matrix &*a*)

Matrix& **operator +=** (const DiagMatrix &*a*)
Matrix& **operator -=** (const DiagMatrix &*a*)

Matrix **operator !** (void) const

ComplexMatrix **operator +** (const Matrix &*a*, const Complex &*s*)
ComplexMatrix **operator -** (const Matrix &*a*, const Complex &*s*)
ComplexMatrix **operator *** (const Matrix &*a*, const Complex &*s*)
ComplexMatrix **operator /** (const Matrix &*a*, const Complex &*s*)

ComplexMatrix **operator +** (const Complex &s, const Matrix &a)
ComplexMatrix **operator -** (const Complex &s, const Matrix &a)
ComplexMatrix **operator *** (const Complex &s, const Matrix &a)
ComplexMatrix **operator /** (const Complex &s, const Matrix &a)

ColumnVector **operator *** (const Matrix &a, const ColumnVector &b)
ComplexColumnVector **operator *** (const Matrix &a, const ComplexColumnVector &b)

Matrix **operator +** (const Matrix &a, const DiagMatrix &b)
Matrix **operator -** (const Matrix &a, const DiagMatrix &b)
Matrix **operator *** (const Matrix &a, const DiagMatrix &b)

ComplexMatrix **operator +** (const Matrix &a, const ComplexDiagMatrix &b)
ComplexMatrix **operator -** (const Matrix &a, const ComplexDiagMatrix &b)
ComplexMatrix **operator *** (const Matrix &a, const ComplexDiagMatrix &b)

Matrix **operator *** (const Matrix &a, const Matrix &b)
ComplexMatrix **operator *** (const Matrix &a, const ComplexMatrix &b)

ComplexMatrix **operator +** (const Matrix &a, const ComplexMatrix &b)
ComplexMatrix **operator -** (const Matrix &a, const ComplexMatrix &b)

ComplexMatrix **product** (const Matrix &a, const ComplexMatrix &b)
ComplexMatrix **quotient** (const Matrix &a, const ComplexMatrix &b)

Matrix **map** (d_d_Mapper f, const Matrix &a)
void **map** (d_d_Mapper f)

Matrix **all** (void) const
Matrix **any** (void) const

Matrix **cumprod** (void) const
Matrix **cumsum** (void) const
Matrix **prod** (void) const
Matrix **sum** (void) const
Matrix **sumsq** (void) const

ColumnVector **diag** (void) const
ColumnVector **diag** (int k) const

ColumnVector **row_min** (void) const
ColumnVector **row_min_loc** (void) const

ColumnVector **row_max** (void) const
ColumnVector **row_max_loc** (void) const

RowVector **column_min** (void) const
RowVector **column_min_loc** (void) const

RowVector **column_max** (void) const
RowVector **column_max_loc** (void) const

ostream& **operator** << (ostream &*os*, const Matrix &*a*)
istream& **operator** >> (istream &*is*, Matrix &*a*)

(**void**)
(**int** *n*)
(**int** *n*, double *val*)
(**const** Array<double> &*a*)
(**const** ColumnVector &*a*)

ColumnVector& **operator** = (const ColumnVector &*a*)

int **operator** == (const ColumnVector &*a*) const
int **operator** != (const ColumnVector &*a*) const

ColumnVector& **insert** (const ColumnVector &*a*, int *r*)

ColumnVector& **fill** (double *val*)
ColumnVector& **fill** (double *val*, int r1, int r2)

ColumnVector **stack** (const ColumnVector &*a*) const

RowVector **transpose** (void) const

ColumnVector **extract** (int r1, int r2) const

ColumnVector& **operator** += (const ColumnVector &*a*)
ColumnVector& **operator** -= (const ColumnVector &*a*)

ComplexColumnVector **operator** + (const ColumnVector &*a*, const Complex &*s*)
ComplexColumnVector **operator** - (const ColumnVector &*a*, const Complex &*s*)
ComplexColumnVector **operator** * (const ColumnVector &*a*, const Complex &*s*)
ComplexColumnVector **operator** / (const ColumnVector &*a*, const Complex &*s*)

ComplexColumnVector **operator** + (const Complex &*s*, const ColumnVector &*a*)
ComplexColumnVector **operator** - (const Complex &*s*, const ColumnVector &*a*)
ComplexColumnVector **operator** * (const Complex &*s*, const ColumnVector &*a*)
ComplexColumnVector **operator** / (const Complex &*s*, const ColumnVector &*a*)

Matrix **operator** * (const ColumnVector &*a*, const RowVector &*a*)

ComplexMatrix **operator** * (const ColumnVector &*a*, const ComplexRowVector &*b*)

ComplexColumnVector **operator** + (const ComplexColumnVector &*a*, const ComplexColumnVector &*b*)

ComplexColumnVector **operator** - (const ComplexColumnVector &*a*,
const ComplexColumnVector &*b*)

ComplexColumnVector **product** (const ComplexColumnVector &*a*,
const ComplexColumnVector &*b*)

ComplexColumnVector **quotient** (const ComplexColumnVector &*a*,
const ComplexColumnVector &*b*)

ColumnVector **map** (d_d_Mapper *f*, const ColumnVector &*a*)
void **map** (d_d_Mapper *f*)

double **min** (void) const
double **max** (void) const

ostream& **operator** << (ostream &*os*, const ColumnVector &*a*)

(**void**)
(**int** *n*)
(**int** *n*, double *val*)
(**const** Array<double> &*a*)
(**const** RowVector &*a*)

RowVector& **operator** = (const RowVector &*a*)

int **operator** == (const RowVector &*a*) const
int **operator** != (const RowVector &*a*) const

RowVector& **insert** (const RowVector &*a*, int *c*)

RowVector& **fill** (double *val*)
RowVector& **fill** (double *val*, int c1, int c2)

RowVector **append** (const RowVector &*a*) const

ColumnVector **transpose** (void) const

RowVector **extract** (int c1, int c2) const

RowVector& **operator** += (const RowVector &*a*)
RowVector& **operator** -= (const RowVector &*a*)

ComplexRowVector **operator** + (const RowVector &*a*, const Complex
&*s*)
ComplexRowVector **operator** - (const RowVector &*a*, const Complex
&*s*)
ComplexRowVector **operator** * (const RowVector &*a*, const Complex
&*s*)
ComplexRowVector **operator** / (const RowVector &*a*, const Complex
&*s*)

ComplexRowVector **operator +** (const Complex &*s*, const RowVector &*a*)
ComplexRowVector **operator -** (const Complex &*s*, const RowVector &*a*)
ComplexRowVector **operator *** (const Complex &*s*, const RowVector &*a*)
ComplexRowVector **operator /** (const Complex &*s*, const RowVector &*a*)

double **operator *** (const RowVector &*a*, ColumnVector &*b*)

Complex **operator *** (const RowVector &*a*, const ComplexColumnVector &*b*)

RowVector **operator *** (const RowVector &*a*, const Matrix &*b*)

ComplexRowVector **operator *** (const RowVector &*a*, const ComplexMatrix &*b*)

ComplexRowVector **operator +** (const RowVector &*a*, const ComplexRowVector &*b*)
ComplexRowVector **operator -** (const RowVector &*a*, const ComplexRowVector &*b*)

ComplexRowVector **product** (const RowVector &*a*, const ComplexRowVector &*b*)
ComplexRowVector **quotient** (const RowVector &*a*, const ComplexRowVector &*b*)

RowVector **map** (d_d_Mapper *f*, const RowVector &*a*)
void **map** (d_d_Mapper *f*)

double **min** (void) const
double **max** (void) const

ostream& **operator <<** (ostream &*os*, const RowVector &*a*)

(**void**)
(**int** *n*)
(**int** *n*, double *val*)
(**int** *r*, int *c*)
(**int** *r*, int *c*, double *val*)
(**const** RowVector &*a*)
(**const** ColumnVector &*a*)
(**const** DiagArray<double> &*a*)
(**const** DiagMatrix &*a*)

DiagMatrix& **operator =** (const DiagMatrix &*a*)

int **operator ==** (const DiagMatrix &*a*) const
int **operator !=** (const DiagMatrix &*a*) const

DiagMatrix& **fill** (double *val*)
DiagMatrix& **fill** (double *val*, int *beg*, int *end*)
DiagMatrix& **fill** (const ColumnVector &*a*)
DiagMatrix& **fill** (const RowVector &*a*)
DiagMatrix& **fill** (const ColumnVector &*a*, int *beg*)
DiagMatrix& **fill** (const RowVector &*a*, int *beg*)

DiagMatrix **transpose** (void) const

Matrix **extract** (int r1, int c1, int r2, int c2) const

RowVector **row** (int *i*) const
RowVector **row** (char *s) const

ColumnVector **column** (int *i*) const
ColumnVector **column** (char *s) const

DiagMatrix **inverse** (void) const
DiagMatrix **inverse** (int &*info*) const

DiagMatrix& **operator** += (const DiagMatrix &*a*)
DiagMatrix& **operator** -= (const DiagMatrix &*a*)

Matrix **operator** + (const DiagMatrix &*a*, double *s*)
Matrix **operator** - (const DiagMatrix &*a*, double *s*)

ComplexMatrix **operator** + (const DiagMatrix &*a*, const Complex &*s*)
ComplexMatrix **operator** - (const DiagMatrix &*a*, const Complex &*s*)

ComplexDiagMatrix **operator** * (const DiagMatrix &*a*, const Complex &*s*)
ComplexDiagMatrix **operator** / (const DiagMatrix &*a*, const Complex &*s*)

Matrix **operator** + (double *s*, const DiagMatrix &*a*)
Matrix **operator** - (double *s*, const DiagMatrix &*a*)

ComplexMatrix **operator** + (const Complex &*s*, const DiagMatrix &*a*)
ComplexMatrix **operator** - (const Complex &*s*, const DiagMatrix &*a*)

ComplexDiagMatrix **operator** * (const Complex &*s*, const DiagMatrix &*a*)

ColumnVector **operator** * (const DiagMatrix &*a*, const ColumnVector &*b*)

ComplexColumnVector **operator** * (const DiagMatrix &*a*, const ComplexColumnVector &*b*)

ComplexDiagMatrix **operator** + (const DiagMatrix &*a*, const ComplexDiagMatrix &*b*)
ComplexDiagMatrix **operator** - (const DiagMatrix &*a*, const ComplexDiagMatrix &*b*)

ComplexDiagMatrix **product** (const DiagMatrix &*a*, const ComplexDiagMatrix &*b*)

Matrix **operator +** (const DiagMatrix &*a*, const Matrix &*b*)
Matrix **operator -** (const DiagMatrix &*a*, const Matrix &*b*)
Matrix **operator *** (const DiagMatrix &*a*, const Matrix &*b*)

ComplexMatrix **operator +** (const DiagMatrix &*a*, const ComplexMatrix &*b*)
ComplexMatrix **operator -** (const DiagMatrix &*a*, const ComplexMatrix &*b*)
ComplexMatrix **operator *** (const DiagMatrix &*a*, const ComplexMatrix &*b*)

ColumnVector **diag** (void) const
ColumnVector **diag** (int *k*) const

ostream& **operator <<** (ostream &*os*, const DiagMatrix &*a*)

(void)
(int *r*, int *c*)
(int *r*, int *c*, const Complex &*val*)
(const Matrix &*a*)
(const Array2<Complex> &*a*)
(const ComplexMatrix &*a*)
(const DiagMatrix &*a*)
(const DiagArray<Complex> &*a*)
(const ComplexDiagMatrix &*a*)

ComplexMatrix& **operator =** (const ComplexMatrix &*a*)

int **operator ==** (const ComplexMatrix &*a*) const
int **operator !=** (const ComplexMatrix &*a*) const

ComplexMatrix& **insert** (const Matrix &*a*, int *r*, int *c*)
ComplexMatrix& **insert** (const RowVector &*a*, int *r*, int *c*)
ComplexMatrix& **insert** (const ColumnVector &*a*, int *r*, int *c*)
ComplexMatrix& **insert** (const DiagMatrix &*a*, int *r*, int *c*)

ComplexMatrix& **insert** (const ComplexMatrix &*a*, int *r*, int *c*)
ComplexMatrix& **insert** (const ComplexRowVector &*a*, int *r*, int *c*)
ComplexMatrix& **insert** (const ComplexColumnVector &*a*, int *r*, int *c*)
ComplexMatrix& **insert** (const ComplexDiagMatrix &*a*, int *r*, int *c*)

ComplexMatrix& **fill** (double *val*)
ComplexMatrix& **fill** (const Complex &*val*)
ComplexMatrix& **fill** (double *val*, int r1, int c1, int r2, int c2)
ComplexMatrix& **fill** (const Complex &*val*, int r1, int c1, int r2, int c2)

ComplexMatrix **append** (const Matrix &*a*) const
ComplexMatrix **append** (const RowVector &*a*) const
ComplexMatrix **append** (const ColumnVector &*a*) const
ComplexMatrix **append** (const DiagMatrix &*a*) const

ComplexMatrix **append** (const ComplexMatrix &*a*) const
ComplexMatrix **append** (const ComplexRowVector &*a*) const
ComplexMatrix **append** (const ComplexColumnVector &*a*) const
ComplexMatrix **append** (const ComplexDiagMatrix &*a*) const

ComplexMatrix **stack** (const Matrix &*a*) const
ComplexMatrix **stack** (const RowVector &*a*) const
ComplexMatrix **stack** (const ColumnVector &*a*) const
ComplexMatrix **stack** (const DiagMatrix &*a*) const

ComplexMatrix **stack** (const ComplexMatrix &*a*) const
ComplexMatrix **stack** (const ComplexRowVector &*a*) const
ComplexMatrix **stack** (const ComplexColumnVector &*a*) const
ComplexMatrix **stack** (const ComplexDiagMatrix &*a*) const

ComplexMatrix **transpose** (void) const

Matrix **real** (const ComplexMatrix &*a*)
Matrix **imag** (const ComplexMatrix &*a*)
ComplexMatrix **conj** (const ComplexMatrix &*a*)

ComplexMatrix **extract** (int r1, int c1, int r2, int c2) const

ComplexRowVector **row** (int *i*) const
ComplexRowVector **row** (char *s) const

ComplexColumnVector **column** (int *i*) const
ComplexColumnVector **column** (char *s) const

ComplexMatrix **inverse** (void) const
ComplexMatrix **inverse** (int &*info*) const
ComplexMatrix **inverse** (int &*info*, double &*rcond*) const

ComplexMatrix **fourier** (void) const
ComplexMatrix **ifourier** (void) const

ComplexDET **determinant** (void) const
ComplexDET **determinant** (int &*info*) const
ComplexDET **determinant** (int &*info*, double &*rcond*) const

ComplexMatrix **solve** (const Matrix &*b*) const
ComplexMatrix **solve** (const Matrix &*b*, int &*info*) const
ComplexMatrix **solve** (const Matrix &*b*, int &*info*, double &*rcond*) const

ComplexMatrix **solve** (const ComplexMatrix &*b*) const
ComplexMatrix **solve** (const ComplexMatrix &*b*, int &*info*) const
ComplexMatrix **solve** (const ComplexMatrix &*b*, int &*info*, double &*rcond*) const

ComplexColumnVector **solve** (const ComplexColumnVector &*b*) const
ComplexColumnVector **solve** (const ComplexColumnVector &*b*, int &*info*) const
ComplexColumnVector **solve** (const ComplexColumnVector &*b*, int &*info*, double &*rcond*) const

ComplexMatrix **lssolve** (const ComplexMatrix &*b*) const
ComplexMatrix **lssolve** (const ComplexMatrix &*b*, int &*info*) const
ComplexMatrix **lssolve** (const ComplexMatrix &*b*, int &*info*, int &*rank*) const

ComplexColumnVector **lssolve** (const ComplexColumnVector &*b*) const
ComplexColumnVector **lssolve** (const ComplexColumnVector &*b*, int &*info*) const
ComplexColumnVector **lssolve** (const ComplexColumnVector &*b*, int &*info*, int &*rank*) const

ComplexMatrix& **operator +=** (const DiagMatrix &*a*)
ComplexMatrix& **operator -=** (const DiagMatrix &*a*)

ComplexMatrix& **operator +=** (const ComplexDiagMatrix &*a*)
ComplexMatrix& **operator -=** (const ComplexDiagMatrix &*a*)

ComplexMatrix& **operator +=** (const Matrix &*a*)
ComplexMatrix& **operator -=** (const Matrix &*a*)

ComplexMatrix& **operator +=** (const ComplexMatrix &*a*)
ComplexMatrix& **operator -=** (const ComplexMatrix &*a*)

Matrix **operator !** (void) const

ComplexMatrix **operator +** (const ComplexMatrix &*a*, double *s*)
ComplexMatrix **operator -** (const ComplexMatrix &*a*, double *s*)
ComplexMatrix **operator *** (const ComplexMatrix &*a*, double *s*)
ComplexMatrix **operator /** (const ComplexMatrix &*a*, double *s*)

ComplexMatrix **operator +** (double *s*, const ComplexMatrix &*a*)
ComplexMatrix **operator -** (double *s*, const ComplexMatrix &*a*)
ComplexMatrix **operator *** (double *s*, const ComplexMatrix &*a*)
ComplexMatrix **operator /** (double *s*, const ComplexMatrix &*a*)

ComplexColumnVector **operator *** (const ComplexMatrix &*a*, const ColumnVector &*b*)

ComplexColumnVector **operator *** (const ComplexMatrix &*a*, const ComplexColumnVector &*b*)

ComplexMatrix **operator +** (const ComplexMatrix &*a*, const DiagMatrix &*b*)
ComplexMatrix **operator -** (const ComplexMatrix &*a*, const DiagMatrix &*b*)
ComplexMatrix **operator *** (const ComplexMatrix &*a*, const DiagMatrix &*b*)

ComplexMatrix **operator +** (const ComplexMatrix &*a*, const ComplexDiagMatrix &*b*)
ComplexMatrix **operator -** (const ComplexMatrix &*a*, const ComplexDiagMatrix &*b*)
ComplexMatrix **operator *** (const ComplexMatrix &*a*, const ComplexDiagMatrix &*b*)

ComplexMatrix **operator +** (const ComplexMatrix &*a*, const Matrix &*b*)
ComplexMatrix **operator -** (const ComplexMatrix &*a*, const Matrix &*b*)

ComplexMatrix **operator *** (const ComplexMatrix &*a*, const Matrix &*b*)
ComplexMatrix **operator *** (const ComplexMatrix &*a*, const ComplexMatrix &*b*)

ComplexMatrix **product** (const ComplexMatrix &*a*, const Matrix &*b*)
ComplexMatrix **quotient** (const ComplexMatrix &*a*, const Matrix &*b*)

ComplexMatrix **map** (c_c_Mapper *f*, const ComplexMatrix &*a*)
Matrix **map** (d_c_Mapper *f*, const ComplexMatrix &*a*)
void **map** (c_c_Mapper *f*)

Matrix **all** (void) const
Matrix **any** (void) const

ComplexMatrix **cumprod** (void) const
ComplexMatrix **cumsum** (void) const
ComplexMatrix **prod** (void) const
ComplexMatrix **sum** (void) const
ComplexMatrix **sumsq** (void) const

ComplexColumnVector **diag** (void) const
ComplexColumnVector **diag** (int *k*) const

ComplexColumnVector **row_min** (void) const
ComplexColumnVector **row_min_loc** (void) const

ComplexColumnVector **row_max** (void) const
ComplexColumnVector **row_max_loc** (void) const

ComplexRowVector **column_min** (void) const
ComplexRowVector **column_min_loc** (void) const

ComplexRowVector **column_max** (void) const
ComplexRowVector **column_max_loc** (void) const

ostream& **operator <<** (ostream &*os*, const ComplexMatrix &*a*)
istream& **operator >>** (istream &*is*, ComplexMatrix &*a*)

(**void**)
(**int** *n*)
(**int** *n*, const Complex &*val*)
(**const** ColumnVector &*a*)
(**const** Array<Complex> &*a*)
(**const** ComplexColumnVector &*a*)

ComplexColumnVector& **operator =** (const ComplexColumnVector &*a*)

int **operator ==** (const ComplexColumnVector &*a*) const
int **operator !=** (const ComplexColumnVector &*a*) const

ComplexColumnVector& **insert** (const ColumnVector &*a*, int *r*)
ComplexColumnVector& **insert** (const ComplexColumnVector &*a*, int *r*)

ComplexColumnVector& **fill** (double *val*)
ComplexColumnVector& **fill** (const Complex &*val*)
ComplexColumnVector& **fill** (double *val*, int r1, int r2)
ComplexColumnVector& **fill** (const Complex &*val*, int r1, int r2)

ComplexColumnVector **stack** (const ColumnVector &*a*) const
ComplexColumnVector **stack** (const ComplexColumnVector &*a*) const

ComplexRowVector **transpose** (void) const

ColumnVector **real** (const ComplexColumnVector &*a*)
ColumnVector **imag** (const ComplexColumnVector &*a*)
ComplexColumnVector **conj** (const ComplexColumnVector &*a*)

ComplexColumnVector **extract** (int r1, int r2) const

ComplexColumnVector& **operator +=** (const ColumnVector &*a*)
ComplexColumnVector& **operator -=** (const ColumnVector &*a*)

ComplexColumnVector& **operator +=** (const ComplexColumnVector &*a*)
ComplexColumnVector& **operator -=** (const ComplexColumnVector &*a*)

ComplexColumnVector **operator +** (const ComplexColumnVector &*a*,
double *s*)
ComplexColumnVector **operator -** (const ComplexColumnVector &*a*,
double *s*)
ComplexColumnVector **operator *** (const ComplexColumnVector &*a*,
double *s*)
ComplexColumnVector **operator /** (const ComplexColumnVector &*a*,
double *s*)

ComplexColumnVector **operator +** (double *s*, const
ComplexColumnVector &*a*)
ComplexColumnVector **operator -** (double *s*, const
ComplexColumnVector &*a*)
ComplexColumnVector **operator *** (double *s*, const
ComplexColumnVector &*a*)
ComplexColumnVector **operator /** (double *s*, const
ComplexColumnVector &*a*)

ComplexMatrix **operator *** (const ComplexColumnVector &*a*, const
ComplexRowVector &*b*)

ComplexColumnVector **operator +** (const ComplexColumnVector &*a*,
const ColumnVector &*b*)
ComplexColumnVector **operator -** (const ComplexColumnVector &*a*,
const ColumnVector &*b*)

ComplexColumnVector **product** (const ComplexColumnVector &*a*,
const ColumnVector &*b*)
ComplexColumnVector **quotient** (const ComplexColumnVector &*a*,
const ColumnVector &*b*)

ComplexColumnVector **map** (c_c_Mapper *f*, const
ComplexColumnVector &*a*)
ColumnVector **map** (d_c_Mapper *f*, const ComplexColumnVector &*a*)
void **map** (c_c_Mapper *f*)

Complex **min** (void) const
Complex **max** (void) const

ostream& **operator** << (ostream &*os*, const ComplexColumnVector &*a*)

(**void**)
(**int** *n*)
(**int** *n*, const Complex &*val*)
(**const** RowVector &*a*)
(**const** Array<Complex> &*a*)
(**const** ComplexRowVector &*a*)

ComplexRowVector& **operator** = (const ComplexRowVector &*a*)

int **operator** == (const ComplexRowVector &*a*) const
int **operator** != (const ComplexRowVector &*a*) const

ComplexRowVector& **insert** (const RowVector &*a*, int *c*)
ComplexRowVector& **insert** (const ComplexRowVector &*a*, int *c*)

ComplexRowVector& **fill** (double *val*)
ComplexRowVector& **fill** (const Complex &*val*)
ComplexRowVector& **fill** (double *val*, int c1, int c2)
ComplexRowVector& **fill** (const Complex &*val*, int c1, int c2)

ComplexRowVector **append** (const RowVector &*a*) const
ComplexRowVector **append** (const ComplexRowVector &*a*) const

ComplexColumnVector **transpose** (void) const

RowVector **real** (const ComplexRowVector &*a*)
RowVector **imag** (const ComplexRowVector &*a*)
ComplexRowVector **conj** (const ComplexRowVector &*a*)

ComplexRowVector **extract** (int c1, int c2) const

ComplexRowVector& **operator** += (const RowVector &*a*)
ComplexRowVector& **operator** -= (const RowVector &*a*)

ComplexRowVector& **operator** += (const ComplexRowVector &*a*)
ComplexRowVector& **operator** -= (const ComplexRowVector &*a*)

ComplexRowVector **operator +** (const ComplexRowVector &a, double s)

ComplexRowVector **operator -** (const ComplexRowVector &a, double s)

ComplexRowVector **operator *** (const ComplexRowVector &a, double s)

ComplexRowVector **operator /** (const ComplexRowVector &a, double s)

ComplexRowVector **operator +** (double s, const ComplexRowVector &a)
ComplexRowVector **operator -** (double s, const ComplexRowVector &a)
ComplexRowVector **operator *** (double s, const ComplexRowVector &a)
ComplexRowVector **operator /** (double s, const ComplexRowVector &a)

Complex **operator *** (const ComplexRowVector &a, const ColumnVector &b)

Complex **operator *** (const ComplexRowVector &a, const ComplexColumnVector &b)

ComplexRowVector **operator *** (const ComplexRowVector &a, const ComplexMatrix &b)

ComplexRowVector **operator +** (const ComplexRowVector &a, const RowVector &b)
ComplexRowVector **operator -** (const ComplexRowVector &a, const RowVector &b)

ComplexRowVector **product** (const ComplexRowVector &a, const RowVector &b)
ComplexRowVector **quotient** (const ComplexRowVector &a, const RowVector &b)

ComplexRowVector **map** (c_c_Mapper f, const ComplexRowVector &a)
RowVector **map** (d_c_Mapper f, const ComplexRowVector &a)
void **map** (c_c_Mapper f)

Complex **min** (void) const
Complex **max** (void) const

ostream& **operator <<** (ostream &os, const ComplexRowVector &a)

(**void**)
(**int** *n*)
(**int** *n*, const Complex &*val*)
(**int** *r*, int *c*)
(**int** *r*, int *c*, const Complex &*val*)
(**const** RowVector &*a*)
(**const** ComplexRowVector &*a*)
(**const** ColumnVector &*a*)
(**const** ComplexColumnVector &*a*)
(**const** DiagMatrix &*a*)
(**const** DiagArray<Complex> &*a*)
(**const** ComplexDiagMatrix &*a*)

ComplexDiagMatrix& **operator** = (const ComplexDiagMatrix &*a*)

int **operator** == (const ComplexDiagMatrix &*a*) const
int **operator** != (const ComplexDiagMatrix &*a*) const

ComplexDiagMatrix& **fill** (double *val*)
ComplexDiagMatrix& **fill** (const Complex &*val*)
ComplexDiagMatrix& **fill** (double *val*, int *beg*, int *end*)
ComplexDiagMatrix& **fill** (const Complex &*val*, int *beg*, int *end*)
ComplexDiagMatrix& **fill** (const ColumnVector &*a*)
ComplexDiagMatrix& **fill** (const ComplexColumnVector &*a*)
ComplexDiagMatrix& **fill** (const RowVector &*a*)
ComplexDiagMatrix& **fill** (const ComplexRowVector &*a*)
ComplexDiagMatrix& **fill** (const ColumnVector &*a*, int *beg*)
ComplexDiagMatrix& **fill** (const ComplexColumnVector &*a*, int *beg*)
ComplexDiagMatrix& **fill** (const RowVector &*a*, int *beg*)
ComplexDiagMatrix& **fill** (const ComplexRowVector &*a*, int *beg*)

ComplexDiagMatrix **transpose** (void) const

DiagMatrix **real** (const ComplexDiagMatrix &*a*)
DiagMatrix **imag** (const ComplexDiagMatrix &*a*)
ComplexDiagMatrix **conj** (const ComplexDiagMatrix &*a*)

ComplexMatrix **extract** (int r1, int c1, int r2, int c2) const

ComplexRowVector **row** (int *i*) const
ComplexRowVector **row** (char *s) const

ComplexColumnVector **column** (int *i*) const
ComplexColumnVector **column** (char *s) const

ComplexDiagMatrix **inverse** (int &*info*) const
ComplexDiagMatrix **inverse** (void) const

ComplexDiagMatrix& **operator** += (const DiagMatrix &*a*)
ComplexDiagMatrix& **operator** -= (const DiagMatrix &*a*)

ComplexDiagMatrix& **operator** += (const ComplexDiagMatrix &*a*)
ComplexDiagMatrix& **operator** -= (const ComplexDiagMatrix &*a*)

ComplexMatrix **operator +** (const ComplexDiagMatrix &*a*, double *s*)
ComplexMatrix **operator -** (const ComplexDiagMatrix &*a*, double *s*)

ComplexMatrix **operator +** (const ComplexDiagMatrix &*a*, const Complex &*s*)
ComplexMatrix **operator -** (const ComplexDiagMatrix &*a*, const Complex &*s*)

ComplexDiagMatrix **operator *** (const ComplexDiagMatrix &*a*, double *s*)
ComplexDiagMatrix **operator /** (const ComplexDiagMatrix &*a*, double *s*)

ComplexMatrix **operator +** (double *s*, const ComplexDiagMatrix &*a*)
ComplexMatrix **operator -** (double *s*, const ComplexDiagMatrix &*a*)

ComplexMatrix **operator +** (const Complex &*s*, const ComplexDiagMatrix &*a*)
ComplexMatrix **operator -** (const Complex &*s*, const ComplexDiagMatrix &*a*)

ComplexDiagMatrix **operator *** (double *s*, const ComplexDiagMatrix &*a*)

ComplexColumnVector **operator *** (const ComplexDiagMatrix &*a*, const ColumnVector &*b*)

ComplexColumnVector **operator *** (const ComplexDiagMatrix &*a*, const ComplexColumnVector &*b*)

ComplexDiagMatrix **operator +** (const ComplexDiagMatrix &*a*, const DiagMatrix &*b*)
ComplexDiagMatrix **operator -** (const ComplexDiagMatrix &*a*, const DiagMatrix &*b*)

ComplexDiagMatrix **product** (const ComplexDiagMatrix &*a*, const DiagMatrix &*b*)

ComplexMatrix **operator +** (const ComplexDiagMatrix &*a*, const Matrix &*b*)
ComplexMatrix **operator -** (const ComplexDiagMatrix &*a*, const Matrix &*b*)
ComplexMatrix **operator *** (const ComplexDiagMatrix &*a*, const Matrix &*b*)

ComplexMatrix **operator +** (const ComplexDiagMatrix &*a*, const ComplexMatrix &*b*)
ComplexMatrix **operator -** (const ComplexDiagMatrix &*a*, const ComplexMatrix &*b*)
ComplexMatrix **operator *** (const ComplexDiagMatrix &*a*, const ComplexMatrix &*b*)

ComplexColumnVector **diag** (void) const
ComplexColumnVector **diag** (int *k*) const

`ostream&` **operator** `<<` (`ostream &`*os*, `const ComplexDiagMatrix &`*a*)

5 Matrix Factorizations

(void)
(const `Matrix &`*a*`, const char *`*balance_job*`)**
(const `AEPBALANCE &`*a*`)**

`AEPBALANCE&` **operator =** `(const AEPBALANCE &`*a*`)`

`Matrix` **balanced_matrix** `(void) const`
`Matrix` **balancing_matrix** `(void) const`

`ostream&` **operator <<** `(ostream &`*os*`, const AEPBALANCE &`*a*`)`

`ComplexAEPBALANCE` **(void)**
`ComplexAEPBALANCE` **(const** `ComplexMatrix &`*a*`, const char *`*balance_job*`)**
`ComplexAEPBALANCE` **(const** `ComplexAEPBALANCE &`*a*`)**

`ComplexAEPBALANCE&` **operator =** `(const ComplexAEPBALANCE &`*a*`)`

`ComplexMatrix` **balanced_matrix** `(void) const`
`ComplexMatrix` **balancing_matrix** `(void) const`

`ostream&` **operator <<** `(ostream &`*os*`, const ComplexAEPBALANCE &`*a*`)`

(void)
(const `DET &`*a*`)**

`DET&` **operator =** `(const DET &`*a*`)`

`int` **value_will_overflow** `(void) const`
`int` **value_will_underflow** `(void) const`

`double` **coefficient** `(void) const`
`int` **exponent** `(void) const`
`double` **value** `(void) const`

`ostream&` **operator <<** `(ostream &`*os*`, const DET &`*a*`)`

(void)
(const `ComplexDET &`*a*`)**

`ComplexDET&` **operator =** `(const ComplexDET &`*a*`)`

`int` **value_will_overflow** `(void) const`
`int` **value_will_underflow** `(void) const`

`Complex` **coefficient** `(void) const`
`int` **exponent** `(void) const`
`Complex` **value** `(void) const`

`ostream&` **operator <<** `(ostream &`*os*`, const ComplexDET &`*a*`)`

(void)
(const `Matrix &`*a*`, const Matrix &, const char *`*balance_job*`)**
(const `GEPBALANCE &`*a*`)**

GEPBALANCE& **operator** = (const GEPBALANCE &*a*)

Matrix **balanced_a_matrix** (void) const
Matrix **balanced_b_matrix** (void) const
Matrix **left_balancing_matrix** (void) const
Matrix **right_balancing_matrix** (void) const

ostream& **operator** << (ostream &*os*, const GEPBALANCE &*a*)

(**void**)
(**const** Matrix &*a*)
(**const** Matrix &*a*, int &*info*)
(**const** CHOL &*a*)

CHOL& **operator** = (const CHOL &*a*)

Matrix **chol_matrix** (void) const

ostream& **operator** << (ostream &*os*, const CHOL &*a*)

(**void**)
(**const** ComplexMatrix &*a*)
(**const** ComplexMatrix &*a*, int &*info*)
(**const** ComplexCHOL &*a*)

ComplexCHOL& **operator** = (const ComplexCHOL &*a*)

ComplexMatrix **chol_matrix** (void) const

ostream& **operator** << (ostream &*os*, const ComplexCHOL &*a*)

(**void**)
(**const** Matrix &*a*)
(**const** Matrix&a, int &*info*)
(**const** HESS &*a*)

HESS& **operator** = (const HESS &*a*)

Matrix **hess_matrix** (void) const
Matrix **unitary_hess_matrix** (void) const

ostream& **operator** << (ostream &*os*, const HESS &*a*)

(**void**)
(**const** ComplexMatrix &*a*)
(**const** ComplexMatrix &*a*, int &*info*)
(**const** ComplexHESS &*a*)

ComplexHESS& **operator** = (const ComplexHESS &*a*)

ComplexMatrix **hess_matrix** (void) const
ComplexMatrix **unitary_hess_matrix** (void) const

ostream& **operator** << (ostream &*os*, const ComplexHESS &*a*)

(**void**)
(**const** Matrix &*a*, const char **ord*)
(**const** Matrix &*a*, const char **ord*, int &*info*)
(**const** SCHUR &*a*, const char **ord*)

SCHUR& **operator =** (const SCHUR &*a*)

Matrix **schur_matrix** (void) const
Matrix **unitary_matrix** (void) const

ostream& **operator <<** (ostream &*os*, const SCHUR &*a*)

(**void**)
(**const** ComplexMatrix &*a*, const char **ord*)
(**const** ComplexMatrix &*a*, const char **ord*, int &*info*)
(**const** ComplexSCHUR &*a*, const char **ord*)

ComplexSCHUR& **operator =** (const ComplexSCHUR &*a*)

ComplexMatrix **schur_matrix** (void) const
ComplexMatrix **unitary_matrix** (void) const

ostream& **operator <<** (ostream &*os*, const ComplexSCHUR &*a*)

(**void**)
(**const** Matrix &*a*)
(**const** Matrix &*a*, int &*info*)
(**const** SVD &*a*)

SVD& **operator =** (const SVD &*a*)

DiagMatrix **singular_values** (void) const
Matrix **left_singular_matrix** (void) const
Matrix **right_singular_matrix** (void) const

ostream& **operator <<** (ostream &*os*, const SVD &*a*)

(**void**)
(**const** ComplexMatrix &*a*)
(**const** ComplexMatrix &*a*, int &*info*)
(**const** ComplexSVD &*a*)

ComplexSVD& **operator =** (const ComplexSVD &*a*)

DiagMatrix **singular_values** (void) const
ComplexMatrix **left_singular_matrix** (void) const
ComplexMatrix **right_singular_matrix** (void) const

ostream& **operator <<** (ostream &*os*, const ComplexSVD &*a*)

(**void**)
(**const** Matrix &*a*)
(**const** Matrix &*a*, int &*info*)
(**const** ComplexMatrix &*a*)
(**const** ComplexMatrix &*a*, int &*info*)
(**const** EIG &*a*)

EIG& **operator =** (const EIG &*a*)

ComplexColumnVector **eigenvalues** (void) const

ComplexMatrix **eigenvectors** (void) const

`ostream&` **operator** `<<` (`ostream &`*os*, `const EIG &`*a*)

(**void**)
(**const** `Matrix &`*a*)
(**const** `LU &`*a*)

`LU&` **operator** `=` (`const LU &`*a*)

`Matrix` **L** (`void`) `const`
`Matrix` **U** (`void`) `const`
`Matrix` **P** (`void`) `const`

`ostream&` **operator** `<<` (`ostream &`*os*, `const LU &`*a*)

(**void**)
(**const** `ComplexMatrix &`*a*)
(**const** `ComplexLU &`*a*)

`ComplexLU&` **operator** `=` (`const ComplexLU &`*a*)

`ComplexMatrix` **L** (`void`) `const`
`ComplexMatrix` **U** (`void`) `const`
`Matrix` **P** (`void`) `const`

`ostream&` **operator** `<<` (`ostream &`*os*, `const ComplexLU &`*a*)

(**void**)
(**const** `Matrix &`*A*)
(**const** `QR &`*a*)

`QR&` **operator** `=` (`const QR &`*a*)

`Matrix` **Q** (`void`) `const`
`Matrix` **R** (`void`) `const`

`ostream&` **operator** `<<` (`ostream &`*os*, `const QR &`*a*)

(**void**)
(**const** `ComplexMatrix &`*A*)
(**const** `ComplexQR &`*a*)

`ComplexQR&` **operator** `=` (`const ComplexQR &`*a*)

`ComplexMatrix` **Q** (`void`) `const`
`ComplexMatrix` **R** (`void`) `const`

`ostream&` **operator** `<<` (`ostream &`*os*, `const ComplexQR &`*a*)

6 Ranges

(**void**)
(**const** `Range &`*r*)
(**double** *b*, `double` *l*)
(**double** *b*, `double` *l*, `double` *i*)

`double` **base** (`void`) `const`
`double` **limit** (`void`) `const`
`double` **inc** (`void`) `const`

`void` **set_base** (`double` *b*)
`void` **set_limit** (`double` *l*)
`void` **set_inc** (`double` *i*)

`int` **nelem** (`void`) `const`

`double` **min** (`void`) `const`
`double` **max** (`void`) `const`

`void` **sort** (`void`)

`ostream&` **operator** `<<` (`ostream &`*os*, `const Range &`*r*)
`istream&` **operator** `>>` (`istream &`*is*, `Range &`*r*)

`void` **print_range** (`void`)

7 Nonlinear Functions

(void)
(const *nonlinear_fcn*)
(const *nonlinear_fcn*, `const` *jacobian_fcn*)
(const `NLFunc &`*a*)

`NLFunc&` **operator =** (`const NLFunc &`*a*)

`nonlinear_fcn` **function** (`void`) `const;`

`NLFunc&` **set_function** (`const nonlinear_fcn` *f*)

`jacobian_fcn` **jacobian_function** (`void`) `const;`

`NLFunc&` **set_jacobian_function** (`const jacobian_fcn` *j*)

8 Nonlinear Equations

(void)
(const `NLEqn_options &`*opt*)

`NLEqn_options&` **operator =** (`const NLEqn_options &`*opt*)

`void` **init** (`void`)

`void` **copy** (`const NLEqn_options &`*opt*)

`void` **set_default_options** (`void`)

`void` **set_tolerance** (`double` *val*)

`double` **tolerance** (`void`)

(void)
(const `ColumnVector&, const` *NLFunc*)
(const `NLEqn &`*a*)

`NLEqn&` **operator =** (`const NLEqn &`*a*)

`void` **resize** (`int` *n*)

`void` **set_states** (`const ColumnVector &`*x*)

`ColumnVector` **states** (`void`) `const`

`int` **size** (`void`) `const`

`ColumnVector` **solve** (`void`)
`ColumnVector` **solve** (`const ColumnVector &`*x*)

`ColumnVector` **solve** (`int &`*info*)
`ColumnVector` **solve** (`const ColumnVector &`*x*, `int &`*info*)

9 Optimization

9.1 Objective Functions

(void)
(const *objective_fcn*)
(const *objective_fcn*, `const` *gradient_fcn*)
(const `Objective &`*a*)

`Objective&` **operator =** (`const Objective &`*a*)

`objective_fcn` **objective_function** (`void`) `const;`

`Objective&` **set_objective_function** (`const` *objective_fcn*)

`gradient_fcn` **gradient_function** (`void`) `const;`

`Objective&` **set_gradient_function** (`const` *gradient_fcn*)

9.2 Bounds

(void)
(int *n*)
(const `ColumnVector` *lb*, `const ColumnVector` *ub*)
(const `Bounds &`*a*)

`Bounds&` **operator =** (`const Bounds &`*a*)

`Bounds&` **resize** (`int` *n*)

`double` **lower_bound** (`int` *index*) `const;`
`double` **upper_bound** (`int` *index*) `const;`

`ColumnVector` **lower_bounds** (`void`) `const;`
`ColumnVector` **upper_bounds** (`void`) `const;`

`int` **size** (`void`) `const;`

`Bounds&` **set_bound** (`int` *index*, `double` *low*, `double` *high*)

`Bounds&` **set_bounds** (`double` *low*, `double` *high*)
`Bounds&` **set_bounds** (`const ColumnVector` *lb*, `const ColumnVector` *ub*)

`Bounds&` **set_lower_bound** (`int` *index*, `double` *low*)
`Bounds&` **set_upper_bound** (`int` *index*, `double` *high*)

`Bounds&` **set_lower_bounds** (`double` *low*)
`Bounds&` **set_upper_bounds** (`double` *high*)

`Bounds&` **set_lower_bounds** (`const ColumnVector` *lb*)
`Bounds&` **set_upper_bounds** (`const ColumnVector` *ub*)

`ostream&` **operator <<** (`ostream &`*os*, `const Bounds &`*b*)

9.3 Linear Constraints

(void)
(int *nclin*, int *nx*)
(int *nclin_eq*, int *nclin_ineq*, int *nx*)
(const ColumnVector &*lb*, const Matrix &*A*, const ColumnVector &*ub*)
(const Matrix &*A_eq*, const ColumnVector &*b_eq*, const Matrix &*A_ineq*,
const ColumnVector &*b_ineq*)
(const LinConst &*a*)

LinConst& **operator =** (const LinConst &*a*)

LinConst& **resize** (int *nclin*, int *n*)

Matrix **constraint_matrix** (void) const;

LinConst& **set_constraint_matrix** (const Matrix &*A*)

Matrix **eq_constraint_matrix** (void) const;
Matrix **ineq_constraint_matrix** (void) const;

ColumnVector **eq_constraint_vector** (void) const;
ColumnVector **ineq_constraint_vector** (void) const;

ostream& **operator <<** (ostream &*os*, const LinConst &*b*)

9.4 Nonlinear Constraints

(void)
(int *n*)
(const ColumnVector *lb*, const NLFunc *f*, const ColumnVector *ub*)
(const NLConst &*a*)

NLConst& **operator =** (const NLConst &*a*)

9.5 Quadratic Programming

(void)
(const ColumnVector &*x*, const Matrix &*H*)
(const ColumnVector &*x*, const Matrix &*H*, const ColumnVector &*c*)
(const ColumnVector &*x*, const Matrix &*H*, const Bounds &*b*)
(const ColumnVector &*x*, const Matrix &*H*, const LinConst &*lc*)
(const ColumnVector &*x*, const Matrix &*H*, const ColumnVector &*c*,
const Bounds &*b*)
(const ColumnVector &*x*, const Matrix &*H*, const ColumnVector &*c*,
const LinConst &*lc*)
(const ColumnVector &*x*, const Matrix &*H*, const Bounds &*b*, const
LinConst &*lc*)
(const ColumnVector &*x*, const Matrix &*H*, const ColumnVector &*c*,
const Bounds &*b*, const LinConst &*lc*)

virtual ColumnVector **minimize** (void)
virtual ColumnVector **minimize** (double &*objf*)
virtual ColumnVector **minimize** (double &*objf*, int &*inform*)
virtual ColumnVector **minimize** (double &*objf*, int &*inform*, ColumnVector &*lambda*) = 0;

virtual ColumnVector **minimize** (const ColumnVector &*x*)
virtual ColumnVector **minimize** (const ColumnVector &*x*, double &*objf*)
virtual ColumnVector **minimize** (const ColumnVector &*x*, double &*objf*, int &*inform*)
virtual ColumnVector **minimize** (const ColumnVector &*x*, double &*objf*, int &*inform*, ColumnVector &*lambda*)

ColumnVector **minimize** (double &*objf*, int &*inform*, ColumnVector &*lambda*)

9.6 Nonlinear Programming

(void)
(const ColumnVector &*x*, const Objective &*phi*)
(const ColumnVector &*x*, const Objective &*phi*, const Bounds &*b*)
(const ColumnVector &*x*, const Objective &*phi*, const Bounds &*b*, const LinConst &*lc*)
(const ColumnVector &*x*, const Objective &*phi*, const Bounds &*b*, const LinConst &*lc*, const NLConst &*nlc*)
(const ColumnVector &*x*, const Objective &*phi*, const LinConst &*lc*)
(const ColumnVector &*x*, const Objective &*phi*, const LinConst &*lc*, const NLConst &*nlc*)
(const ColumnVector &*x*, const Objective &*phi*, const NLConst &*nlc*)
(const ColumnVector &*x*, const Objective &*phi*, const Bounds &*b*, const NLConst &*nlc*)

NLP& **operator** = (const NLP &*a*)

int **size** (void) const

ColumnVector **minimize** (void)
ColumnVector **minimize** (double &*objf*)
ColumnVector **minimize** (double &*objf*, int &*inform*)
ColumnVector **minimize** (double &*objf*, int &*inform*, ColumnVector &*lambda*)

ColumnVector **minimize** (const ColumnVector &*x*)
ColumnVector **minimize** (const ColumnVector &*x*, double &*objf*)
ColumnVector **minimize** (const ColumnVector &*x*, double &*objf*, int &*inform*)
ColumnVector **minimize** (const ColumnVector &*x*, double &*objf*, int &*inform*, ColumnVector &*lambda*)

10 Quadrature

(**integrand_fcn** *fcn*)
(**integrand_fcn** *fcn*, `double` *abs*, `double` *rel*)

`virtual double` **integrate** (`void`)
`virtual double` **integrate** (`int &`*ier*)
`virtual double` **integrate** (`int &`*ier*, `int &`*neval*)
`virtual double` **integrate** (`int &`*ier*, `int &`*neval*, `double &`*abserr*) `= 0`

`Quad_options` (**void**)
`Quad_options` (**const** `Quad_options &`*opt*)

`Quad_options&` **operator =** (`const Quad_options &`*opt*)

`void` **init** (`void`)

`void` **copy** (`const Quad_options &`*opt*)

`void` **set_default_options** (`void`)

`void` **set_absolute_tolerance** (`double` *val*)

`void` **set_relative_tolerance** (`double` *val*)

`double` **absolute_tolerance** (`void`)
`double` **relative_tolerance** (`void`)

(**integrand_fcn** *fcn*)
(**integrand_fcn** *fcn*, `double` *ll*, `double` *ul*)
(**integrand_fcn** *fcn*, `double` *ll*, `double` *ul*, `double` *abs*, `double` *rel*)
(**integrand_fcn** *fcn*, `double` *ll*, `double` *ul*, `const ColumnVector &`*sing*)
(**integrand_fcn** *fcn*, `const ColumnVector &`*sing*, `double` *abs*, `double` *rel*)

(**integrand_fcn** *fcn*, `const ColumnVector &`*sing*)
(**integrand_fcn** *fcn*, `double` *ll*, `double` *ul*, `const ColumnVector &`*sing*,
`double` *abs*, `double` *rel*)

(**integrand_fcn** *fcn*)
(**integrand_fcn** *fcn*, `double` *b*, `IntegralType` *t*)
(**integrand_fcn** *fcn*, `double` *b*, `IntegralType` *t*, `double` *abs*, `double` *rel*)

(**integrand_fcn** *fcn*, `double` *abs*, `double` *rel*)

10.1 Collocation Weights

(**void**)
(**int** *n*, `int` *inc_l*, `int` *inc_r*)
(**int** *n*, `int` *inc_l*, `int` *inc_r*, `double` *l*, `double` *r*)
(**int** *n*, `double` a, `double` *b*, `int` *inc_l*, `int` *inc_r*)
(**int** *n*, `int` *inc_l*, `int` *inc_r*, `double` *l*, `double` *r*)
(**const** `CollocWt&`)

`CollocWt&` **operator =** (`const CollocWt&`)

`CollocWt&` **resize** (`int` *ncol*)

`CollocWt&` **add_left** (`void`)
`CollocWt&` **add_right** (`void`)

`CollocWt&` **delete_left** (`void`)
`CollocWt&` **delete_right** (`void`)

`CollocWt&` **set_left** (`double` *val*)
`CollocWt&` **set_right** (`double` *val*)

`CollocWt&` **set_alpha** (`double` *val*)
`CollocWt&` **set_beta** (`double` *val*)

`int` **ncol** (`void`) `const`

`int` **left_included** (`void`) `const`
`int` **right_included** (`void`) `const`

`double` **left** (`void`) `const`
`double` **right** (`void`) `const`
`double` **width** (`void`) `const`

`double` **alpha** (`void`) `const`
`double` **beta** (`void`) `const`

`ColumnVector` **roots** (`void`)
`ColumnVector` **quad** (`void`)
`ColumnVector` **quad_weights** (`void`)

`Matrix` **first** (`void`)
`Matrix` **second** (`void`)

`ostream&` **operator <<** (`ostream &`*os*, `const CollocWt &`*c*)

11 Ordinary Differential Equations

(void)
(const `ODE_options &`*opt*)

`ODE_options&` **operator =** (`const ODE_options &`*opt*)

`void` **init** (`void`)

`void` **copy** (`const ODE_options &`*opt*)

`void` **set_default_options** (`void`)

`void` **set_absolute_tolerance** (`double` *val*)

`void` **set_initial_step_size** (`double` *val*)

`void` **set_maximum_step_size** (`double` *val*)

`void` **set_minimum_step_size** (`double` *val*)

`void` **set_relative_tolerance** (`double` *val*)

`double` **absolute_tolerance** (`void`)
`double` **initial_step_size** (`void`)
`double` **maximum_step_size** (`void`)
`double` **minimum_step_size** (`void`)
`double` **relative_tolerance** (`void`)

(void)
(int *n*)
(const `ColumnVector &`*state*, `double` *time*, `const ODEFunc &`*f*)

`virtual int` **size** (`void`) `const`

`virtual ColumnVector` **state** (`void`) `const`

`virtual double` **time** (`void`) `const`

`virtual void` **force_restart** (`void`)

`virtual void` **initialize** (`const ColumnVector &`*x*, `double` *t*)

`virtual void` **set_stop_time** (`double` *t*)

`virtual void` **clear_stop_time** (`void`)

`virtual ColumnVector` **integrate** (`double` *t*)

`void` **integrate** (`int` *nsteps*, `double` *tstep*, `ostream &`*s*)

`Matrix` **integrate** (`const ColumnVector &`*tout*)
`Matrix` **integrate** (`const ColumnVector &`*tout*, `const ColumnVector &`*tcrit*)

12 Differential Algebraic Equations

(void)
(int *n*)
(const `ColumnVector &`*x*, `double` *time*, `DAEFunc &`*f*)
(const `ColumnVector &`*x*, `ColumnVector &`*xdot*, `double` *time*, `DAEFunc &`*f*)

`ColumnVector` **deriv** (`void`)

`virtual void` **initialize** (`const ColumnVector &`*x*, `double` *t*)
`virtual void` **initialize** (`const ColumnVector &`*x*, `ColumnVector &`*xdot*, `double` *t*)

`ColumnVector` **integrate** (`double` *t*)

`Matrix` **integrate** (`const ColumnVector &`*tout*, `Matrix &`*xdot_out*)
`Matrix` **integrate** (`const ColumnVector &`*tout*, `Matrix &`*xdot_out*, `const ColumnVector &`*tcrit*)

13 Error Handling

14 Installation

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