NAG Library Chapter Introduction

f16 – NAG Interface to BLAS

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1 Scope of the Chapter

This chapter is concerned with basic linear algebra functions which perform elementary algebraic operations involving vectors and matrices.

2 Background to the Problems

The functions in this chapter follow the specification of Basic Linear Algebra Subprograms Technical (BLAST) Forum (2001). They are called extensively by functions in other chapters of the NAG C Library, especially in the linear algebra chapters. They are intended to be useful building-blocks for users of the Library who are developing their own applications.

The functions fall into three main groups:

1. scalar and vector operations, also referred to as Level 1 BLAS;
2. matrix-vector operations or Level 2 BLAS;
3. matrix operations which includes single matrix operations (Level 2 BLAS), matrix-matrix operations (Level 3 BLAS) and data movement operations on matrices.

The terminology reflects the number of operations involved, so for example a Level 2 function involves $O(n^2)$ operations, for vectors and matrices of order n.

In many implementations of the NAG C Library, the functions in this chapter serve as interfaces to an efficient machine-specific implementation of the BLAS, usually provided by the vendor of the machine. Such implementations are stringently tested before being used with the NAG Library, to ensure that they correctly meet the specifications of the BLAS, and that they return the desired accuracy.

3 Recommendations on Choice and Use of Available Functions

The functions in this chapter make available only some of the Basic Linear Algebra Subprograms which carry out the low level operations required by linear algebra applications.

The operator arguments **conj**, **diag**, **norm**, **order**, **side**, **trans** and **uplo** are defined as enumeration types.

The **order** argument allows for 2D arrays to be supplied in either row or column ordering. The precise meaning of this for the packed and banded matrix storage schemes which are used by some of the functions in this chapter is described in the f07 and f08 Chapter Introductions.

The following values of arguments are invalid:

- any value of the operator arguments whose meaning is not specified;
- a negative value of any problem dimension or bandwidth;
- too small a value for any of the stride arguments;
- a zero value for the increment arguments.

Zero values for the matrix dimensions are considered valid.

4 Functionality Index

Matrix operations,
  complex matrices,
    matrix copy,
      rectangular matrix ..... nag_zge_copy (f16tfc)
      triangular matrix ..... nag_ztr_copy (f16tec)
    matrix initialization,
      rectangular matrix ..... nag_zge_load (f16thc)
      triangular matrix ..... nag_ztr_load (f16tgc)
    matrix-matrix product,
      one matrix Hermitian ..... nag_zhemm (f16zcc)
      one matrix symmetric ..... nag_zsymm (f16ztc)

one matrix triangular ..... nag_ztrmm (f16zfc)
rectangular matrices ..... nag_zgemm (f16zac)
rank-2*k* update,
of a Hermitian matrix ..... nag_zher2k (f16zrc)
of a symmetric matrix ..... nag_zsyr2k (f16zwc)
rank-*k* update,
of a Hermitian matrix ..... nag_zherk (f16zpc)
of a symmetric matrix ..... nag_zsyrk (f16zuc)
solution of triangular systems of equations ..... nag_ztrsm (f16zjc)
real matrices,
matrix copy,
rectangular matrix ..... nag_dge_copy (f16qfc)
triangular matrix ..... nag_dtr_copy (f16qec)
matrix initialization,
rectangular matrix ..... nag_dge_load (f16qhc)
triangular matrix ..... nag_dtr_load (f16qgc)
matrix-matrix product,
one matrix symmetric ..... nag_dsymm (f16ycc)
one matrix triangular ..... nag_dtrmm (f16yfc)
rectangular matrices ..... nag_dgemm (f16yac)
rank-2*k* update of a symmetric matrix ..... nag_dsyr2k (f16yrc)
rank-*k* update of a symmetric matrix ..... nag_dsyrk (f16ypc)
solution of triangular systems of equations ..... nag_dtrsm (f16yjc)
Matrix-vector operations,
complex matrix and vector(s),
compute a norm or the element of largest absolute value,
band matrix ..... nag_zgb_norm (f16ubc)
general matrix ..... nag_zge_norm (f16uac)
Hermitian band matrix ..... nag_zhb_norm (f16uec)
Hermitian matrix ..... nag_zhe_norm (f16ucc)
Hermitian packed matrix ..... nag_zhp_norm (f16udc)
symmetric matrix ..... nag_zsy_norm (f16ufc)
symmetric packed matrix ..... nag_zsp_norm (f16ugc)
matrix-vector product,
Hermitian band matrix ..... nag_zhbmv (f16sdc)
Hermitian matrix ..... nag_zhemv (f16scc)
Hermitian packed matrix ..... nag_zhpmv (f16sec)
rectangular band matrix ..... nag_zgbmv (f16sbc)
rectangular matrix ..... nag_zgemv (f16sac)
symmetric matrix ..... nag_zsymv (f16tac)
symmetric packed matrix ..... nag_zspmv (f16tcc)
triangular band matrix ..... nag_ztbmv (f16sgc)
triangular matrix ..... nag_ztrmv (f16sfc)
triangular packed matrix ..... nag_ztpmv (f16shc)
rank-1 update,
Hermitian matrix ..... nag_zher (f16spc)
Hermitian packed matrix ..... nag_zhpr (f16sqc)
rectangular matrix, unconjugated vector ..... nag_zger (f16smc)
rank-2 update,
Hermitian matrix ..... nag_zher2 (f16src)
Hermitian packed matrix ..... nag_zhpr2 (f16ssc)
solution of a system of equations,
triangular band matrix ..... nag_ztbsv (f16skc)
triangular matrix ..... nag_ztrsv (f16sjc)
triangular packed matrix ..... nag_ztpsv (f16slc)
real matrix and vector(s),
compute a norm or the element of largest absolute value,
band matrix ..... nag_dgb_norm (f16rbc)

- general matrix ..... nag_dge_norm (f16rac)
- symmetric band matrix ..... nag_dsb_norm (f16rec)
- symmetric matrix ..... nag_dsy_norm (f16rcc)
- symmetric packed matrix ..... nag_dsp_norm (f16rdc)

matrix-vector product,
- rectangular band matrix ..... nag_dgbmv (f16pbc)
- rectangular matrix ..... nag_dgemv (f16pac)
- symmetric band matrix ..... nag_dsbmv (f16pdc)
- symmetric matrix ..... nag_dsymv (f16pcc)
- symmetric packed matrix ..... nag_dspmv (f16pec)
- triangular band matrix ..... nag_dtbmv (f16pgc)
- triangular matrix ..... nag_dtrmv (f16pfc)
- triangular packed matrix ..... nag_dtpmv (f16phc)

rank-1 update,
- rectangular matrix ..... nag_dger (f16pmc)
- symmetric matrix ..... nag_dsyr (f16ppc)
- symmetric packed matrix ..... nag_dspr (f16pqc)

rank-2 update,
- symmetric matrix ..... nag_dsyr2 (f16prc)
- symmetric packed matrix ..... nag_dspr2 (f16psc)

solution of a system of equations,
- triangular band matrix ..... nag_dtbsv (f16pkc)
- triangular matrix ..... nag_dtrsv (f16pjc)
- triangular packed matrix ..... nag_dtpsv (f16plc)

Scalar and vector operations,

complex vector(s),
- broadcast a scalar into a vector ..... nag_zload (f16hbc)
- maximum absolute value and location ..... nag_zamax_val (f16jsc)
- minimum absolute value and location ..... nag_zamin_val (f16jtc)
- sum of elements ..... nag_zsum (f16glc)
- sum of two scaled vectors ..... nag_zaxpby (f16gcc)
- sum of two scaled vectors preserving input ..... nag_zwaxpby (f16ghc)

integer vector(s),
- broadcast a scalar into a vector ..... nag_iload (f16dbc)
- maximum absolute value and location ..... nag_iamax_val (f16dqc)
- maximum value and location ..... nag_imax_val (f16dnc)
- minimum absolute value and location ..... nag_iamin_val (f16drc)
- minimum value and location ..... nag_imin_val (f16dpc)
- sum of elements ..... nag_isum (f16dlc)

real vector(s),
- broadcast a scalar into a vector ..... nag_dload (f16fbc)
- dot product of two vectors with optional scaling and accumulation ..... nag_ddot (f16eac)
- maximum absolute value and location ..... nag_damax_val (f16jqc)
- maximum value and location ..... nag_dmax_val (f16jnc)
- minimum absolute value and location ..... nag_damin_val (f16jrc)
- minimum value and location ..... nag_dmin_val (f16jpc)
- sum of elements ..... nag_dsum (f16elc)
- sum of two scaled vectors ..... nag_daxpby (f16ecc)
- sum of two scaled vectors preserving input ..... nag_dwaxpby (f16ehc)

5 Auxiliary Functions Associated with Library Function Arguments

None.

6 Functions Withdrawn or Scheduled for Withdrawal

None.

7 References

Basic Linear Algebra Subprograms Technical (BLAST) Forum (2001) *Basic Linear Algebra Subprograms Technical (BLAST) Forum Standard* University of Tennessee, Knoxville, Tennessee http://www.netlib.org/blas/blast-forum/blas-report.pdf