

NAG Library Chapter Introduction

F16 – Further Linear Algebra Support Routines

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1 Scope of the Chapter

This chapter is concerned with basic linear algebra routines which perform elementary algebraic operations involving vectors and matrices. Other routines for such operations are available in Chapter F06.

2 Background to the Problems

The routines in this chapter follow the specification of The BLAS Technical Forum Standard (2001). They are called extensively as auxiliaries by routines in other chapters of the NAG 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 routines 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 routine involves $O(n^2)$ operations, for vectors and matrices of order n .

In many implementations of the NAG Library, the routines 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.

Because of the overlap of functionality with Chapter F06, only a subset of routines defined by the Technical Forum are implemented in this chapter.

3 Recommendations on Choice and Use of Available Routines

The routines 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. These will not normally be needed by the general user. The purpose of each routine is described by its individual document.

It should be noted that, in some cases, The BLAS Technical Forum Standard (2001) extends the functionality of earlier BLAS specifications. For example, F06ECF (DAXPY) carrying out the operation

$$y \leftarrow \alpha x + y$$

is extended by F16EHF (BLAS_DWAXPBY), which performs the operation

$$w \leftarrow \alpha x + \beta y.$$

Invalid values of arguments cause an error message to be returned via the default error-handler described in The BLAS Technical Forum Standard (2001); the handler prints an informative error message and then aborts execution.

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Level 1 (Vector) operations:

Complex vector(s),	
maximum absolute value and location.....	F16JSF (BLAS_ZAMAX_VAL)
minimum absolute value and location	F16JTF (BLAS_ZAMIN_VAL)
scaled vector addition preserving input	F16GHF (BLAS_ZWAXPBY)
sum of elements	F16GLF (BLAS_ZSUM)
Integer vector(s),	
maximum absolute value and location.....	F16DQF
maximum value and location.....	F16DNF
minimum absolute value and location	F16DRF
minimum value and location	F16DPF

sum of elements	F16DLF
Real vector(s),	
maximum absolute value and location.....	F16JQF (BLAS_DAMAX_VAL)
maximum value and location.....	F16JNF (BLAS_DMAX_VAL)
minimum absolute value and location	F16JRF (BLAS_DAMIN_VAL)
minimum value and location	F16JPF (BLAS_DMIN_VAL)
scaled vector addition preserving input	F16EHF (BLAS_DWXPBY)
sum of elements	F16ELF (BLAS_DSUM)

5 Routines Withdrawn or Scheduled for Withdrawal

None.

6 References

The BLAS Technical Forum Standard (2001) <http://www.netlib.org/blas/blast-forum>
