cross

Cross product

Syntax

```
C = cross(A,B)
C = cross(A,B,dim)
```

example

example

Description

`C = cross(A,B)` returns the cross product of `A` and `B`. example

- If `A` and `B` are vectors, then they must have a length of 3.
- If `A` and `B` are matrices or multidimensional arrays, then they must have the same size. In this case, the `cross` function treats `A` and `B` as collections of three-element vectors. The function calculates the cross product of corresponding vectors along the first array dimension whose size equals 3.

`C = cross(A,B,dim)` evaluates the cross product of arrays `A` and `B` along dimension, `dim`. `A` and `B` must have the same size, and both `size(A,dim)` and `size(B,dim)` must be 3. The `dim` input is a positive integer scalar. example

Examples

collapse all

Cross Product of Vectors

Create two 3-D vectors.

```
A = [4 -2 1];
B = [1 -1 3];
```

Find the cross product of `A` and `B`.

```
C = cross(A,B)
```

```
C =

    -5   -11    -2
```

The result, `C`, is a vector that is perpendicular to both `A` and `B`.

Use dot products to verify that `C` is perpendicular to `A` and `B`.

```
dot(C,A)==0 & dot(C,B)==0
```

```
ans =

     1
```

The result is logical `1` (`true`).

Cross Product of Matrices

Create two matrices containing random integers.

```
rng(0)
A = randi(15,3,5)
B = randi(25,3,5)
```

```
A =

    13    14     5    15    15
    14    10     9     3     8
     2     2    15    15    13


B =

     4    20     1    17    10
    11    24    22    19    17
    23    17    24    19     5
```

Find the cross product of A and B.

```
C = cross(A,B)
```

```
C =

   300   122  -114  -228  -181
  -291  -198  -105   -30    55
    87   136   101   234   175
```

The result, C, contains five independent cross products between the columns of A and B. For example, C(:,1) is equal to the cross product of A(:,1) with B(:,1).

Cross Product of Multidimensional Arrays

Create two 3-by-3-by-3 multidimensional arrays of random integers.

```
rng(0)
A = randi(10,3,3,3);
B = randi(25,3,3,3);
```

Find the cross product of A and B, treating the rows as vectors.

```
C = cross(A,B,2)
```

```
C(:,:,1) =

   -34    12    62
    15    72  -109
   -49     8     9


C(:,:,2) =

   198  -164  -170
    45     0   -18
   -55   190  -116


C(:,:,3) =

  -109   -45   131
     1   -74    82
    -6   101  -121
```

The result is a collection of row vectors. For example, `C(1,:,1)` is equal to the cross product of `A(1,:,1)` with `B(1,:,1)`.

Find the cross product of `A` and `B` along the third dimension (`dim = 3`).

```
D = cross(A,B,3)
```

```
D(:,:,1) =

   -14   179  -106
   -56    -4   -75
     2   -37    10


D(:,:,2) =

   -37  -162   -37
    50  -124   -78
     1    63   118


D(:,:,3) =

    62  -170    56
    46    72   105
    -2   -53  -160
```

The result is a collection of vectors oriented in the third dimension. For example, `C(1,1,:)` is equal to the cross product of `A(1,1,:)` with `B(1,1,:)`.

Input Arguments

collapse all

`A,B` — Input arrays
numeric arrays

Input arrays, specified as numeric arrays.

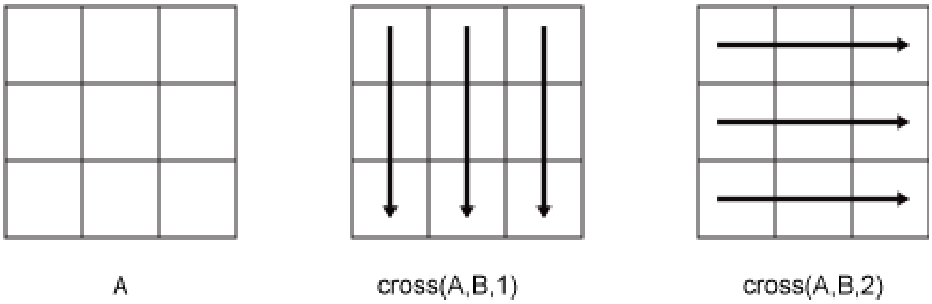
Data Types: `single` | `double`
Complex Number Support: Yes

`dim` — Dimension to operate along
positive integer scalar

Dimension to operate along, specified as a positive integer scalar. The size of dimension `dim` must be 3. If no value is specified, the default is the first array dimension whose size equals 3.

Consider two 2-D input arrays, `A` and `B`:

- `cross(A,B,1)` treats the columns of `A` and `B` as vectors and returns the cross products of corresponding columns.
- `cross(A,B,2)` treats the rows of `A` and `B` as vectors and returns the cross products of corresponding rows.



`cross` returns an error if `dim` is greater than `ndims(A)`.

More About

expand all

Cross Product

The cross product between two 3-D vectors produces a new vector that is perpendicular to both.

Consider the two vectors

$$A = a_1\hat{i} + a_2\hat{j} + a_3\hat{k} \;,$$

$$B = b_1\hat{i} + b_2\hat{j} + b_3\hat{k} \;.$$

In terms of a matrix determinant involving the basis vectors $\hat{i}$, $\hat{j}$, and $\hat{k}$, the cross product of *A* and *B* is

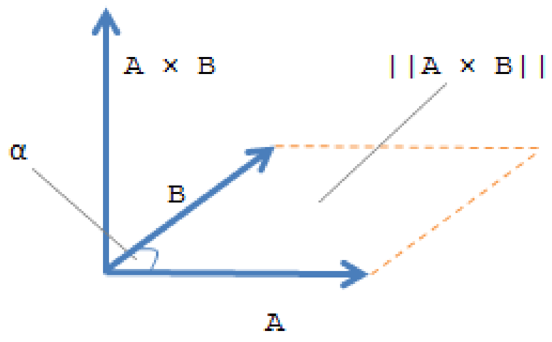
$$C = A \times B = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ a_1 & a_2 & a_3 \\ b_1 & b_2 & b_3 \end{vmatrix}$$

$$= (a_2b_3 - a_3b_2)\hat{i} + (a_3b_1 - a_1b_3)\hat{j} + (a_1b_2 - a_2b_1)\hat{k} \;.$$

Geometrically, $A \times B$ is perpendicular to both *A* and *B*. The magnitude of the cross product, $\|A \times B\|$, is equal to the area of the parallelogram formed using *A* and *B* as sides. This area is related to the magnitudes of *A* and *B* as well as the angle between the vectors by

$$\|A \times B\| = \|A\|\,\|B\|\,\sin\alpha \;.$$

Thus, if *A* and *B* are parallel, then the cross product is zero.



See Also

dot | kron

Introduced before R2006a