conv

Convolution and polynomial multiplication

Syntax

```
w = conv(u,v)
```
example

```
w = conv(u,v,shape)
```
example

Description

`w = conv(u,v)` returns the convolution of vectors u and v. If u and v are vectors of polynomial coefficients, convolving them is equivalent to multiplying the two polynomials.

example

`w = conv(u,v,shape)` returns a subsection of the convolution, as specified by `shape`. For example, `conv(u,v,'same')` returns only the central part of the convolution, the same size as u, and `conv(u,v,'valid')` returns only the part of the convolution computed without the zero-padded edges.

example

Examples

collapse all

Polynomial Multiplication via Convolution

Create vectors u and v containing the coefficients of the polynomials $x^2 + 1$ and $2x + 7$.

Open This Example

```
u = [1 0 1];
v = [2 7];
```

Use convolution to multiply the polynomials.

```
w = conv(u,v)
```

```
w =

     2     7     2     7
```

`w` contains the polynomial coefficients for $2x^3 + 7x^2 + 2x + 7$.

Vector Convolution

Create two vectors and convolve them.

Open This Example

```
u = [1 1 1];
v = [1 1 0 0 0 1 1];
w = conv(u,v)
```

```
w =

     1     2     2     1     0     1     2     2     1
```

The length of `w` is `length(u)+length(v)-1`, which in this example is `9`.

Central Part of Convolution

Create two vectors. Find the central part of the convolution of u and v that is the same size as u.

Open This Example

```
u = [-1 2 3 -2 0 1 2];
v = [2 4 -1 1];
w = conv(u,v,'same')
```

```
w =

    15     5    -9     7     6     7    -1
```

w has a length of 7. The full convolution would be of length `length(u)+length(v)-1`, which in this example would be 10.

Input Arguments

collapse all

u,v — Input vectors
vectors

Input vectors, specified as either row or column vectors. The output vector is the same orientation as the first input argument, u. The vectors u and v can be different lengths or data types.

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

shape — Subsection of convolution
`'full'` (default) | `'same'` | `'valid'`

Subsection of the convolution, specified as `'full'`, `'same'`, or `'valid'`.

`'full'`	Full convolution (default).
`'same'`	Central part of the convolution of the same size as u.
`'valid'`	Only those parts of the convolution that are computed without the zero-padded edges. Using this option, `length(w)` is `max(length(u)-length(v)+1,0)`, except when `length(v)` is zero. If `length(v) = 0`, then `length(w) = length(u)`.

More About

collapse all

Convolution

The convolution of two vectors, u and v, represents the area of overlap under the points as v slides across u. Algebraically, convolution is the same operation as multiplying polynomials whose coefficients are the elements of u and v.

Let `m = length(u)` and `n = length(v)` . Then w is the vector of length `m+n-1` whose kth element is

The sum is over all the values of j that lead to legal subscripts for `u(j)` and `v(k-j+1)`, specifically `j = max(1,k+1-n):1:min(k,m)`. When m = n, this gives

```
w(1) = u(1)*v(1)
w(2) = u(1)*v(2)+u(2)*v(1)
w(3) = u(1)*v(3)+u(2)*v(2)+u(3)*v(1)
...
w(n) = u(1)*v(n)+u(2)*v(n-1)+ ... +u(n)*v(1)
...
w(2*n-1) = u(n)*v(n)
```

See Also

conv2 | convmtx | convn | deconv | filter | xcorr

Introduced before R2006a