

# Multipoly: A Toolbox for Multivariable Polynomials

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## Abstract

Multipoly is a matlab toolbox for the creation and manipulation of polynomials with one or more variables. This document briefly describes the use and functionality of this toolbox.

## 1 Installation

- The toolbox was tested with MATLAB version R2008b and R2009a.
- Download the zip file and extract the contents to the directory where you want to install the toolbox.
- Add the multipoly directory and all subdirectories to the path. Note that the toolbox will not work if you are currently in the @polynomial directory. This is due to MATLABs handling of class methods.
- As described below, the `subs` command can be used to evaluate polynomials at specific values of the variables. The toolbox contains one lower level mex function, `peval.c`, which can be compiled to greatly speed up evaluation of polynomials. In the multipoly folder, type `mex peval.c` to compile this function. There is a m-file version of this function which will be called if the mex version is not compiled.

## 2 Creation of Polynomial Objects

Polynomial objects are most easily constructed by performing basic operations on polynomial variables. Use the `pvar` command to create polynomial variables, e.g.

```
>> pvar x1 x2 x3
```

A multivariable polynomial object can be created from these variables using addition, multiplication, and exponentiation:

```
>> p = x3^4+5*x2+x1^2
p =
    x3^4 + x1^2 + 5*x2
```

Matrices of polynomials can be created from polynomials using horizontal/vertical concatenation and block diagonal augmentation:

```
>> p = x3^4+5*x2+x1^2
p =
    x3^4 + x1^2 + 5*x2
>> M1=[p 2*x2]
M1 =
    [ x3^4 + x1^2 + 5*x2 , 2*x2 ]
>> M2=[p; 2*x1*x2*x3]
M2 =
    [ x3^4 + x1^2 + 5*x2 ]
    [          2*x1*x2*x3 ]
>> M3 = blkdiag(p,x1-5)
```

```
M3 =
[ x3^4 + x1^2 + 5*x2 ,      0 ]
[                0 , x1 - 5 ]
```

Elements of a polynomial matrix can be referenced and assigned using the standard MATLAB referencing notation:

```
>> M3
M3 =
[ x3^4 + x1^2 + 5*x2 ,      0 ]
[                0 , x1 - 5 ]
>> M3(2,2)
ans =
x1 - 5
>> M3(1,:)
ans =
[ x3^4 + x1^2 + 5*x2 , 0 ]
>> M3(1,2) = (x1+2)^2
M3 =
[ x3^4 + x1^2 + 5*x2 , x1^2 + 4*x1 + 4 ]
[                0 ,      x1 - 5 ]
```

### 3 List of Functions

(in contents.m—type help multipoly)

- all
- any
- blkdiag
- char
- cleanpoly
- collect
- combine
- ctranspose
- det
- diff
- double
- eq
- ge
- get
- gt
- horzcat
- isempty
- ismonom
- ispvar

- jacobian
- le
- length
- lt
- minus
- monomials
- mpower
- mpvar
- mrdivide
- mtimes
- ne
- not
- pcontour
- pcontour3
- peval
- plus
- polylib
- polynomial
- poly2basis
- power
- psample
- psim
- pvar
- pvolume
- p2s
- rdivide
- reshape
- set
- size
- sort
- subs
- sum
- s2p
- times

- transpose
- uminus
- unique
- uplus
- vertcat