

# NEWS for pracma version 1.1.0

June 6, 2012

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NEWS

*pracma News*

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## Changes in Version 1.1.0 (2012-06-06)

- `hurst()`, `hurstexp()` calculate the Hurst exponent of a time series.
- Updated the NEWS.Rd file.

## Changes in Version 1.0.9 (2012-06-03)

- `lsqnonneg()` solves nonnegative least-squares problems by using the trick “ $x \rightarrow \exp(x)$ ” and applying `lsqnonlin()`; example function `lsqcurvefit()` for nonlinear curve fitting.
- Renamed `ridder()` to `ridders()`, thanks to Robert Monfera for pointing it out (he also suggested a multi-dimensional variant).

## Changes in Version 1.0.8 (2012-05-22)

- `movavg()` moving average of types “simple”, “weighted”, “modified”, “exponential” (EMA), or “triangular”.
- `modlin()` solves modular linear equations.

## Changes in Version 1.0.7 (2012-05-11)

- `lsqnonlin()` solves nonlinear least-squares problems using the Levenberg-Marquardt approach.
- renamed `froots()` to `findzeros()`, and `fmins()` to `findmins()`.

## Changes in Version 1.0.6 (2012-04-21)

- `fornberg()` finite difference (i.e., polynomial) approximation of derivatives for unevenly spaced grid points – Fornberg’s method.

## Changes in Version 1.0.5 (2012-04-15)

- `randsample()` randomly sampling, alias for `sample` (Matlab style).
- `rands()` generates uniform random points on an N-sphere.
- Added `tic()`, `toc()` measuring elapsed time (Matlab style).
- `previousPrime()` finds the next prime below a number.

**Changes in Version 1.0.4 (2012-04-01)**

- invlap() computes the inverse Lapacian numerically.
- ppfit() piecewise polynomial fitting procedure.

**Changes in Version 1.0.3 (2012-03-21)**

- cubicspline() interpolating cubic spline (w/ endpoint conditions).
- mkpp() and ppval() for piecewise polynomial structures.

**Changes in Version 1.0.2 (2012-03-17)**

- accumarray() resembles the related Matlab function more closely.
- invperm() returns the inverse of a permutation.
- randperm() changed to make it more Matlab-like.

**Changes in Version 1.0.1 (2012-03-09)**

- agm() example computes pi to an arbitrary number of decimal digits using the Rmpfr package for variable precision arithmetic.
- plotyy() corrected right ordinate, prettying the labels.
- peaks() peaks function (Matlab style).

**Changes in Version 1.0.0 (2012-03-01)**

- Updated the NEWS.Rd file.

**Changes in Version 0.9.9 (2012-01-29)**

- qrSolve solves overdetermined system of linear equations.
- DSCsearch() removed, now in package 'pracopt'.
- randp() found a better, non-selective approach.

**Changes in Version 0.9.8 (2012-02-23)**

- gramSchmidt() modified Gram-Schmidt process.
- householder() Householder reflections and QR decomposition.
- givens() Givens rotation and QR decomposition.
- corrected a small error in ridder() (thanks to Roger Harbord).

**Changes in Version 0.9.7 (2012-02-17)**

- erf() corrected, erfc() and erfcx() as new functions, including their inverses erfinv() and erfcinv().
- hypot() now numerically more stable (thanks to Jerry Lewis).

**Changes in Version 0.9.6 (2012-01-25)**

- Changed third example for dblquad() [new Windows toolchain problem].
- Deactivated the test for gammaz() because of problems on Solaris.

**Changes in Version 0.9.5 (2012-01-16)**

- `kmeanspp()` kmeans++ clustering algorithm.
- `savgol()` and `hampel()` with new options, fuelled by a blog entry of Ron Pearson in his ExploringDataBlog.

**Changes in Version 0.9.4 (2012-01-08)**

- `DSCsearch()` Davies-Swann-Campey search in one dimension.
- Improved `modpower()` through modular exponentiation. Added `lehmann_test()` Lehmann's primality test as example.
- Corrected `polar()` and `andrewsplot()`.

**Changes in Version 0.9.3 (2011-12-27)**

- `direct1d()` one-dimensional version of the DIRECT algorithm for global function minimization.

**Changes in Version 0.9.2 (2011-12-26)**

- `ApEn()` approximate entropy of a time series.
- `cirshift()` circularly shifting arrays (Matlab Style).

**Changes in Version 0.9.1 (2011-12-12)**

- `plotyy()` plots curves with y-axes on both left and right side.
- `fplot()` plots components of a multivariate function.

**Changes in Version 0.9.0 (2011-12-11)**

- `errorbar()` routine for plotting error bars in both directions.
- Whittaker-Henderson smoothing **\*\* Not yet running\*\*** .
- `rref()` reduced row echelon form.

**Changes in Version 0.8.9 (2011-12-08)**

- `cutpoints()` automatically finds cutting points based on gaps.
- `hausdorff_dist` calculates the Hausdorff distance / Hausdorff dimension.
- `nnz()` number of non-zeros elements (Matlab style).

**Changes in Version 0.8.8 (2011-12-06)**

- `polar()` for polar plots (Matlab style), see the example plots.
- `andrewsplot()` plots Andrews curves in polar coordinates.
- Vectorized: `cart2sph()`, `sph2cart()`, `cart2pol()`, `pol2cart()`.

**Changes in Version 0.8.7 (2011-11-30)**

- `deg2rad()`, `rad2deg()`
- `figure()` Matlab style, and `pltcross()` plotting crosses.

**Changes in Version 0.8.6 (2011-11-21)**

- `ridder()` Ridder's method for zero finding of univariate functions.

**Changes in Version 0.8.5 (2011-11-19)**

- `sqrtm()` matrix square root, based on Denman-Beavers iteration, `rootm()` matrix  $p$ -th root, computing a complex contour integral, `signm()` matrix sign function.
- `fzero()` now uses the new `zeroIn()` function, i.e., a Brent-Dekker approach instead of referring to `uniroot()`.
- `twinPrimes()` twin primes in a given interval, and `nextPrime` will find the next higher prime.

**Changes in Version 0.8.4 (2011-11-14)**

- Transformations between cartesian, spherical, polar and cylindrical coordinate systems: `cart2sph()`, `sph2cart()`, `cart2pol()`, `pol2cart()`.
- `polar()` uniformly random points in the unit circle (till Matlab 5).

**Changes in Version 0.8.3 (2011-11-11)**

- `accumarray()` grouping elements and applying a function to each group.
- `uniq()` Matlab-style 'unique' function, `allsums()` in the examples.
- small correction to `fsolve()`, mentioned on the 'check summary' page.

**Changes in Version 0.8.2 (2011-11-04)**

- `newmark()` Newmark's method for solving second order differential equations of the form  $y''(t) = f(t, y(t), y'(t))$  on  $[t1, t2]$ .
- `cranknic()` Crank-Nicolson 'ivp' solver, combining the forward and backward Euler methods for ordinary differential equations.

**Changes in Version 0.8.1 (2011-10-30)**

- Corrected `pinv()` for (nearly) singular matrices.
- Renamed `ifactor()` to `factorize()`.

**Changes in Version 0.8.0 (2011-10-27)**

- Minor corrections and improvements to the 'pracma.pdf' manual, incl. `numdiff()`, `refindall()`, `trigApprox()`, and `subspace()`.

**Changes in Version 0.7.9 (2011-10-22)**

- `spinterp()` monotonic (and later on shape-preserving) interpolation following the approach of Delbourgo and Gregory.

**Changes in Version 0.7.8 (2011-10-17)**

- `bvp()` solves boundary value problems of the following kind:  
 $-u''(x) + c1 u'(x) + c2 u(x) = f(x)$  for  $x$  in  $[a, b]$ .

**Changes in Version 0.7.7 (2011-10-14)**

- `primes2(n1, n2)` will return all prime numbers between `n1` and `n2` (without storing the numbers from `sqrt(n2)` up to `n1`).

**Changes in Version 0.7.6 (2011-08-05)**

- `gaussNewton()` for function minimization and solving systems of nonlinear equations. `fsolve()` as a wrapper for it.
- `fzsolve()` for root finding of complex functions.
- `softline()` Fletcher's inexact linesearch algorithm.

**Changes in Version 0.7.5 (2011-07-26)**

- Put `NEWS.Rd` in the `/inst` subdirectory (and `NEWS.pdf` in `/doc`), thanks to Kurt Hornik; slightly changed the version numbering.

**Changes in Version 0.7.4 (2011-07-22)**

- `rortho()` generate random orthogonal matrix of size `n`.
- Titanium data set for testing fitting procedures.

**Changes in Version 0.7.3 (2011-07-15)**

- `erf()` and `erfc()` error and complementary error functions (Matlab style) as (almost) aliases for `pnorm()`.
- `erfz()` complex error function.

**Changes in Version 0.7.2 (2011-07-11)**

- `broyden()` quasi-Newton root finding method for systems of nonlinear equations.

**Changes in Version 0.7.1 (2011-07-09)**

- `cross()` has been vectorized (remark on R-help).

**Changes in Version 0.7.0 (2011-07-07)**

- Sigmoid and Einstein functions.

**Changes in Version 0.6.9 (2011-07-06)**

- Runge-Kutta-Fehlberg method of order (5,4).

**Changes in Version 0.6.8 (2011-07-05)**

- `triquad()` Gaussian quadrature over triangles.
- `cotes()` Newton-Cotes integration formulae for 2 to 8 nodes.

**Changes in Version 0.6.7 (2011-07-04)**

- `lagrangeInterp()`, `newtonInterp()` Lagrange and Newton polynomial interpolation, `neville()` Neville's methods.
- `tril()`, `triu()` extracting triangular matrices (Matlab style).

**Changes in Version 0.6.6 (2011-07-02)**

- `charpoly()` computes the characteristic polynomial, the determinant, and the inverse for matrices that are relatively small, applying the Faddejew-Leverrier method.
- `froots()` to find *\*all\** roots (also of second or higher order) of a univariate function in a given interval. The same with `fmins()` to find all minima.

**Changes in Version 0.6.5 (2011-07-01)**

- Adams-Bashford and Adams-Moulton (i.e., multi-step) methods for ordinary differential equations in function `abm3pc()`.

**Changes in Version 0.6.4 (2011-06-30)**

- Changed the description to be more precise about the package.
- `droplet_e()` generation of digits for the Euler number. (Should be followed by a function `droplet_pi()`.)

**Changes in Version 0.6.3 (2011-06-28)**

- `rationalfit()` rational function approximation
- `ratinterp()` rational interpolation a la Burlisch-Stoer.

**Changes in Version 0.6.2 (2011-06-26)**

- `pade()` Pade approximation.

**Changes in Version 0.6.1 (2011-06-25)**

- `quadgk()` adaptive Gauss-Kronrod quadrature.

**Changes in Version 0.6.0 (2011-06-24)**

- `muller()` Muller's root finding method.
- Added differential equation example to `expm()`'s help page.
- Changed NEWS file to become simpler (no subsections).

**Changes in Version 0.5.9 (2011-06-23)**

- `quadl()` recursive adaptive Gauss-Lobatto quadrature.
- `simpadpt()` another recursively adaptive Simpson's rule.
- Added testing procedures for all integration routines; corrected, refined some of these procedures.

**Changes in Version 0.5.8 (2011-06-20)**

- `quadgr()` Gaussian Quadrature with Richardson extrapolation, can handle singularities at endpoints and (half-)infinite intervals.

**Changes in Version 0.5.7 (2011-06-18)**

- `expm()` for matrix exponentials.
- `clenshaw_curtis()` the Clenshaw-Curtis quadrature formula.

**Changes in Version 0.5.6 (2011-06-17)**

- `simpson2d()` as non-adaptive 2-dimensional Simpson integration.
- `dblquad()` twofold application of internal function `integrate()`.

**Changes in Version 0.5.5 (2011-06-15)**

- `gaussHermite()` and `gaussLaguerre()` for infinite intervals.
- Fresnel integrals `fresnelS()` and `fresnelC()`.

**Changes in Version 0.5.4 (2011-06-12)**

- `gaussLegendre()` computes coefficients for Gauss Quadrature, and `quad2d()` uses these weights for 2-dimensional integration.
- `quadinf()` wrapper for `integrate()` on infinite intervals.
- Added a version for rapid pi computation to the `agm()` examples.

**Changes in Version 0.5.3 (2011-06-06)**

- `ode23()` solving first order (systems of) differential equations.
- `barylag2d()` 2-dimensional barycentric Lagrange interpolation.

**Changes in Version 0.5.2 (2011-06-04)**

- `interp2()` for two-dimensional interpolation.
- `gradient()` now works in two dimensions too.

**Changes in Version 0.5.1 (2011-06-01)**

- `fzero()`, `fminbnd()`, `fminsearch()`, `fsolve()` as aliases for `uniroot()`, `optimize()`, `optim()` with Nelder-Mead, `newtonsys()`.

**Changes in Version 0.5.0 (2011-05-31)**

- Corrections to help pages.

**Changes in Version 0.4.9 (2011-05-30)**

- `romberg()` and `gauss_kronrod()` for numerical integration.
- Richardson's extrapolation in `numderiv()`, `numdiff()`.
- Discrete numerical derivatives (one dimension): `gradient()`.

**Changes in Version 0.4.8 (2011-05-28)**

- Numerical function derivatives: `fderiv()`, `grad()`.
- Specialized operators: `hessian()`, `laplacian()`.
- Application: `taylor()`.

**Changes in Version 0.4.7 (2011-05-27)**

- plot vector fields: `quiver()` and `vectorfield()`.
- `findintervals()`.
- Corrections in `deval()`, `deeve()`, using `findintervals()`.

**Changes in Version 0.4.6 (2011-05-26)**

- Laguerre's method `laguerre()`.
- `rk4()` and `rk4sys()` classical fourth order Runge-Kutta.
- `deval()`, `deeve()` evaluate ODE solutions.

**Changes in Version 0.4.5 (2011-05-24)**

- Lebesgue coefficient: `lebesgue()`.
- `poly2str()` for string representation of a polynomial.

**Changes in Version 0.4.4 (2011-05-23)**

- Dirichlet's `eta()` and Riemann's `zeta()` function.
- `rmsserr()` different accuracy measures; `std_err()` standard error.

**Changes in Version 0.4.3 (2011-05-22)**

- `polypow()` and `polytrans()` for polynomials.
- `polyApprox()` polynomial approximation using Chebyshev.
- `trigPoly()`, `trigApprox()` for trigonometric regression.

**Changes in Version 0.4.2 (2011-05-17)**

- `segm_intersect()` and `segm_distance()` segment distances.
- `inpolygon()`.

**Changes in Version 0.4.1 (2011-05-13)**

- `polyadd()` polynomial addition.
- `conv()` and `deconv()` time series (de)convolution.
- `detrend()` removes (piecewise) linear trends.
- `ifft()` for normalized inverse Fast Fourier Transform.

**Changes in Version 0.4.0 (2011-05-10)**

- Added tests for functions since version 0.3-7.

**Changes in Version 0.3.9 (2011-05-09)**

- `and()` and `or()`.



**Changes in Version 0.3.8 (2011-05-06)**

- `pchip()` and option 'cubic' for `interp1()` interpolation.
- The complex gamma functions `gammaz()`.
- `hadamard()` and `toeplitz()` matrices.

**Changes in Version 0.3.7 (2011-05-04)**

- Rank of a matrix, `mrnk()`, and `nullspace()` for the kernel.
- `orth()`, orthogonal basis of the image space, and `subspace()` determines the angle between two subspaces.
- `normest()` for estimating the (Frobenius) norm of a matrix, and `cond()` determines the condition number of a matrix.

**Changes in Version 0.3.6 (2011-04-30)**

- `fact()`, more accurate than the R internal function 'factorial'.
- `ezplot()` as an alias for `curve()`, but with option "fill = TRUE".
- `aitken()` for accelerating iterations.
- Renamed `polycnv()` to `polymul()`.
- Renamed `outlierMAD()` to `hampel()`.

**Changes in Version 0.3.5 (2011-04-23)**

- `agm()` for the arithmetic-geometric mean.
- Lambert W function `lambertWp()` for the real principal branch.
- "Complex Step" derivation with `complexstep()` and `complexstepJ()`.

**Changes in Version 0.3.4 (2011-04-21)**

- Barycentric Lagrange interpolation through `barylag()`.
- `polyfit2()` fits a polynomial that exactly meets one additional point.
- Added more references to the help entry 'pracma-package.Rd'.

**Changes in Version 0.3.3 (2011-04-19)**

- `hornerdefl()` for also returning the deflated polynomial.
- `newtonHorner()` combining Newton's method and the Horner scheme for root finding for polynomials.
- `jacobian()` computes the Jacobian of a function  $R^n \rightarrow R^m$  as simple numerical derivative.
- `newtonsys()` applies Newton's method to functions  $R^n \rightarrow R^n$  with special application to root finding of complex functions.
- `newton()` renamed to `newtonRaphson()`.

**Changes in Version 0.3.2 (2011-04-17)**

- Sorting functions: `bubbleSort()`, `insertionSort()`, `selectionSort()`, `shellSort()`, `heapSort()`, `mergeSort()`, `mergeOrdered()`, `quickSort()`, `quickSortx()`, `is.sorted()`, and `testSort()`.
- Functions from number theory: `eulersPhi()`, `moebiusFun()` and the `mertensFun()`, `sigma()`, `tau()`, `omega()`, and `Omega()`.

**Changes in Version 0.3.1 (2011-04-16)**

- Chebyshev polynomials of the first kind: `chebPoly()`, `chebCoeff()`, and `chebApprox()`.

**Changes in Version 0.3.0 (2011-04-09)**

- New version of `news.Rd`, `news.pdf`.
- More test functions for root finding and quadrature.

**Changes in Version 0.2.9**

- `fnorm()` and the Runge function `runge()`.
- `contfrac()`, `rat()`, and `rats()` for continuous fractions.
- `meshgrid()` and `magic()`.

**Changes in Version 0.2.8**

- `quad()` adaptive Simpson quadrature.
- Minimum finding with `fibsearch()` and `golden_ratio()`.
- Root finding with `newton()`, `secant()`, and `brentDekker()`.

**Changes in Version 0.2.7**

- Regular expression functions `regexp()`, `regexpi()`, `regexprep()` and `refindall()`.

**Changes in Version 0.2.6**

- String functions `blanks()`, `strtrim()`, `deblank()`, `strjust()`, and `strep()`.
- `interp1()` one-dimensional interpolation (incl. spline)

**Changes in Version 0.2.5**

- Matlab functions `mode()`, `clear()` and `beep()`.

**Changes in Version 0.2.4**

- `primroot()` finds the smallest primitive root modulo a given `n`; needed functions are `mod-power()` and `modorder()`.
- `humps()` and `sinc()`: Matlab test functions.
- Root finding through bisection: `bisect()`, `regulaFalsi()`.
- `outlierMAD()`, `findpeaks()`, and `piecewise()`.
- `polycnv()` for polynomial multiplication.
- Functions `extgcd()`, `gcd()`, and `lcm()` have been renamed to `extGCD()`, `GCD()`, and `LCM()` respectively.

**Changes in Version 0.2.3**

- `strfind()`, `strfindi()`, and `findstr()`.
- `circlefit()` fitting a circle to plane points.
- `mldivide()` and `mrdivide()`, emulating the Matlab backslash operator.

**Changes in Version 0.2.2**

- `vnorm()` vector norm
- Warning about a nasty “non-ASCII input” in the `savgol.RD` file has been resolved.

**Changes in Version 0.2.1**

- `horner()` implementing the horner scheme for evaluating a polynomial and its derivative.
- `savgol()` Savitzki-Golay smoothing and needed pseudoinverse `pinv()`.

**Changes in Version 0.2.0**

- Package renamed to ‘`pracma`’ to avoid name clashes with packages such as ‘`matlab`’ that are sticking closer to the original.
- Added ‘`pracma-package`’ section to the manual.

**Changes in Version 0.1.9**

- `reshape()`, `repmat()`, and `blkdiag()` matrix functions.
- `combs()` chooses all combinations of `k` elements out of `n`, and `randcomb()` generates a random selection.
- `perms()` generates all permutations, `randperm()` a random permutation.
- Pascal triangle as `pascal()`; `nchoosek()` returns binomial coefficients.
- Some string functions: `strcmp()`, `strcmpi()`, `strcat()`.

**Changes in Version 0.1.8**

- `std()` as refinement of the standard deviation function.
- `ceil()` and `fix()` as aliases for `ceiling()` and `trunc()`. [`floor()` and `round()` already exist in R.]
- Modulo functions `mod()`, `rem()` and integer division `idiv()`.
- Integer functions related to the Euclidean algorithm: `extgcd()`, `gcd()`, `lcm()`, `coprime()`, and `modinv()`.
- `distmat()` and `crossn()`, the vector product in `n`-dimensional space.

**Changes in Version 0.1.7**

- `size()`, `numel()`, `ndims()`, `isempty()`, and `find()`.
- `eye()`, `ones()`, `zeros()`.
- Functions returning random numbers: `rand()`, `randn()`, `randi()`.
- `linspace()`, `logspace()`, and `logseq()` for linearly, logarithmically, and exponentially spaced sequences.  
Note that the functions in the ‘`matlab`’ package are not exactly mimicking the corresponding Matlab/Octave functions.

**Changes in Version 0.1.6**

- Matrix functions `mdiag()` and `mtrace()` added. `inv()` is introduced as an alias for `solve()` in R.
- Generate special matrices `hankel()`, `rosser()`, and `wilkinson()`. `kron()` is an alias for the R function `kronecker()`.
- Renamed `factors()` to `ifactor()` to distinguish it more clearly from `factors` as used in R.

**Changes in Version 0.1.5**

- Added functions for flipping or rotating numeric and complex matrices: `flipdim()`, `flipud()`, `fliplr()`, and `rot90()`.

**Changes in Version 0.1.4**

- Added basic complex functions `real()`, `imag()`, `conj()`, and `angle()` which are essentially only aliases of the R functions `Re()`, `Im()`, and `Conj()`.  
`angle()` returns the angle of a complex number in radians. The R function `Mod()` is here only available as `abs()`.

**Changes in Version 0.1.3**

- Added `compan()` function for the ‘companion’ matrix; the `eig()` function is an alias for the R `eigen()` values function.
- Added the polynomial functions `poly()`, `polyder()`, `polyfit()`, `polyint()`, and `polyval()`.
- `roots()` returns real and complex roots of polynomials.
- Simplified the `trapz()` function.

**Changes in Version 0.1.2**

- Added functions from number theory: `primes()`, `isprime()` and `factors()`.
- The corresponding function for `factors()` in Matlab/Octave is called `factor()`, but that name should not be shadowed in R!
- Added the `polyarea()` and `trapz()` functions.

**Changes in Version 0.1.1**

- Added some simple functions such as `nthroot()`, `pow2()`, and `nextpow2()`.
- `dot()` and `cross()` functions for scalar and vector product.
- Generate matrices through `vander()` and `hilb()`.

**Changes in Version 0.1.0**

- Installation  
‘pracma’ will be a pure R package without using source code in C or Fortran. Therefore, installation will be immediate on all platforms.
- Intention  
This package provides R implementations of more advanced math functions from Matlab and Octave (and the Euler Math Toolbox) with a special view on optimization and time series routines.
- Remark: Typeset this document as:  
`R CMD Rd2pdf NEWS.Rd --title="NEWS for pracma version 1.1.0"`.

# Index

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