Genetic Algorithm and Direct Search Toolbox Release Notes

Contents

Summary by Version

This table provides quick access to what's new in each version. For clarification, see "About Release Notes" on page 1.

Version (Release)	New Features and Changes	Version Compatibility Considerations	Fixed Bugs and Known Problems	Related Documentation at Web Site
Latest Version V2.2 (R2007b)	Yes Details	No	Bug Reports Includes fixes	Printable Release Notes: PDF Current product documentation
V2.1 (R2007a)	Yes Details	Yes Summary	Bug Reports Includes fixes	No
V2.0.2 (R2006b)	Yes Details	Yes Summary	Bug Reports Includes fixes	No
V2.0.1 (R2006a)	No	No	Bug Reports Includes fixes	No
V2.0 (R14SP3)	Yes Details	No	Bug Reports Includes fixes	No

About Release Notes

Use release notes when upgrading to a newer version to learn about new features and changes, and the potential impact on your existing files and practices. Release notes are also beneficial if you use or support multiple versions.

If you are not upgrading from the most recent previous version, review release notes for all interim versions, not just for the version you are installing. For example, when upgrading from V1.0 to V1.2, review the New Features and Changes, Version Compatibility Considerations, and Bug Reports for V1.1 and V1.2.

New Features and Changes

These include

- New functionality

- Changes to existing functionality

- Changes to system requirements (complete system requirements for the current version are at the MathWorks Web site)

- Any version compatibility considerations associated with each new feature or change

Version Compatibility Considerations

When a new feature or change introduces a reported incompatibility between versions, its description includes a **Compatibility Considerations** subsection that details the impact. For a list of all new features and changes that have reported compatibility impact, see the "Compatibility Summary for Genetic Algorithm and Direct Search Toolbox" on page 15.

Compatibility issues that are reported after the product has been released are added to Bug Reports at the MathWorks Web site. Because bug fixes can sometimes result in incompatibilities, also review fixed bugs in Bug Reports for any compatibility impact.

Fixed Bugs and Known Problems

MathWorks Bug Reports is a user-searchable database of known problems, workarounds, and fixes. The MathWorks updates the Bug Reports database as new problems and resolutions become known, so check it as needed for the latest information.

Access Bug Reports at the MathWorks Web site using your MathWorks Account. If you are not logged in to your MathWorks Account when you link to Bug Reports, you are prompted to log in or create an account. You then can view bug fixes and known problems for R14SP2 and more recent releases.

The Bug Reports database was introduced for R14SP2 and does not include information for prior releases. You can access a list of bug fixes made in prior versions via the links in the summary table.

Related Documentation at Web Site

Printable Release Notes (PDF). You can print release notes from the PDF version, located at the MathWorks Web site. The PDF version does not support links to other documents or to the Web site, such as to Bug Reports. Use the browser-based version of release notes for access to all information.

Product Documentation. At the MathWorks Web site, you can access complete product documentation for the current version and some previous versions, as noted in the summary table.

Version 2.2 (R2007b) Genetic Algorithm and Direct Search Toolbox

This table summarizes what's new in version 2.2 (R2007b):

New Features and Changes	Version Compatibility Considerations	Fixed Bugs and Known Problems	Related Documentation at Web Site
Yes Details below	No	Bug Reports Includes fixes	Printable Release Notes: PDF Current product documentation

New features and changes introduced in this version are described here:

- "Multiobjective Optimization with Genetic Algorithm" on page 4

- "Multiobjective Optimization with Genetic Algorithm and Custom Data Types" on page 5

- "Hybrid Multiobjective Optimization Combining Genetic Algorithm with Optimization Toolbox" on page 5

- "Vectorized Function Inputs with Nonlinear Constraints" on page 5

- "New Demos" on page 5

Multiobjective Optimization with Genetic Algorithm

Multiobjective optimization, with linear and bound constraints, is now available through the new function gamultiobj. This function determines optimal Pareto fronts from specified criteria, including Pareto fronts that are nonconvex, disconnected, or both.

Optimization Toolbox also contains multiobjective functionality, but cannot reliably generate optimal Pareto fronts if these are nonconvex or disconnected.

Two new demos illustrate this feature. See "New Demos" on page 5.

Multiobjective Optimization with Genetic Algorithm and Custom Data Types

The new function gamultiobj also supports multiobjective optimization with custom data types, including binary.

Hybrid Multiobjective Optimization Combining Genetic Algorithm with Optimization Toolbox

To determine multiobjective optimizations more accurately, you can now combine the new function gamultiobj with the existing function fgoalattain from Optimization Toolbox.

Vectorized Function Inputs with Nonlinear Constraints

The functions ga and patternsearch now accept vectorized function inputs with nonlinear constraints. The new function gamultiobj does as well.

New Demos

Two accompanying demos illustrate the use of the new multiobjective genetic algorithm function gamultiobj:

- gamultiobjfitness uses gamultiobj to solve a simple problem with one decision variable and two objectives.

- gamultiobjoptionsdemo shows how to set options for multiobjective optimization with a simple genetic algorithm problem.

Version 2.1 (R2007a) Genetic Algorithm and Direct Search Toolbox

This table summarizes what's new in version 2.1 (R2007a):

New Features and Changes	Version Compatibility Considerations	Fixed Bugs and Known Problems	Related Documentation at Web Site
Yes Details below	Yes–Details labeled as **Compatibility Considerations**, below. See also Summary.	Bug Reports Includes fixes	None

New features and changes introduced in this version are described here:

- "New Functions for Simulated Annealing and Threshold Acceptance" on page 6

- "ga Output Argument exitflag Returns Numeric Value" on page 7

New Functions for Simulated Annealing and Threshold Acceptance

The following functions have been added for simulated annealing and threshold acceptance:

simulannealbnd	Perform unconstrained or bound-constrained minimization of a function of several variables using simulated annealing. The default algorithm uses adaptive annealing, but options can be changed to use Boltzmann annealing, fast annealing, and other variants.
threshacceptbnd	Perform unconstrained or bound-constrained minimization of a function of several variables using threshold acceptance.
saoptimset	Create or modify optimization options for simulannealbnd or threshacceptbnd.
saoptimget	Access options for simulannealbnd or threshacceptbnd.

If you are viewing this documentation in the Help browser, the following demos are available:

- Minimization Using Simulated Annealing And Threshold Acceptance Algorithms

- Simulated Annealing and Threshold Acceptance Options

- Custom Data Type Optimization Using Simulated Annealing

ga Output Argument exitflag Returns Numeric Value

The third output argument returned by the ga function is now a numeric value. This change is consistent with other optimization solvers in MATLAB® and makes it easier to programmatically determine the reason the solver stopped. As in previous versions, the fourth output argument is a structure with the field message containing a string that indicates the reason the solver stopped.

The new syntax is as follows:

```
[x,fval,exitflag,output] = ga(fitnessfcn, ...)
```

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For more information, including a description of the messages that correspond to the numeric values for each `exitflag` value, see the `ga` function reference page in the Genetic Algorithm and Direct Search Toolbox User's Guide for more information.

Compatibility Considerations

In previous versions, the third output argument returned by `ga` is a string describing the reason the solver stopped.

```
[x,fval,reason] = ga(fitnessfcn, ...)
```

If you used the third output argument of the `ga` function programmatically in a previous release, for example, to compare the value to a string, this code will now produce an error.

Version 2.0.2 (R2006b) Genetic Algorithm and Direct Search Toolbox

This table summarizes what's new in version 2.0.2 (R2006b):

New Features and Changes	Version Compatibility Considerations	Fixed Bugs and Known Problems	Related Documentation at Web Site
Yes Details below	Yes–Details labeled as **Compatibility Considerations**, below. See also Summary.	Bug Reports Includes fixes	No

New features and changes introduced in this version are described here:

New Syntax for Search Method Option in Pattern Search Algorithm Improves Speed and Memory

The new syntax is more efficient both with speed and memory. This is done by changing the way linear and bound constraints are stored and passed to a search function. The following describes the new calling syntax:

```
function [successSearch,xBest,fBest,funccount] =
searchfcntemplate(fun,x,A,b,Aeq,beq,lb,ub, ...
    optimValues,options)
```

For more information on how to use the new search function syntax, see "Structure of the Search Function" in the Genetic Algorithm and Direct Search Toolbox User's Guide. To see a template that you can view and edit, type

```
edit searchfcntemplate
```

at the Command Window.

Compatibility Considerations

Using your search functions in Version 2.0.2. In previous versions, a search function required the following calling syntax:

```
function [successSearch,nextIterate,optimState] =
searchfcntemplate(fun,iterate,tol,A,L,U, ...
    funeval,maxfun,searchoptions,objfcnarg, ...
    iterlimit,factors)
```

If you have a search function written for use in a previous release, the function performs correctly in Version 2.0.2 but returns a warning. Custom search functions written in a previous version need to be updated with the new syntax. In later versions, this syntax may cause a warning or error.

Converting your search functions to the Version 2.0.2 syntax.
The searchConversion utility function is provided to convert your search functions from previous releases to the new syntax of Version 2.0.2. For more information on obtaining and using the conversion function, see this technical support solution.

Version 2.0.1 (R2006a) Genetic Algorithm and Direct Search Toolbox

This table summarizes what's new in version 2.0.1 (R2006a):

New Features and Changes	Version Compatibility Considerations	Fixed Bugs and Known Problems	Related Documentation at Web Site
No	No	Bug Reports Includes fixes	None

Version 2.0 (R14SP3) Genetic Algorithm and Direct Search Toolbox

This table summarizes what's new in version 2.0 (R14SP3):

New Features and Changes	Version Compatibility Considerations	Fixed Bugs and Known Problems	Related Documentation at Web Site
Yes Details below	No	Bug Reports Includes fixes	None

New features and changes introduced in this version are organized by these topics:

- "Both the Genetic Algorithm and the Pattern Search Algorithm Now Accept Nonlinear Constraints" on page 12

- " Direct Search Now Implements Two Algorithms — Generalized Pattern Search Algorithm (GPS) and Mesh Adaptive Search Algorithm (MADS)" on page 13

- " New Options Available in the Genetic Algorithm" on page 13

- " New Options Available in the Pattern Search Algorithm" on page 14

- "New Demos" on page 14

Both the Genetic Algorithm and the Pattern Search Algorithm Now Accept Nonlinear Constraints

Previously, the genetic algorithm solver only solved unconstrained optimization problems, and the pattern search solver solved unconstrained optimization problems as well as those with linear constraints and bounds. Now, both solvers have to ability to solve general nonlinear optimization problems with linear constraints, bounds, and nonlinear constraints by accepting a nonlinear constraint function. The M-file for the nonlinear constraint function is accepted as an input argument at the command line for both the ga and patternsearch functions, as well as in the **Constraints** panel of psearchtool and gatool.

Direct Search Now Implements Two Algorithms — Generalized Pattern Search Algorithm (GPS) and Mesh Adaptive Search Algorithm (MADS)

The GPS algorithm is the pattern search algorithm implemented in previous versions of the toolbox. The MADS algorithm is a modification of the GPS algorithm. The algorithms differ in how the set of points forming the mesh is computed. The GPS algorithm uses fixed direction vectors, whereas the new MADS algorithm uses a random selection of vectors to define the mesh.

New Options Available in the Genetic Algorithm

The following options are available in the gatool and when using the ga function at the command prompt:

- The new **Constraints** panel has a **Nonlinear constraint function** field in addition to fields for linear constraints and bounds for solving constrained optimization problems

- New **Max constraint** (@gaplotmaxconstr) option in the **Plot** pane to plot the maximum nonlinear constraint violation at each generation

- New crossover function, Arithmetic (@crossoverarithmetic), available in the **Crossover** panel that creates children that are the weighted arithmetic mean of two parents

- New mutation function, Adaptive Feasible (mutationadaptfeasible), available in the **Crossover** panel that randomly generates directions that are adaptive with respect to the last successful or unsuccessful generation. This function is the default for constrained problems

- New **Algorithm settings** panel for selecting algorithm specific parameters, such as the penalty parameters, **Initial penalty** and **Penalty factor**, for a nonlinear constraint algorithm

- New **Hybrid function**, fmincon, for constrained problems

- New **Nonlinear constraint tolerance** parameter in **Stopping criteria**

New Options Available in the Pattern Search Algorithm

The following options are available in the `psearchtool` and when using the `patternsearch` function at the command prompt:

- **Constraints** now has a **Nonlinear constraint function** option to solve for constrained optimization problems

- New **Max constraint** (`@psplotmaxconstr`) option in the **Plot** pane to plot the maximum nonlinear constraint violation at each generation

- Updated **Poll method** and **Search method** options for selecting the GPS or MADS algorithms

- New **Algorithm settings** panel for selecting algorithm specific parameters, such as the penalty parameters, **Initial penalty** and **Penalty factor**, for a nonlinear constraint algorithm

- New **Time limit** and **Nonlinear constraint tolerance** parameters in **Stopping criteria**

New Demos

The Genetic Algorithm and Direct Search Toolbox contains the following new demos for Version 2.0:

- Optimization of Non-smooth Objective Function

- Constrained Minimization Using the Genetic Algorithm

- Constrained Minimization Using the Pattern Search

- Optimization of Stochastic Objective Function

- Using the Genetic Algorithm with the Distributed Computing Toolbox

Compatibility Summary for Genetic Algorithm and Direct Search Toolbox

This table summarizes new features and changes that might cause incompatibilities when you upgrade from an earlier version, or when you use files on multiple versions. Details are provided in the description of the new feature or change.

Version (Release)	New Features and Changes with Version Compatibility Impact
Latest Version **V2.2 (R2007b)**	None
V2.1 (R2007a)	See the **Compatibility Considerations** subheading for each of these new features or changes: • "ga Output Argument exitflag Returns Numeric Value" on page 7
V2.0.2 (R2006b)	See the **Compatibility Considerations** subheading for each of these new features or changes: • "New Syntax for Search Method Option in Pattern Search Algorithm Improves Speed and Memory" on page 9
V2.0.1 (R2006a)	None
V2.0 (R14SP3)	None