

MATLAB[®] Coder[™] Release Notes



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MATLAB[®] Coder[™] Release Notes

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Check Bug Reports for Issues and Fixes

Software is inherently complex and is not free of errors. The output of a code generator might contain bugs, some of which are not detected by a compiler. MathWorks reports critical known bugs brought to its attention on its Bug Report system at www.mathworks.com/support/bugreports/. Use the Saved Searches and Watched Bugs tool with the search phrase "Incorrect Code Generation" to obtain a report of known bugs that produce code that might compile and execute, but still produce wrong answers.

The bug reports are an integral part of the documentation for each release. Examine periodically all bug reports for a release, as such reports may identify inconsistencies between the actual behavior of a release you are using and the behavior described in this documentation.

In addition to reviewing bug reports, you should implement a verification and validation strategy to identify potential bugs in your design, code, and tools.

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R2015a

Version: 2.8

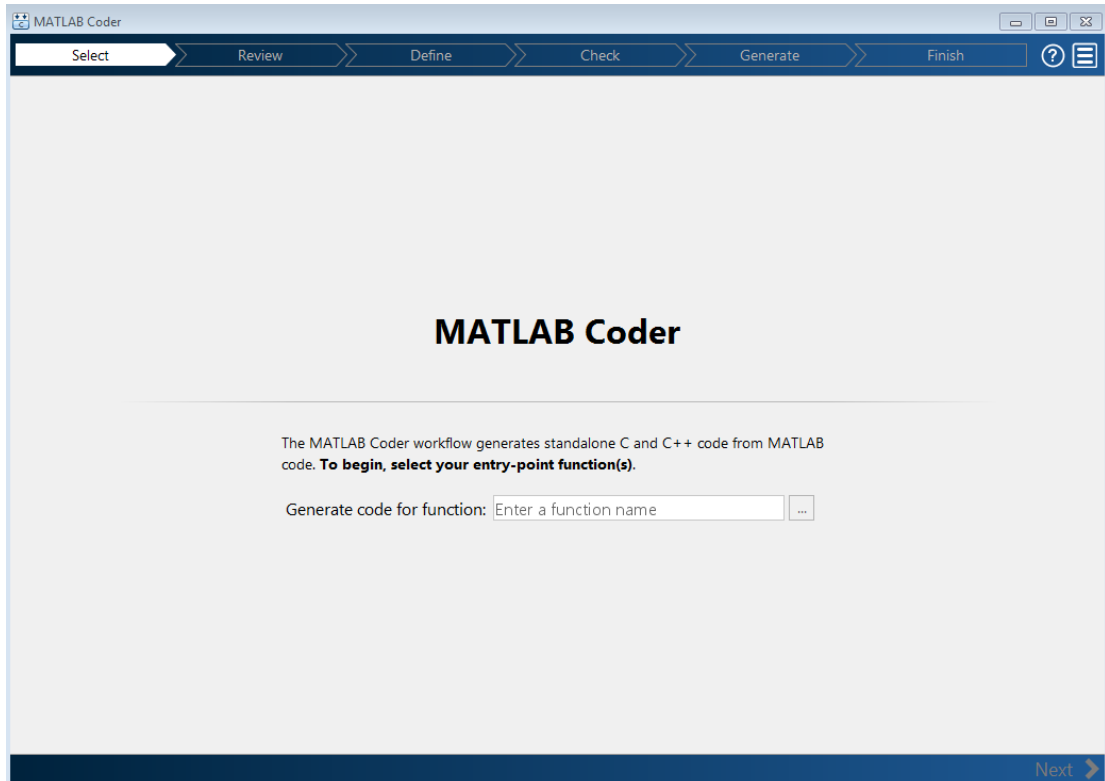
New Features

Bug Fixes

Compatibility Considerations

Improved MATLAB Coder app with integrated editor and simplified workflow

In R2015a, the MATLAB® Coder™ app has a new user interface for the code generation workflow.



The improved app includes:

- Automatic checks for code generation readiness and run-time issues. The code generation readiness checks include identification of unsupported functions.
- An integrated editor to fix issues in your MATLAB code without leaving the app.
- A project summary and access to generated files.
- Export of project settings in the form of a MATLAB script.
- Help for each step and links to documentation for more information.

See “C Code Generation Using the MATLAB Coder App”.


Generation of example C/C++ main for integration of generated code into an application

In R2015a, you can generate an example C/C++ main function when generating source code, a static library, a dynamic library, or an executable. You modify the example main function to meet the requirements of your application.

An example main function provides a template that helps you incorporate generated code into your application. The template shows how to initialize function input arguments to zero and call entry-point functions. Generating an example main function is especially useful when the code uses dynamic memory allocation for data. See “Use an Example C Main in an Application”.

By default, MATLAB Coder generates an example main function when generating source code, a static library, a dynamic library, or an executable.

To control generation of an example main function using the MATLAB Coder app:

- 1 On the **Generate Code** page, to open the **Generate** dialog box, click the **Generate** arrow .
- 2 In the **Generate** dialog box, set **Build type** to one of the following:
 - Source Code
 - Static Library (.lib)
 - Dynamic Library (.dll)
 - Executable (.exe)
- 3 Click **More Settings**.
- 4 On the **All Settings** tab, under **Advanced**, set **Generate example main** to one of the following:
 - Do not generate an example main function
 - Generate, but do not compile, an example main function (default)
 - Generate and compile an example main function

To control generation of an example main function using the command-line interface:

- 1 Create a code configuration object for 'lib', 'dll', or 'exe'. For example:

```
cfg = coder.config('lib'); % or dll or exe
```
- 2 Set the `GenerateExampleMain` property to one of the following:
 - 'DoNotGenerate'
 - 'GenerateCodeOnly' (default)
 - 'GenerateCodeAndCompile'

For example:

```
cfg.GenerateExampleMain = 'GenerateCodeOnly';
```

Better preservation of MATLAB variable names in generated code

To reduce memory usage, when possible, variables share names and memory in the generated code. In previous releases, this variable reuse optimization reused your variable names for other variables or replaced your variable names with the names of other variables. In R2015a, by default, this optimization preserves your variable names—it does not replace or reuse them. Other optimizations, however, can remove your variable names from the generated code. See “Variable Reuse in Generated Code”.

Compatibility Considerations

If your MATLAB code uses large arrays or structures, in some cases, the extra memory to preserve your variable names can affect performance. To reduce memory usage, specify that the variable reuse optimization does not have to preserve variable names:

- Using a project, in the Project Settings dialog box, on the **All Settings** tab, set **Preserve variable names** to None.
- Using the command-line interface, set the configuration object property `PreserveVariableNames` to None.

See “Reuse Large Arrays and Structures”.

More efficient generated code for logical indexing

Code generated for logical array indexing is faster and uses less memory than in previous releases. For example, the generated code for the following function is more efficient than in previous releases.

```
function x = foo(x,N)
assert(all(size(x) == [1 100]))
x(x>N) = N;
```

In R2015a, you do not have to replace `x(x>N) = N` with a `for`-loop to improve performance.

Code generation for additional Image Processing Toolbox and Computer Vision System Toolbox functions

Image Processing Toolbox

- `bweuler`
- `bwlabel`
- `bwperim`
- `regionprops`
- `watershed`

See “Image Processing in MATLAB”.

Computer Vision System Toolbox

- `cameraMatrix`
- `cameraParameters`
- `extrinsics`
- `opticalFlow`
- `opticalFlowHS`
- `opticalFlowLK`
- `opticalFlowLKDoG`
- `reconstructScene`
- `rectifyStereoImages`
- `stereoParameters`
- `triangulate`
- `undistortImage`

- `vision.DeployableVideoPlayer` on Mac platform.

In previous releases, `vision.DeployableVideoPlayer` supported code generation on Linux® and Windows® platforms. In R2015a, `vision.DeployableVideoPlayer` also supports code generation on a Mac platform.

See “Computer Vision System Toolbox”.

Code generation for additional Communications System Toolbox, DSP System Toolbox, and Phased Array System Toolbox System objects

Communications System Toolbox

- `comm.CarrierSynchronizer`
- `comm.FMBroadcastDemodulator`
- `comm.FMBroadcastModulator`
- `comm.FMDemodulator`
- `comm.FMModulator`
- `comm.SymbolSynchronizer`

See “Communications System Toolbox”.

DSP System Toolbox

- `iirparameq`
- `dsp.HighpassFilter`
- `dsp.LowpassFilter`

See “DSP System Toolbox”.

Phased Array System Toolbox

- `pilotcalib`
- `phased.UCA`
- `phased.MFSKWaveform`

See “Phased Array System Toolbox”

Code generation for additional Statistics and Machine Learning Toolbox functions

- `betafit`
- `betalike`
- `pca`
- `pearsrnd`

See “Statistics and Machine Learning Toolbox”.

Code generation for additional MATLAB functions

Linear Algebra

- `bandwidth`
- `isbanded`
- `isdiag`
- `istril`
- `istriu`
- `lsqnonneg`

See “Linear Algebra in MATLAB”.

Statistics in MATLAB

- `cummin`
- `cummax`

See “Statistics in MATLAB”

Code generation for additional MATLAB function options

- `dimension` option for `cumsum` and `cumprod`

See “Functions and Objects Supported for C and C++ Code Generation — Alphabetical List”.

Conversion from project to MATLAB script using MATLAB Coder app

In previous releases, to convert a project to a MATLAB script, you used the `-tocode` option of the `coder` command. In R2015a, you can also use the MATLAB Coder app to convert a project to a script. Before you convert a project to a script, complete the **Define Input Types** step.

To convert a project to a script using the MATLAB Coder app, on the workflow bar, click



and then select **Convert to script**.

See “Convert MATLAB Coder Project to MATLAB Script”.

Improved recognition of compile-time constants

In previous releases, the code generation software recognized that structure fields or array elements were constant only when all fields or elements were constant. In R2015a, in some cases, the software can recognize constant fields or constant elements even when some structure fields or array elements are not constant.

For example, consider the following code. Field `s.a` is constant and field `s.b` is not constant:

```
function y = create_array(x)
s.a = 10;
s.b = x;
y = zeros(1, s.a);
```

In previous releases, the software did not recognize that field `s.a` was constant. In the generated code, if variable-sizing was enabled, `y` was a variable-size array. If variable-sizing was disabled, the code generation software reported an error. In R2015a, the software recognizes that `s.a` is a constant. `y` is a static row vector with 10 elements.

As a result of this improvement, you can use individual assignments to assign constant values to structure fields. For example:

```
function y = mystruct(x)
s.a = 3;
s.b = 4;
y = zeros(s.a,s.b);
```

In previous releases, the software recognized the constants only if you defined the complete structure using the `struct` function: For example:

```
function y = mystruct(x)
s = struct('a', 3, 'b', 4);
y = zeros(s.a,s.b);
```

In some cases, the code generation software cannot recognize constant structure fields or array elements. See “Code Generation for Constants in Structures and Arrays”.

Compatibility Considerations

The improved recognition of constant fields and elements can cause the following differences between code generated in R2015a and code generated in previous releases:

- A function output can be more specific in R2015a than it was in previous releases. An output that was complex in previous releases can be real in R2015a. An array output that was variable-size in previous releases can be fixed-size in R2015a.
- Some branches of code that are present in code generated using previous releases are eliminated from the generated code in R2015a.

Improved emxArray interface function generation

When you generate code that uses variable-size data, MATLAB Coder exports functions that you can use to create and interact with `emxArrays` in your generated code. R2015a includes the following improvements to `emxArray` interface functions:

emxArray interface functions for variable-size arrays that external C/C++ functions use

When you use `coder.ceval` to call an external C/C++ function, MATLAB Coder generates `emxArray` interface functions for the variable-size arrays that the external function uses.

Functions to initialize output emxArrays and emxArrays in structure outputs

MATLAB Coder generates functions to initialize `emxArrays` that are outputs or `emxArrays` that are in structure outputs.

A function that creates an empty `emxArray` on the heap has a name of the form:

```
emxInitArray_<baseType>
```

`<baseType>` is the type of the elements of the `emxArray`. The inputs to this function are a pointer to an `emxArray` pointer and the number of dimensions. For example:

```
void emxInitArray_real_T(emxArray_real_T **pEmxArray, int numDimensions);
```

A function that creates empty `emxArrays` in a structure has a name of the form:

```
void emxInitArray_<structType>
```

`<structType>` is the type of the structure. The input to this function is a pointer to the structure that contains the `emxArrays`. For example:

```
void emxInitArray_cstruct0_T(cstruct0_T *structure);
```

MATLAB Coder also generates functions that free the dynamic memory that the functions that create the `emxArrays` allocate. For example, the function that frees dynamic memory that `emxInitArray_real_T` allocates is:

```
void emxDestroyArray_real_T(emxArray_real_T *emxArray)
```

The function that frees dynamic memory that `emxInitArray_cstruct0_T` allocates is:

```
void emxDestroyArray_struct0_T(struct0_T *structure)
```

See “C Code Interface for Arrays”.

External definition of a structure that contains `emxArrays`

In previous releases, MATLAB Coder did not allow external definition of a structure that contained `emxArrays`. If you defined the structure in C code and declared it in an external header file, MATLAB Coder reported an error.

In R2015a, MATLAB Coder allows external definition of a structure that contains `emxArrays`. However, do not define the type of the `emxArray` in the external C code. MATLAB Coder defines the types of the `emxArrays` that a structure contains.

Code generation for casts to and from types of variables declared using `coder.opaque`

For code generation, you can use the MATLAB `cast` function to cast a variable to or from a variable that is declared using `coder.opaque`. Use `cast` with `coder.opaque` only for numeric types.

To cast a variable declared by `coder.opaque` to a MATLAB type, you can use the `B = cast(A, type)` syntax. For example:


```
x = coder.opaque('size_t','0');
x1 = cast(x, 'int32');
```

You can also use the `B = cast(A, 'like', p)` syntax. For example:

```
x = coder.opaque('size_t','0');
x1 = cast(x, 'like', int32(0));
```

To cast a MATLAB variable to the type of a variable declared by `coder.opaque`, you must use the `B = cast(A, 'like', p)` syntax. For example:

```
x = int32(12);
x1 = coder.opaque('size_t', '0');
x2 = cast(x, 'like', x1);
```

Use `cast` with `coder.opaque` to generate the correct data types for:

- Inputs to C/C++ functions that you call using `coder.ceval`.
- Variables that you assign to outputs from C/C++ functions that you call using `coder.ceval`.

Without this casting, it is possible to receive compiler warnings during code generation.

Consider this MATLAB code:

```
yt = coder.opaque('size_t', '42');
yt = coder.ceval('foo');
y = cast(yt, 'int32');
```

- `coder.opaque` declares that `yt` has C type `size_t`.
- `y = cast(yt, 'int32')` converts `yt` to `int32` and assigns the result to `y`.

Because `y` is a MATLAB numeric type, you can use `y` as you would normally use a variable in your MATLAB code.

The generated code looks like:

```
size_t yt= 42;
int32_T y;
y = (int32_T)yt;
```

It is possible that the explicit cast in the generated code prevents a compiler warning.

Generation of reentrant code without an Embedded Coder license

In previous releases, generation of reentrant code required an Embedded Coder[®] license. In R2015a, you can generate reentrant code using MATLAB Coder without an Embedded Coder license.

See “Reentrant Code”.

Code generation for `parfor`-loops with stack overflow

In previous releases, you could not generate code for `parfor`-loops that contained variables that did not fit on the stack. In R2015a, you can generate code for these `parfor`-loops. See “Algorithm Acceleration Using Parallel for-Loops (`parfor`)”.

Change in default value of the `PassStructByReference` code configuration object property

The `PassStructByReference` code configuration object property controls whether the `codegen` command generates pass by reference or pass by value structures for entry-point input and output structures.

In previous releases, the default value of `PassStructByReference` was `false`. By default, `codegen` generated pass by value structures. This default behavior differed from the MATLAB Coder app default behavior. The app generated pass by reference structures.

In R2015a, the value of `PassStructByReference` is `true`. By default, `codegen` generates pass by reference structures. The default behavior now matches the default behavior of the MATLAB Coder app.

See “Pass Structure Arguments by Reference or by Value”.

Compatibility Considerations

For an entry-point function with structure arguments, if the `PassStructByReference` property has the default value, `codegen` generates a different function signature in R2015a than in previous releases.

Here is an example of a function signature generated in R2015a using the `codegen` command with the `PassStructByReference` property set to the default value, `true`:

```
void my_struct_in(const struct0_T *s, double y[4])
```

`my_struct_in` passes the input structure `s` by reference.

The signature for the same function generated in previous releases, using the `codegen` command with the `PassStructByReference` property set to the default value, `false` is:

```
void my_struct_in(const struct0_T s, double y[4])
```

`my_struct_in` passes the input structure `s` by value.

To control whether `codegen` generates pass by reference or pass by value structures, set the `PassStructByReference` code configuration object property. For example, to generate pass by value structures:

```
cfg = coder.config('lib');  
cfg.PassStructByReference = false;
```

Change in GLOBALS variable in scripts generated from a project

A script generated from a MATLAB Coder project that uses global variables creates the variable `GLOBALS`. In previous releases, `GLOBALS` stored the types of global variables. The initial values of the global variables were specified directly in the `codegen` command. In R2015a, `GLOBALS` stores both the types and the initial values of global variables. The `codegen` command obtains the initial values from `GLOBALS`.

See “Convert MATLAB Coder Project to MATLAB Script”.

Target build log display for command-line code generation when hyperlinks disabled

In previous releases, if hyperlinks were disabled, you could not access the code generation report to view compiler or linker messages in the target build log. In R2015a, when hyperlinks are disabled, you see the target build log in the Command Window.

If you use the `-nojvm` startup option when you start MATLAB, hyperlinks are disabled. See “Commonly Used Startup Options”.

For more information about the target build log, see “View Target Build Information”.

Removal of instrumented MEX output type

You can no longer specify the output type Instrumented MEX.

Compatibility Considerations

For manual fixed-point conversion, use the command-line workflow. This workflow uses the Fixed-Point Designer™ functions `buildInstrumentedMex` and `showInstrumentationResults`. See “Manually Convert a Floating-Point MATLAB Algorithm to Fixed Point” in the Fixed-Point Designer documentation.

Fixed-point conversion enhancements

Support for multiple entry-point functions

Fixed-point conversion now supports multiple entry-point functions. You can generate C/C++ library functions to integrate with larger applications.

Support for global variables

You can now convert MATLAB algorithms that contain global variables to fixed-point code without modifying your MATLAB code.

Code coverage-based translation

During fixed-point conversion, MATLAB Coder now detects dead and constant folded code. It warns you if any parts of your code do not execute during the simulation of your test file. This detection can help you verify if your test file is testing the algorithm over the intended operating range. The software uses this code coverage information during the translation of your code from floating-point MATLAB code to fixed-point MATLAB code. The software inserts inline comments in the fixed-point code to mark the dead and untranslated regions. It includes the code coverage information in the generated fixed-point conversion HTML report.

Generated fixed-point code enhancements

The generated fixed-point code now:

- Uses colon syntax for multi-output assignments, reducing the number of `fi` casts in the generated fixed-point code.

- Preserves the indentation and formatting of your original algorithm, improving the readability of the generated fixed-point code.

Automated fixed-point conversion of additional DSP System Toolbox objects

If you have a DSP System Toolbox™ license, you can now convert the following DSP System Toolbox System objects to fixed-point:

- `dsp.FIRDecimator`
- `dsp.FIRInterpolator`
- `dsp.FIRFilter`, direct form and direct form transposed only
- `dsp.LUFactor`
- `dsp.VariableFractionalDelay`
- `dsp.Window`

You can propose and apply data types for these System objects based on simulation range data. Using the MATLAB Coder app, during the conversion process, you can view simulation minimum and maximum values and proposed data types for these System objects. You can also view whole number information and histogram data. You cannot propose data types for these System objects based on static range data.

New interpolation method for generating lookup table MATLAB function replacements

The `coder.approximation` function now offers a 'Flat' interpolation method for generating lookup table MATLAB function replacements. This fully specified lookup table achieves high speeds by discarding the prelookup step and reducing the use of multipliers in the data path. This interpolation method is available from the command-line workflow, and in the **Function Replacements** tab of the Fixed-Point Conversion step.

Check bug reports for issues and fixes

Software is inherently complex and is not free of errors. The output of a code generator might contain bugs, some of which are not detected by a compiler. MathWorks reports critical known bugs brought to its attention on its Bug Report system at www.mathworks.com/support/bugreports/. Use the Saved Searches and Watched Bugs tool with the search phrase "Incorrect Code Generation" to obtain a report of known bugs that produce code that might compile and execute, but still produce wrong answers.

The bug reports are an integral part of the documentation for each release. Examine periodically all bug reports for a release, as such reports may identify inconsistencies between the actual behavior of a release you are using and the behavior described in this documentation.

In addition to reviewing bug reports, you should implement a verification and validation strategy to identify potential bugs in your design, code, and tools.

R2014b

Version: 2.7

New Features

Bug Fixes

Compatibility Considerations

Code generation for additional Image Processing Toolbox and Computer Vision System Toolbox functions

Image Processing Toolbox

<code>bwdist</code>	<code>imadjust</code>	<code>intlut</code>	<code>ordfilt2</code>
<code>bwtraceboundary</code>	<code>imclearborder</code>	<code>iptcheckmap</code>	<code>rgb2ycbcr</code>
<code>fitgeotrans</code>	<code>imlincomb</code>	<code>medfilt2</code>	<code>stretchlim</code>
<code>histeq</code>	<code>imquantize</code>	<code>multithresh</code>	<code>ycbcr2rgb</code>

For the list of Image Processing Toolbox™ functions supported for code generation, see Image Processing Toolbox.

Computer Vision System Toolbox

- `bbboxOverlapRatio`
- `selectStrongestBbox`
- `vision.DeployableVideoPlayer` on Linux

For the list of Computer Vision System Toolbox™ functions supported for code generation, see Computer Vision System Toolbox.

Code generation for additional Communications System Toolbox and DSP System Toolbox functions and System objects

Communications System Toolbox

- `iqcoef2imbal`
- `iqimbal2coef`
- `comm.IQImbalanceCompensator`

For the list of Communications System Toolbox™ functions supported for code generation, see Communications System Toolbox.

DSP System Toolbox

- `dsp.CICCompensationDecimator`
- `dsp.CICCompensationInterpolator`

- `dsp.FarrowRateConverter`
- `dsp.FilterCascade`

You cannot generate code directly from this System object™. You can use the `generateFilteringCode` method to generate a MATLAB function. You can generate C/C++ code from this MATLAB function.

- `dsp.FIRDecimator` for transposed structure
- `dsp.FIRHalfbandDecimator`
- `dsp.FIRHalfbandInterpolator`
- `dsp.PeakToPeak`
- `dsp.PeakToRMS`
- `dsp.PhaseExtractor`
- `dsp.SampleRateConverter`
- `dsp.StateLevels`

For the list of DSP System Toolbox functions and System objects supported for code generation, see DSP System Toolbox.

Code generation for enumerated types based on built-in MATLAB integer types

In previous releases, enumeration types were based on `int32`. In R2014b, you can base an enumerated type on one of the following built-in MATLAB integer data types:

- `int8`
- `uint8`
- `int16`
- `uint16`
- `int32`

You can use the base type to control the size of the enumerated type in the generated code. You can choose a base type to:

- Represent an enumerated type as a fixed-size integer that is portable to different targets.
- Reduce memory usage.

- Interface to legacy code.
- Match company standards.

The base type determines the representation of the enumerated types in the generated C and C++ code. For the base type `int32`, the code generation software generates a C enumeration type. For example:

```
enum LEDcolor
{
    GREEN = 1,
    RED
};
```

```
typedef enum LEDcolor LEDcolor;
```

For the other base types, the code generation software generates a `typedef` statement for the enumerated type and `#define` statements for the enumerated values. For example:

```
typedef short LEDColor;
#define GREEN ((LEDColor)1)
#define RED((LEDColor)2)
```

See Enumerated Types Supported for Code Generation.

Code generation for function handles in structures

You can now generate code for structures containing fields that are function handles. See Function Handle Definition for Code Generation.

Change in enumerated type value names in generated code

In previous releases, by default, the enumerated type value name in the generated code included a class name prefix, for example, `LEDcolor_GREEN`. In R2014b, by default, the generated enumerated type value name does not include the class name prefix. To generate enumerated type value names that include the class name prefix, in the enumerated type definition, modify the `addClassNameToEnumNames` method to return `true` instead of `false`:

```
classdef(Enumeration) LEDcolor < int32
    enumeration
        GREEN(1),
```

```
        RED(2)
    end

    methods(Static)
        function y = addClassNameToEnumNames()
            y = true;
        end
    end
end
```

See Control Names of Enumerated Type Values in Generated Code.

Compatibility Considerations

The name of an enumerated type value in code generated using previous releases differs from the name generated using R2014b. If you have code that uses one of these names, modify the code to use the R2014b name or generate the name so that it matches the name from a previous release. If you want an enumerated type value name generated in R2014b to match the name from a previous release, in the enumerated types definition, modify the `addClassNameToEnumNames` method to return `true` instead of `false`.

Code generation for ode23 and ode45 ordinary differential equation solvers

- `ode23`
- `ode45`
- `odeget`
- `odeset`

See Numerical Integration and Differentiation in MATLAB.

Code generation for additional MATLAB functions

Data and File Management in MATLAB

- `feof`
- `frewind`

See Data and File Management in MATLAB.

Linear Algebra in MATLAB

- `ishermitian`
- `issymmetric`

See Linear Algebra in MATLAB.

String Functions in MATLAB

`str2double`

See String Functions in MATLAB.

Code generation for additional MATLAB function options

- `'vector'` and `'matrix'` eigenvalue options for `eig`
- All output class options for `sum` and `prod`
- All output class options for `mean` except `'native'` for integer types
- Multidimensional array support for `flipud`, `fliplr`, and `rot90`
- Dimension to operate along option for `circshift`

See Functions and Objects Supported for C and C++ Code Generation — Alphabetical List.

Collapsed list for inherited properties in code generation report

The code generation report displays inherited object properties on the **Variables** tab. In R2014b, the list of inherited properties is collapsed by default.

Change in length of exported identifiers

In previous releases, the code generation software limited exported identifiers, such as entry-point function names or `emxArray` utility function names, to a maximum length defined by the maximum identifier length setting. If the truncation of identifiers resulted in different functions having identical names, the code generation failed. In R2014b, for exported identifiers, the code generation software uses the entire generated identifier, even if its length exceeds the maximum identifier length setting. If, however, the target C compiler has a maximum identifier length that is less than the length of the generated identifier, the target C compiler truncates the identifier.

Compatibility Considerations

Unless the target C compiler has a maximum identifier length that equals the length of a truncated exported identifier from a previous release, the identifier from the previous release does not match the identifier that R2014b generates. For example, suppose the maximum identifier length setting has the default value 31 and the target C compiler has a maximum identifier length of 255. Suppose that in R2014b, the code generation software generates the function `emxCreateWrapperND_StructType_123` for an unbounded variable-size structure array named `StructType_123`. In previous releases, the same function had the truncated name `emxCreateWrapperND_StructType_1`. In this example, code that previously called `emxCreateWrapperND_StructType_1` must now call `emxCreateWrapperND_StructType_123`.

Intel Performance Primitives (IPP) platform-specific code replacement libraries for cross-platform code generation

In R2014b, you can select an Intel® Performance Primitive (IPP) code replacement library for a specific platform. You can generate code for a platform that is different from the host platform that you use for code generation. The new code replacement libraries are:

- Intel IPP for x86-64 (Windows)
- Intel IPP/SSE with GNU99 extensions for x86-64 (Windows)
- Intel IPP for x86/Pentium (Windows)
- Intel IPP/SSE with GNU99 extensions for x86/Pentium (Windows)
- Intel IPP for x86-64 (Linux)
- Intel IPP/SSE with GNU99 extensions for x86-64 (Linux)

In a MATLAB Coder project that you create in R2014b, you can no longer select these libraries:

- Intel IPP
- Intel IPP/SSE with GNU99 extensions

If, however, you open a project from a previous release that specifies Intel IPP or Intel IPP/SSE with GNU99 extensions, the library selection is preserved and that library appears in the selection list.

See [Choose a Code Replacement Library](#).

Fixed-point conversion enhancements

Conversion from project to MATLAB scripts for command-line fixed-point conversion and code generation

For a MATLAB Coder project that includes automated fixed-point conversion, you can use the `-tocode` option of the `coder` command to create a pair of scripts for fixed-point conversion and fixed-point code generation. You can use the scripts to repeat the project workflow in a command-line workflow. Before you convert the project to the scripts, you must complete the **Test Numerics** step of the fixed-point conversion process.

For example:

```
coder -tocode my_fixpt_proj -script myscript.m
```

This command generates two scripts:

- `myscript.m` contains the MATLAB commands to create a code configuration object and generate fixed-point C code from fixed-point MATLAB code. The code configuration object has the same settings as the project.
- `myscriptsuffix.m` contains the MATLAB commands to create a floating-point to fixed-point configuration object and generate fixed-point MATLAB code from the entry-point function. The floating-point to fixed-point configuration object has the same fixed-point conversion settings as the project. `suffix` is the generated fixed-point file name suffix specified by the project file.

If you do not specify the `-script` option, `coder` writes the scripts to the Command Window.

See [Convert Fixed-Point Conversion Project to MATLAB Scripts](#).

Lookup table approximations for unsupported functions

The Fixed-Point Conversion tool now provides an option to generate lookup table approximations for continuous and stateless functions in your original MATLAB code. This capability is useful for handling functions that are not supported for fixed point. To replace a function with a generated lookup table, specify the function that you want to replace on the **Function Replacements** tab.

In the command-line workflow, use `coder.approximation` and the `coder.FixptConfig` configuration object `addApproximation` method.

See Replacing Functions Using Lookup Table Approximations.

Enhanced plotting capabilities

The Fixed-Point Conversion tool now provides additional plotting capabilities. You can use these plotting capabilities during the testing phase to compare the generated fixed-point versions of your algorithms to the original floating-point versions.

Default plots

The default comparison plots now plot vector and matrix data in addition to scalar data.

Custom plotting functions

You can now specify your own custom plotting function. The Fixed-Point Conversion tool calls the function and, for each variable, passes in the name of the variable and the function that uses it, and the results of the floating-point and fixed-point simulations. Your function should accept three inputs:

- A structure that holds the name of the variable and the function that uses it.
- A cell array to hold the logged floating-point values for the variable.
- A cell array to hold the logged values for the variable after fixed-point conversion.

For example, function `customComparisonPlot(varInfo, floatVarVals, fixedPtVarVals)`.

To use a custom plot function, in the Fixed-Point Conversion tool, select **Advanced**, and then set **Custom plot function** to the name of your plot function.

In the command-line workflow, set the `coder.FixptConfig` configuration object `PlotFunction` property to the name of your plot function.

See Custom Plot Functions.

Integration with Simulation Data Inspector

You can now use the Simulation Data Inspector for comparison plots. The Simulation Data Inspector provides the capability to inspect and compare logged simulation data for multiple runs. You can import and export logged data, customize the organization of your logged data, and create reports.

In the Fixed-Point Conversion tool, select **Advanced** and then set **Plot with Simulation Data Inspector** to **Yes**. See Enable Plotting Using the Simulation Data Inspector.

When generating fixed-point code in the command-line workflow, set the `coder.FixptConfig` configuration object `PlotWithSimulationDataInspector` property to `true`.

Custom plotting functions take precedence over the Simulation Data Inspector. See [Enable Plotting Using the Simulation Data Inspector](#).

Automated fixed-point conversion for commonly used System objects in MATLAB including Biquad Filter, FIR Filter, and Rate converter

You can now convert the following DSP System Toolbox System objects to fixed point using the Fixed-Point Conversion tool.

- `dsp.BiquadFilter`
- `dsp.FIRFilter`, Direct Form only
- `dsp.FIRRateConverter`
- `dsp.LowerTriangularSolver`
- `dsp.UpperTriangularSolver`
- `dsp.ArrayVectorAdder`

You can propose and apply data types for these System objects based on simulation range data. During the conversion process, you can view simulation minimum and maximum values and proposed data types for these System objects. You can also view Whole Number information and histogram data. You cannot propose data types for these System objects based on static range data.

Additional fixed-point conversion command-line options

You can now use the `codegen` function with the `-float2fixed` option to convert floating point to fixed point based on derived ranges as well as simulation ranges. For more information, see `coder.FixptConfig`.

Type proposal report

After running the Test Numerics step to verify the data type proposals, the tool provides a link to a type proposal report that shows the instrumentation results for the fixed-point simulation. This report includes:

- The fixed-point code generated for each function in your original MATLAB algorithm
- Fixed-point instrumentation results for each variable in these functions:
 - Simulation minimum value

- Simulation maximum value
- Proposed data type

Generated fixed-point code enhancements

The generated fixed-point code now:

- Avoids loss of range or precision in unsigned subtraction operations. When the result of the subtraction is negative, the conversion process promotes the left operand to a signed type.
- Handles multiplication of fixed-point variables by non fixed-point variables. In previous releases, the variable that did not have a fixed-point type had to be a constant.
- Avoids overflows when adding and subtracting non fixed-point variables and fixed-point variables.
- Avoids loss of range when concatenating arrays of fixed-point numbers using `vertcat` and `horzcat`.

If you concatenate matrices, the conversion tool uses the largest numerictype among the expressions of a row and casts the leftmost element to that type. This type is then used for the concatenated matrix to avoid loss of range.

- If the function that you are converting has a scalar input, and the `mpower` exponent input is not constant, the conversion tool sets `fimath ProductMode` to `SpecifyPrecision` in the generated code. With this setting, the output data type can be determined at compile time.
- Supports the following functions:
 - `true(m,n)`
 - `false(m,n)`
 - `sub2ind`
 - `mode`
 - `rem`
- Uses enhanced division replacement.

For more information, see [Generated Fixed-Point Code](#).

The tool now numbers function specializations sequentially in the **Function** list. In the generated fixed-point code, the number of each fixed-point specialization matches the

number in the **Function** list which makes it easy to trace between the floating-point and fixed-point versions of your code. For example, the generated fixed-point function for the specialization of function `foo` named `foo > 1` is named `foo_s1`. For more information, see [Specializations](#).

Highlighting of potential data type issues in generated HTML report

You now have the option to highlight potential data type issues in the generated HTML report. The report highlights MATLAB code that requires single-precision, double-precision, or expensive fixed-point operations. The expensive fixed-point operations check identifies optimization opportunities for fixed-point code. It highlights expressions in the MATLAB code that require cumbersome multiplication or division, or expensive rounding. The following example report highlights MATLAB code that requires expensive fixed-point operations.

The screenshot shows the 'Code Generation Report' window with the 'MATLAB code' tab selected. The report displays the MATLAB code for the function `mul2_fixpt`. The code is highlighted in yellow, indicating it requires expensive fixed-point operations. A tooltip is visible over the expression `in1*in2` on line 10, showing the following information:

Information for the selected expression:	
Size	1 x 1
Class	embedded_fi
Complex	No
Signedness	Unsigned
VVL	128
FL	6

The report also includes a summary section at the bottom, showing the following information:

- Summary | All Messages (0) | Variables
- C source code generated on: 30-Apr-2014 10:34:13
- Coding target: C MEX Function
- Number of errors: 0
- Number of warnings: 0
- Number of notices: 0
- Tell Us What You Think
- We value your feedback. Please take a few minutes to answer this short questionnaire regarding the Code Generation Report.
- [>>Provide Feedback](#)

The checks for the data type issues are disabled by default.

To enable the checks in a project:

- 1 In the Fixed-Point Conversion Tool, click **Advanced** to view the advanced settings.
- 2 Set **Highlight potential data type issues** to **Yes**.

To enable the checks at the command-line interface:

- 1 Create a floating-point to fixed-point conversion configuration object:

```
fxptcfg = coder.config('fixpt');
```
- 2 Set the `HighlightPotentialDataTypeIssues` property to `true`:

```
fxptcfg.HighlightPotentialDataTypeIssues = true;
```

See [Data Type Issues in Generated Code](#).

Check bug reports for issues and fixes

Software is inherently complex and is not free of errors. The output of a code generator might contain bugs, some of which are not detected by a compiler. MathWorks reports critical known bugs brought to its attention on its Bug Report system at www.mathworks.com/support/bugreports/. Use the Saved Searches and Watched Bugs tool with the search phrase "Incorrect Code Generation" to obtain a report of known bugs that produce code that might compile and execute, but still produce wrong answers.

The bug reports are an integral part of the documentation for each release. Examine periodically all bug reports for a release, as such reports may identify inconsistencies between the actual behavior of a release you are using and the behavior described in this documentation.

In addition to reviewing bug reports, you should implement a verification and validation strategy to identify potential bugs in your design, code, and tools.

R2014a

Version: 2.6

New Features

Bug Fixes

Compatibility Considerations

Code generation for additional Image Processing Toolbox and Computer Vision System Toolbox functions

Image Processing Toolbox

affine2d	im2uint16	imhist
bwpack	im2uint8	imopen
bwselect	imbothat	imref2d
bwunpack	imclose	imref3d
edge	imdilate	imtophat
getrangefromclass	imerode	imwarp
im2double	imextendedmax	mean2
im2int16	imextendedmin	projective2d
im2single	imfilter	strel

See Image Processing Toolbox.

Computer Vision System Toolbox

- detectHarrisFeatures
- detectMinEigenFeatures
- estimateGeometricTransform

See Computer Vision System Toolbox.

Code generation for additional Signal Processing Toolbox, Communications System Toolbox, and DSP System Toolbox functions and System objects

Signal Processing Toolbox

- findpeaks
- db2pow
- pow2db

See Signal Processing Toolbox.

Communications System Toolbox

- comm.OFDMModulator
- comm.OFDMDemodulator

See Communications System Toolbox.

DSP System Toolbox

ca2tf	firhalfband	ifir	iirnotch
cl2tf	firlpnorm	iircomb	iirpeak
firceqrip	firminphase	iirgrpdelay	tf2ca
fireqint	firnyquist	iirlpnorm	tf2cl
firgr	firpr2chfb	iirlpnormc	dsp.DCBlocker

See DSP System Toolbox.

Code generation for `fminsearch` optimization function and additional interpolation functions in MATLAB**Optimization Functions in MATLAB**

- `fminsearch`
- `optimget`
- `optimset`

See Optimization Functions in MATLAB.

Interpolation and Computational Geometry in MATLAB

- `interp3`
- `mkpp`
- `pchip`
- `ppval`
- `spline`
- `unmkpp`
- `'spline'` and `'v5cubic'` interpolation methods for `interp1`
- `'spline'` and `'cubic'` interpolation methods for `interp2`

See Interpolation and Computational Geometry in MATLAB.

Conversion from project to MATLAB script for command-line code generation

Using the `-tocode` option of the `coder` command, you can convert a MATLAB Coder project to the equivalent MATLAB code in a MATLAB script. The script reproduces the project in a configuration object and runs the `codegen` command. With this capability, you can:

- Move from a project workflow to a command-line workflow.
- Save the project as a text file that you can share.

The following command converts the project named `myproject` to the script named `myscript.m`:

```
coder -tocode myproject -script myscript.m
```

If you omit the `-script` option, the `coder` command writes the script to the Command Window.

See Convert MATLAB Coder Project to MATLAB Script.

Code generation for fread function

In R2014a, you can generate code for the `fread` function.

See Data and File Management in MATLAB.

Automatic C/C++ compiler setup

Previously, you used `mex -setup` to set up a compiler for C/C++ code generation. In R2014a, the code generation software locates and uses a supported installed compiler. You can use `mex -setup` to change the default compiler. See Changing Default Compiler.

Compile-time declaration of constant global variables

You can specify that a global variable is a compile-time constant. Use a constant global variable to:

- Generate optimized code.
- Define the value of a constant without changing source code.

To declare a constant global variable in a MATLAB Coder project:

- 1 On the **Overview** tab, click **Add global**. Enter a name for the global variable.
- 2 Click the field to the right of the global variable name.
- 3 Select **Define Constant Value**.
- 4 Enter the value in the field to the right of the global variable name.

To declare a constant global variable at the command-line interface, use the `-globals` option along with the `coder.Constant` function.

In the following code, `gConstant` is a global variable with constant value 42.

```
cfg = coder.config('mex');
globals = {'gConstant', coder.Constant(42)};
codegen -config cfg myfunction -globals globals
```

See Define Constant Global Data.

Enhanced code generation support for switch statements

Code generation now supports:

- Switch expressions and case expressions that are noninteger numbers, nonconstant strings, variable-size strings, or empty matrices
- Case expressions with mixed types and sizes

If all case expressions are scalar integer values, the code generation software generates a C `switch` statement. If at run time, the switch value is not an integer, the code generation software generates an error.

When the case expressions contain noninteger or nonscalar values, the code generation software generates C `if` statements in place of a C `switch` statement.

Code generation support for value classes with set.prop methods

In R2014a, you can generate code for value classes that have `set.prop` methods.

Code generation error for property that uses `AbortSet` attribute

Previously, when the current and new property values were equal, the generated code set the property value and called the set property method regardless of the value of the `AbortSet` attribute. When the `AbortSet` attribute was true, the generated code behavior differed from the MATLAB behavior.

In R2014a, if your code has properties that use the `AbortSet` attribute, the code generation software generates an error.

Compatibility Considerations

Previously, for code using the `AbortSet` attribute, code generation succeeded, but the behavior of the generated code was incorrect. Now, for the same code, code generation ends with an error. Remove the `AbortSet` attribute from your code and rewrite the code to explicitly compare the current and new property value.

Independent configuration selections for standard math and code replacement libraries

In R2014a, you can independently select and configure standard math and code replacement libraries for C and C++ code generation.

- The language selection (C or C++) determines the available standard math libraries.
 - In a project, the **Language** setting on the **All Settings** tab determines options that are available for a new **Standard math library** setting on the **Hardware** tab.
 - In a code configuration object, the `TargetLang` parameter determines options that are available for a new `TargetLangStandard` parameter.
- Depending on the your language selection, the following options are available for the **Standard math library** setting in a project and for the `TargetLangStandard` parameter in a configuration object.

Language	Standard Math Libraries (<code>TargetLangStandard</code>)
C	C89/C90 (ANSI) – default C99 (ISO)
C++	C89/C90 (ANSI) – default

Language	Standard Math Libraries (TargetLangStandard)
	C99 (ISO)
	C++03 (ISO)

- The language selection and the standard math library selection determine the available code replacement libraries.
 - In a project, the **Code replacement library** setting on the **Hardware** tab lists available code replacement libraries. The MATLAB Coder software filters the list based on compatibility with the **Language** and **Standard math library** settings and the product licensing. For example, Embedded Coder offers more libraries and the ability to create and use custom code replacement libraries.
 - In a configuration object, the valid values for the `CodeReplacementLibrary` parameter depend on the values of the `TargetLang` and `TargetLangStandard` parameters and the product licensing.

Compatibility Considerations

In R2014a, code replacement libraries provided by MathWorks® no longer include standard math libraries.

- When you open a project that was saved with an earlier version:
 - The **Code replacement library** setting remains the same unless previously set to C89/C90 (ANSI), C99 (ISO), C++ (ISO), Intel IPP (ANSI), or Intel IPP (ISO). In these cases, MATLAB Coder software sets **Code replacement library** to None or Intel IPP.
 - MATLAB Coder software sets the new **Standard math library** setting to a value based on the previous **Code replacement library** setting.

If Code replacement library was set to:	Standard Math Library is set to:
C89/C90 (ANSI), C99 (ISO), or C++ (ISO)	C89/C90 (ANSI), C99 (ISO), C++03 (ISO), respectively
GNU99 (GNU), Intel IPP (ISO), Intel IPP (GNU), ADI TigerSHARC (Embedded Coder only), or MULTI BF53x (Embedded Coder only)	C99 (ISO)

If Code replacement library was set to:	Standard Math Library is set to:
A custom library (Embedded Coder), and the corresponding registration file has been loaded in memory	A value based on the <code>BaseTf1</code> property setting
Any other value	The default standard math library, C89/C90 (ANSI)

- When you load a configuration object from a MAT file that was saved in an earlier version:
 - The `CodeReplacementLibrary` setting remains the same unless previously set to `Intel IPP (ANSI)` or `Intel IPP (ISO)`. In these cases, MATLAB Coder software sets `CodeReplacementLibrary` to `Intel IPP`.
 - MATLAB Coder software sets the new `TargetLangStandard` setting to a value based on the previous `CodeReplacementLibrary` setting.

If <code>CodeReplacementLibrary</code> was set to:	<code>TargetLangStandard</code> is set to:
<code>Intel IPP (ANSI)</code>	C89/C90 ANSI
<code>Intel IPP (ISO)</code>	C99 (ISO)
Any other value	The default standard math library, C89/C90 (ANSI)

- The generated code can differ from earlier versions if you use the default standard math library, C89/C90 (ANSI), with one of these code replacement libraries:
 - GNU99 (GNU)
 - Intel IPP (GNU)
 - ADI TigerSHARC (Embedded Coder only)
 - MULTI BF53x (Embedded Coder only)

To generate the same code as in earlier versions, change `TargetLangStandard` to C99 (ISO).

- After you open a project, if you select a code replacement library provided by MathWorks, the code generation software can produce different code than in previous versions, depending on the **Standard math library** setting. Verify generated code.
- If a script that you used in a previous version sets the configuration object `CodeReplacementLibrary` parameter, modify the script to use both the `CodeReplacementLibrary` and the `TargetLangStandard` parameters.

Restrictions on bit length for integer types in a `coder.HardwareImplementation` object

In R2014a, the code generation software imposes restrictions on the bit length of integer types in a `coder.HardwareImplementation` object. For example, the value of `ProdBitPerChar` must be between 8 and 32 and less than or equal to `ProdBitPerShort`. If you set the bit length to an invalid value, the code generation software reports an error.

See `coder.HardwareImplementation`.

Change in location of interface files in code generation report

The code generation software creates and uses interface files prefixed with `_coder`. For MEX code generation, these files appear in the code generation report. Previously, these files appeared in the **Target Source Files** pane of the **C code** tab of the code generation report. They now appear in the **Interface Source Files** pane of the **C code** tab. The report is now consistent with the folder structure for generated files. Since R2013b, the interface files are in a subfolder named **interface**.

Compiler warnings in code generation report

For MEX code generation, the code generation report now includes C and C++ compiler warning messages. If the code generation software detects compiler warnings, it generates a warning message in the **All Messages** tab. Compiler error and warning messages are highlighted in red on the **Target Build Log** tab.

See View Errors and Warnings in a Report.

Removal of date and time comment from generated code files

Previously, generated code files contained a comment with the string `C source code generated on` followed by a date and time stamp. This comment no longer appears in the generated code files. If you have an Embedded Coder license, you can include the date and time stamp in custom file banners by using code generation template (CGT) files.

Removal of two's complement guard from `rtwtypes.h`

`rtwtypes.h` no longer contains the following code:

```
#if ((SCHAR_MIN + 1) != -SCHAR_MAX)
#error "This code must be compiled using a 2's complement representation for signed integer values"
#endif
```

You must compile the code that is generated by the MATLAB Coder software on a target that uses a two's complement representation for signed integer values. The generated code does not verify that the target uses a two's complement representation for signed integer values.

Removal of TRUE and FALSE from `rtwtypes.h`

When the target language is C, `rtwtypes.h` defines `true` and `false`. It no longer defines `TRUE` and `FALSE`.

Compatibility Considerations

If you integrate code generated in R2014a with custom code that references `TRUE` or `FALSE`, modify your custom code in one of these ways:

- Define `TRUE` or `FALSE` in your custom code.
- Change `TRUE` and `FALSE` to `true` and `false`, respectively.
- Change `TRUE` and `FALSE` to `1U` and `0U`, respectively.

Change to default names for structure types generated from entry-point function inputs and outputs

In previous releases, the code generation software used the same default naming convention for structure types generated from local variables and from entry-point function inputs and outputs. The software used `struct_T` for the first generated structure type name, `a_struct_T` for the next name, `b_struct_T` for the next name, and so on.

In R2014a, the code generation software uses a different default naming convention for structure types generated from entry-point function inputs and outputs. The software uses `struct0_T` for the first generated structure type name, `struct1_T` for the next name, `struct2_T` for the next name, and so on. With this new naming convention, you can more easily predict the structure type name in the generated code.

Compatibility Considerations

If you have C or C++ code that uses default structure type names generated from an entry-point function in a previous release, and you generate the entry-point function in R2014a, you must rewrite the code to use the new structure type names. However, subsequent changes to your MATLAB code, such as adding a variable with a structure type, can change the default structure type names in the generated code. To avoid compatibility issues caused by changes to default names for structure types in generated code, specify structure type names using `coder.cstructname`.

Toolbox functions supported for code generation

See [Functions and Objects Supported for C and C++ Code Generation — Alphabetical List](#) and [Functions and Objects Supported for C and C++ Code Generation — Categorical List](#).

Communications System Toolbox

- `comm.OFDMModulator`
- `comm.OFDMDemodulator`

Computer Vision System Toolbox

- `detectHarrisFeatures`
- `detectMinEigenFeatures`
- `estimateGeometricTransform`

Data and File Management in MATLAB

`fread`

DSP System Toolbox

<code>ca2tf</code>	<code>firhalfband</code>	<code>ifir</code>	<code>iirnotch</code>
<code>cl2tf</code>	<code>firlpnorm</code>	<code>iircomb</code>	<code>iirpeak</code>
<code>firceqrip</code>	<code>firminphase</code>	<code>iirgrpdelay</code>	<code>tf2ca</code>
<code>fireqint</code>	<code>firnyquist</code>	<code>iirlpnorm</code>	<code>tf2cl</code>
<code>firgr</code>	<code>firpr2chfb</code>	<code>iirlpnormc</code>	<code>dsp.DCBlocker</code>

Image Processing Toolbox

affine2d	im2uint16	imhist
bwpack	im2uint8	imopen
bwselect	imbothat	imref2d
bwunpack	imclose	imref3d
edge	imdilate	imtophat
getrangefromclass	imerode	imwarp
im2double	imextendedmax	mean2
im2int16	imextendedmin	projective2d
im2single	imfilter	strel

Interpolation and Computational Geometry in MATLAB

- interp2
- interp3
- mkpp
- pchip
- ppval
- polyarea
- rectint
- spline
- unmkpp

Matrices and Arrays in MATLAB

flip

Optimization Functions in MATLAB

- fminsearch
- optimget
- optimset

Polynomials in MATLAB

- polyder

- polyint
- polyvalm

Signal Processing Toolbox

- findpeaks
- db2pow
- pow2db

Fixed-point conversion enhancements

These capabilities require a Fixed-Point Designer license.

Overflow detection with scaled double data types in MATLAB Coder projects

The MATLAB Coder Fixed-Point Conversion tool now provides the capability to detect overflows. At the numerical testing stage in the conversion process, the tool simulates the fixed-point code using scaled doubles. It then reports which expressions in the generated code produce values that would overflow the fixed-point data type. For more information, see [Detect Overflows Using the Fixed-Point Conversion Tool](#) and [Detecting Overflows](#).

You can also detect overflows when using the `codegen` function. For more information, see `coder.FixptConfig` and [Detect Overflows at the Command Line](#).

Support for MATLAB classes

You can now use the MATLAB Coder Fixed-Point Conversion tool to convert floating-point MATLAB code that uses MATLAB classes. For more information, see [Fixed-Point Code for MATLAB Classes](#).

Generated fixed-point code enhancements

The generated fixed-point code now:

- Uses subscripted assignment (the colon(:) operator). This enhancement produces concise code that is more readable.
- Has better code for constant expressions. In previous releases, multiple parts of an expression were quantized to fixed point. The final value of the expression was less accurate and the code was less readable. Now, constant expressions are quantized only once at the end of the evaluation. This new behavior results in more accurate results and more readable code.

For more informations, see [Generated Fixed-Point Code](#).

Fixed-point report for float-to-fixed conversion

In R2014a, when you convert floating-point MATLAB code to fixed-point C or C++ code, the code generation software generates a fixed-point report in HTML format. For the variables in your MATLAB code, the report provides the proposed fixed-point types and the simulation or derived ranges used to propose those types. For a function `my_fcn` and code generation output folder `out_folder`, the location of the report is `out_folder/my_fcn/fixpt/my_fcn_fixpt_Report.html`. If you do not specify `out_folder` in the project settings or as an option of the `codegen` command, the default output folder is `codegen`.

Check bug reports for issues and fixes

Software is inherently complex and is not free of errors. The output of a code generator might contain bugs, some of which are not detected by a compiler. MathWorks reports critical known bugs brought to its attention on its Bug Report system at www.mathworks.com/support/bugreports/. Use the Saved Searches and Watched Bugs tool with the search phrase "Incorrect Code Generation" to obtain a report of known bugs that produce code that might compile and execute, but still produce wrong answers.

The bug reports are an integral part of the documentation for each release. Examine periodically all bug reports for a release, as such reports may identify inconsistencies between the actual behavior of a release you are using and the behavior described in this documentation.

In addition to reviewing bug reports, you should implement a verification and validation strategy to identify potential bugs in your design, code, and tools.

R2013b

Version: 2.5

New Features

Bug Fixes

Compatibility Considerations

Code generation for Statistics Toolbox and Phased Array System Toolbox

Code generation now supports more than 100 Statistics Toolbox™ functions. For implementation details, see Statistics Toolbox Functions.

Code generation now supports most of the Phased Array System Toolbox™ functions and System objects. For implementation details, see Phased Array System Toolbox Functions and Phased Array System Toolbox System Objects.

Toolbox functions supported for code generation

For implementation details, see Functions Supported for C/C++ Code Generation — Alphabetical List.

Data Type Functions

- narginchk

Programming Utilities

- mfilename

Specialized Math

- psi

Computer Vision System Toolbox Classes and Functions

- extractFeatures
- detectSURFFeatures
- disparity
- detectMSERFeatures
- detectFASTFeatures
- vision.CascadeObjectDetector
- vision.PointTracker
- vision.PeopleDetector
- cornerPoints
- MSERRegions
- SURFPoints

parfor function for standalone code generation, enabling execution on multiple cores

You can use MATLAB Coder software to generate standalone C/C++ code from MATLAB code that contains `parfor`-loops. The code generation software uses the Open Multi-Processing (OpenMP) application interface to generate C/C++ code that runs in parallel on multiple cores on the target hardware.

For more information, see `parfor` and Accelerate MATLAB Algorithms That Use Parallel for-loops (`parfor`).

Persistent variables in parfor-loops

You can now generate code from parallel algorithms that use persistent variables.

For more information, see `parfor`.

Random number generator functions in parfor-loops

You can now generate code from parallel algorithms that use the random number generators `rand`, `randn`, `randi`, `randperm`, and `rng`.

For more information, see `parfor`.

External code integration using `coder.ExternalDependency`

You can define the interface to external code using the new `coder.ExternalDependency` class. Methods of this class update the compile and build information required to integrate the external code with MATLAB code. In your MATLAB code, you can call the external code without needing to update build information. See `coder.ExternalDependency`.

Updating build information using `coder.updateBuildInfo`

You can use the new function `coder.updateBuildInfo` to update build information. For example:

```
coder.updateBuildInfo('addLinkFlags', '/STACK:1000000');
```

adds a stack size option to the linker command line. See `coder.updateBuildInfo`.

Generation of simplified code using built-in C types

By default, MATLAB Coder now uses built-in C types in the generated code. You have the option to use predefined types from `rtwtypes.h`. To control the data type in the generated code:

- In a project, on the Project Settings dialog box **Code Appearance** tab, use the **Data Type Replacement** setting.
- At the command line, use the configuration object parameter `DataTypeReplacement`.

The built-in C type that the code generation software uses depends on the target hardware.

For more information, see [Specify Data Type Used in Generated Code](#).

Compatibility Considerations

If you use the default configuration or project settings, the generated code has built-in C types such as `double` or `char`. Code generated prior to R2013b has predefined types from `rtwtypes.h`, such as `real_T` or `int32_T`.

Conversion of MATLAB expressions into C constants using `coder.const`

You can use the new function `coder.const` to convert expressions and function calls to constants at compile time. See `coder.const` and [Constant Folding](#).

Highlighting of constant function arguments in the compilation report

The compilation report now highlights constant function arguments and displays them in a distinct color. You can display the constant argument data type and value by placing the cursor over the highlighted argument. You can export the constant argument value to the base workspace where you can display detailed information about the argument.

For more information, see [Viewing Variables in Your MATLAB Code](#).

Code Generation Support for `int64`, `uint64` data types

You can now use `int64` and `uint64` data types for code generation.

C99 long long integer data type for code generation

If your target hardware and compiler support the C99 long long integer data type, you can use this data type for code generation. Using long long results in more efficient generated code that contains fewer cumbersome operations and multiword helper functions. To specify the long long data type for code generation:

- In a project, on the Project Settings dialog box **Hardware** tab, use the following production and test hardware settings:
 - **Enable long long:** Specify that your C compiler supports the long long data type. Set to **Yes** to enable **Sizes: long long**.
 - **Sizes: long long:** Describe length in bits of the C long long data type supported by the hardware.
- At the command line, use the following hardware implementation configuration object parameters:
 - **ProdLongLongMode:** Specify that your C compiler supports the long long data type. Set to **true** to enable **ProdBitPerLongLong**.
 - **ProdBitPerLongLong:** Describes the length in bits of the C long long data type supported by the production hardware.
 - **TargetLongLongMode:** Specifies whether your C compiler supports the long long data type. Set to **true** to enable **TargetBitPerLongLong**.
 - **TargetBitPerLongLong:** Describes the length in bits of the C long long data type supported by the test hardware.

For more information, see the class reference information for `coder.HardwareImplementation`.

Change to passing structures by reference

In R2013b, the option to pass structures by reference to entry-point functions in the generated code applies to function outputs and function inputs. In R2013a, this option applied only to inputs to entry-point functions.

Compatibility Considerations

If you select the pass structures by reference option, and a MATLAB entry-point function has a single output that is a structure, the generated C function signature in R2013b

differs from the signature in R2013a. In R2013a, the generated C function returns the output structure. In R2013b, the output structure is a pass by reference function parameter.

If you have code that calls one of these functions generated in R2013a, and then you generate the function in R2013b, you must change the call to the function. For example, suppose `S` is a structure in the following MATLAB function `foo`.

```
function S = foo()
```

If you generate this function in R2013a, you call the function this way:

```
S = foo();
```

If you generate this function in R2013b, you call the function this way:

```
foo(&S);
```

`coder.runTest` new syntax

Use the syntax `coder.runTest(test_fcn, MEX_name_ext)` to run `test_fcn` replacing calls to entry-point functions with calls to the corresponding MEX functions in the MEX file named `MEX_name_ext`. `MEX_name_ext` includes the platform-specific file extension. See `coder.runTest`.

`coder.target` syntax change

The new syntax for `coder.target` is:

```
tf = coder.target('target')
```

For example, `coder.target('MATLAB')` returns true when code is running in MATLAB. See `coder.target`.

You can use the old syntax, but consider changing to the new syntax. The old syntax will be removed in a future release.

Changes for complex values with imaginary part equal to zero

In R2013b, complex values with an imaginary part equal to zero become real when:

- They are returned by a MEX function.

- They are passed to an extrinsic function.

See Expressions With Complex Operands Yield Complex Results.

Compatibility Considerations

MEX functions generated in R2013b return a real value when a complex result has an imaginary part equal to zero. MEX functions generated prior to R2013b return a complex value when a complex result has an imaginary part equal to zero.

In R2013b, complex values with imaginary part equal to zero become real when passed to an extrinsic function. In previous releases, they remain complex.

Subfolder for code generation interface files

Previously, interface files for MEX code generation appeared in the code generation output folder. In R2013b, these interface files have the prefix `_coder`, appear in a subfolder named `interface`, and appear for all code generation output types.

Support for LCC compiler on Windows 64-bit machines

The LCC-win64 compiler is shipping with MATLAB Coder for Microsoft® Windows 64-bit machines. For Windows 64-bit machines that do not have a third-party compiler installed, MEX code generation uses LCC by default.

You cannot use LCC for code generation of C/C++ static libraries, C/C++ dynamic libraries, or C/C++ executables. For these output types, you must install a compiler. See http://www.mathworks.com/support/compilers/current_release/.

Fixed-Point conversion enhancements

These capabilities require a Fixed-Point Designer license.

Fixed-Point conversion option for codegen

You can now convert floating-point MATLAB code to fixed-point code, and then generate C/C++ code at the command line using the option `-float2fixed` with the `codegen` command. See `codegen` and Convert Floating-Point MATLAB Code to Fixed-Point C Code Using `codegen`.

Fixed-point conversion using derived ranges on Mac platforms

You can now convert floating-point MATLAB code to fixed-point C code using the Fixed-Point Conversion tool in MATLAB Coder projects on Mac platforms.

For more information, see [Automated Fixed-Point Conversion and Propose Fixed-Point Data Types Based on Derived Ranges](#).

Derived ranges for complex variables in MATLAB Coder projects

Using the Fixed-Point Conversion tool in MATLAB Coder projects, you can derive ranges for complex variables. For more information, see [Propose Fixed-Point Data Types Based on Derived Ranges](#)

Fixed-point conversion workflow supports designs that use enumerated types

Using the Fixed-Point Conversion tool in MATLAB Coder projects, you can propose data types for enumerated data types using derived and simulation ranges.

For more information, see [Propose Fixed-Point Data Types Based on Derived Ranges and Propose Fixed-Point Data Types Based on Simulation Ranges](#).

Fixed-point conversion of variable-size data using simulation ranges

Using the Fixed-Point Conversion tool in MATLAB Coder projects, you can propose data types for variable-size data using simulation ranges.

For more information, see [Propose Fixed-Point Data Types Based on Simulation Ranges](#).

Fixed-point conversion test file coverage results

The Fixed-Point Conversion tool now provides test file coverage results. After simulating your design using a test file, the tool provides an indication of how often the code is executed. If you run multiple test files at once, the tool provides the cumulative coverage. This information helps you determine the completeness of your test files and verify that they are exercising the full operating range of your algorithm. The completeness of the test file directly affects the quality of the proposed fixed-point types.

For more information, see [Code Coverage](#).

Check bug reports for issues and fixes

Software is inherently complex and is not free of errors. The output of a code generator might contain bugs, some of which are not detected by a compiler. MathWorks reports critical known bugs brought to its attention on its Bug Report system at www.mathworks.com/support/bugreports/. Use the Saved Searches and Watched Bugs tool with the search phrase "Incorrect Code Generation" to obtain a report of known bugs that produce code that might compile and execute, but still produce wrong answers.

The bug reports are an integral part of the documentation for each release. Examine periodically all bug reports for a release, as such reports may identify inconsistencies between the actual behavior of a release you are using and the behavior described in this documentation.

In addition to reviewing bug reports, you should implement a verification and validation strategy to identify potential bugs in your design, code, and tools.

R2013a

Version: 2.4

New Features

Bug Fixes

Compatibility Considerations

Automatic fixed-point conversion during code generation (with Fixed-Point Designer)

You can now convert floating-point MATLAB code to fixed-point C code using the fixed-point conversion capability in MATLAB Coder projects. You can choose to propose data types based on simulation range data, static range data, or both.

Note: You must have a Fixed-Point Designer license.

During fixed-point conversion, you can:

- Propose fraction lengths based on default word lengths.
- Propose word lengths based on default fraction lengths.
- Optimize whole numbers.
- Specify safety margins for simulation min/max data.
- Validate that you can build your project with the proposed data types.
- Test numerics by running the test file with the fixed-point types applied.
- View a histogram of bits used by each variable.

For more information, see [Propose Fixed-Point Data Types Based on Simulation Ranges](#) and [Propose Fixed-Point Data Types Based on Derived Ranges](#).

File I/O function support

The following file I/O functions are now supported for code generation:

- `fclose`
- `fopen`
- `fprintf`

To view implementation details, see [Functions Supported for Code Generation — Alphabetical List](#).

Support for nonpersistent handle objects

You can now generate code for local variables that contain references to handle objects or System objects. In previous releases, generating code for these objects was limited to objects assigned to persistent variables.

Structures passed by reference to entry-point functions

You can now specify to pass structures by reference to entry-point functions in the generated code. This optimization is available for standalone code generation only; it is not available for MEX functions. Passing structures by reference reduces the number of copies at entry-point function boundaries in your generated code. It does not affect how structures are passed to functions other than entry-point functions.

To pass structures by reference:

- In a project, on the Project Settings dialog box **All Settings** tab, under **Advanced**, set **Pass structures by reference to entry-point functions** to **Yes**.
- At the command line, create a code generation configuration object and set the `PassStructByReference` parameter to `true`. For example:

```
cfg = coder.config('lib');  
cfg.PassStructByReference=true;
```

Include custom C header files from MATLAB code

The `coder.cinclude` function allows you to specify in your MATLAB code which custom C header files to include in the generated C code. Each header file that you specify using `coder.cinclude` is included in every C/C++ file generated from your MATLAB code. You can specify whether the `#include` statement uses double quotes for application header files or angle brackets for system header files in the generated code.

For example, the following code for function `foo` specifies to include the application header file `mystruct.h` in the generated code using double quotes.

```
function y = foo(x1, x2)  
%#codegen  
coder.cinclude('mystruct.h');
```

```
...
```

For more information, see `coder.cinclude`.

Load from MAT-files

MATLAB Coder now supports a subset of the `load` function for loading run-time values from a MAT-file while running a MEX function. It also provides a new function, `coder.load`, for loading compile-time constants when generating MEX or standalone code. This support facilitates code generation from MATLAB code that uses `load` to load constants into a function. You no longer have to manually type in constants that were stored in a MAT-file.

To view implementation details for the `load` function, see [Functions Supported for Code Generation — Alphabetical List](#).

For more information, see `coder.load`.

`coder.opaque` function enhancements

When you use `coder.opaque` to declare a variable in the generated C code, you can now also specify the header file that defines the type of the variable. Specifying the location of the header file helps to avoid compilation errors because the MATLAB Coder software can find the type definition more easily.

You can now compare `coder.opaque` variables of the same type. This capability helps you verify, for example, whether an `fopen` command succeeded.

```
null = coder.opaque('FILE*', 'NULL', 'HeaderFile', 'stdio.h');
ftmp = null;
ftmp = coder.ceval('fopen', fname, permission);
if ftmp == null
    % Error - file open failed
end
```

For more information, see `coder.opaque`.

Automatic regeneration of MEX functions in projects

When you run a test file from a MATLAB Coder project to verify the behavior of the generated MEX function, the project now detects when to rebuild the MEX function. MATLAB Coder rebuilds the MEX function only if you have modified the original

MATLAB algorithm since the previous build, saving you time during the verification phase.

MEX function signatures include constant inputs

When you generate a MEX function for a MATLAB function that takes constant inputs, by default, the MEX function signature now contains the constant inputs. If you are verifying your MEX function in a project, this behavior allows you to use the same test file to run the original MATLAB algorithm and the MEX function.

Compatibility Considerations

In previous releases, MATLAB Coder removed the constants from the MEX function signature. To use these existing scripts with MEX functions generated using R2013a software, do one of the following:

- Update the scripts so that they no longer remove the constants.
- Configure MATLAB Coder to remove the constant values from the MEX function signature.

To configure MATLAB Coder to remove the constant values:

- In a project, on the Project Settings dialog box **All Settings** tab, under **Advanced**, set **Constant Inputs to Remove** from MEX signature.
- At the command line, create a code generation configuration object, and, set the `ConstantInputs` parameter to `'Remove'`. For example:

```
cfg = coder.config;  
cfg.ConstantInputs='Remove';
```

Custom toolchain registration

MATLAB Coder software enables you to register third-party software build tools for creating executables and libraries.

- The software automatically detects supported tool chains on your system.
- You can manage and customize multiple tool chain definitions.
- Before generating code, you can select any one of the definitions using a drop-down list.

- The software generates simplified makefiles for improved readability.

For more information:

- See Custom Toolchain Registration.
- See the Adding a Custom Toolchain example.

Compatibility Considerations

If you open a MATLAB Coder project or use a code generation configuration object from R2012b, the current version of MATLAB Coder software automatically tries to use the toolchain approach. If an existing project or configuration object does not use default target makefile settings, MATLAB Coder might not be able to upgrade to use a toolchain approach and will emit a warning. For more information, see [Project or Configuration is Using the Template Makefile](#).

Complex trigonometric functions

Code generation support has been added for complex `acosD`, `acotD`, `acscD`, `asecD`, `asinD`, `atanD`, `cosD`, `cscD`, `cotD`, `secD`, `sinD`, and `tanD` functions.

parfor function reduction improvements and C support

When generating MEX functions for `parfor`-loops, you can now use `intersect` and `union` as reduction functions, and the following reductions are now supported:

- Concatenations
- Arrays
- Function handles

By default, when MATLAB Coder generates a MEX function for MATLAB code that contains a `parfor`-loop, MATLAB Coder no longer requires C++ and now honors the target language setting.

Support for integers in number theory functions

Code generation supports integer inputs for the following number theory functions:

- `cumprod`

- cumsum
- factor
- factorial
- gcd
- isprime
- lcm
- median
- mode
- nchoosek
- nextpow2
- primes
- prod

To view implementation details, see [Functions Supported for Code Generation — Alphabetical List](#).

Enhanced support for class property initial values

If you initialize a class property, you can now assign a different type to the property when you use the class. For example, class `foo` has a property `prop1` of type `double`.

```
classdef foo %#codegen
    properties
        prop1= 0;
    end
    methods
        ...
    end
end
```

Function `bar` assigns a different type to `prop1`.

```
function bar %#codegen
    f=foo;
    f.prop1=single(0);
    ...
end
```

In R2013a, MATLAB Coder ignores the initial property definition and uses the reassigned type. In previous releases, MATLAB Coder did not support this reassignment and code generation failed.

Compatibility Considerations

In previous releases, if the reassigned property had the same type as the initial value but a different size, the property became variable-size in the generated code. In R2013a, MATLAB Coder uses the size of the reassigned property, and the size is fixed. If you have existing MATLAB code that relies on the property being variable-size, you cannot generate code for this code in R2013a. To fix this issue, do not initialize the property in the property definition block.

For example, you can no longer generate code for the following function `bar`.

Class `foo` has a property `prop1` which is a scalar `double`.

```
classdef foo %#codegen
    properties
        prop1= 0;
    end
    methods
        ...
    end
end
```

Function `bar` changes the size of `prop1`.

```
function bar %#codegen
    f=foo;
    f.prop1=[1 2 3];
    % Use f
    disp(f.prop1);
    f.prop1=[1 2 3 4 5 6 ];
```

Optimized generated code for `x=[x c]` when `x` is a vector

MATLAB Coder now generates more optimized code for the expression `x=[x c]`, if:

- `x` is a row or column vector.
- `x` is not in `c`.
- `x` is not aliased.
- There are no function calls in `c`.

In previous releases, the generated code contained multiple copies of `x`. In R2013a, it does not contain multiple copies of `x`.

This enhancement reduces code size and execution time. It also improves code readability.

Default use of Basic Linear Algebra Subprograms (BLAS) libraries

MATLAB Coder now uses BLAS libraries whenever they are available. There is no longer an option to turn off the use of these libraries.

Compatibility Considerations

If existing configuration settings disable BLAS, MATLAB Coder now ignores these settings.

Changes to compiler support

MATLAB Coder supports these new compilers.

- On Microsoft Windows platforms, Visual C++[®] 11.
- On Mac OS X platforms, Apple Xcode 4.2 with Clang.

MATLAB Coder no longer supports the `gcc` compiler on Mac OS X platforms.

MATLAB Coder no longer supports Watcom for standalone code generation. Watcom is still supported for building MEX functions.

Compatibility Considerations

- Because Clang is the only compiler supported on Mac OS X platforms, and Clang does not support Open MP, `parfor` is no longer supported on Mac OS X platforms.
- MATLAB Coder no longer supports Watcom for standalone code generation. Use Watcom only for building MEX functions. Use an alternative compiler for standalone code generation. For a list of supported compilers, see http://www.mathworks.com/support/compilers/current_release/.

New toolbox functions supported for code generation

To view implementation details, see Functions Supported for Code Generation — Alphabetical List.

Bitwise Operation Functions

- flintmax

Computer Vision System Toolbox Classes and Functions

- binaryFeatures
- insertMarker
- insertShape

Data File and Management Functions

- computer
- fclose
- fopen
- fprintf
- load

Image Processing Toolbox Functions

- conndef
- imcomplement
- imfill
- imhmax
- imhmin
- imreconstruct
- imregionalmax
- imregionalmin
- iptcheckconn
- padarray

Interpolation and Computational Geometry

- interp2

MATLAB Desktop Environment Functions

- ismac

- `ispc`
- `isunix`

Functions being removed

These functions have been removed from MATLAB Coder software.

Function Name	What Happens When You Use This Function?
<code>emlc</code>	Errors in R2013a.
<code>emlmex</code>	Errors in R2013a.

Compatibility Considerations

`emlc` and `emlmex` have been removed. Use `codegen` instead. If you have existing code that calls `emlc` or `emlmex`, use `coder.upgrade` to help convert your code to the new syntax.

Check bug reports for issues and fixes

Software is inherently complex and is not free of errors. The output of a code generator might contain bugs, some of which are not detected by a compiler. MathWorks reports critical known bugs brought to its attention on its Bug Report system at www.mathworks.com/support/bugreports/. Use the Saved Searches and Watched Bugs tool with the search phrase "Incorrect Code Generation" to obtain a report of known bugs that produce code that might compile and execute, but still produce wrong answers.

The bug reports are an integral part of the documentation for each release. Examine periodically all bug reports for a release, as such reports may identify inconsistencies between the actual behavior of a release you are using and the behavior described in this documentation.

In addition to reviewing bug reports, you should implement a verification and validation strategy to identify potential bugs in your design, code, and tools.

R2012b

Version: 2.3

New Features

Bug Fixes

parfor function support for MEX code generation, enabling execution on multiple cores

You can use MATLAB Coder software to generate MEX functions from MATLAB code that contains `parfor`-loops. The generated MEX functions can run on multiple cores on a desktop. For more information, see `parfor` and Acceleration of MATLAB Algorithms Using Parallel for-loops (`parfor`).

Code generation readiness tool

The code generation readiness tool screens MATLAB code for features and functions that are not supported for code generation. The tool provides a report that lists the source files that contain unsupported features and functions and an indication of how much work is needed to make the MATLAB code suitable for code generation.

For more information, see `coder.screener` and Code Generation Readiness Tool.

Reduced data copies and lightweight run-time checks for generated MEX functions

MATLAB Coder now eliminates data copies for built-in, non-complex data types. It also performs faster bounds checks. These enhancements result in faster generated MEX functions.

Additional string function support for code generation

The following string functions are now supported for code generation. To view implementation details, see Functions Supported for Code Generation — Alphabetical List.

- `deblank`
- `hex2num`
- `isletter`
- `isspace`
- `isstrprop`
- `lower`

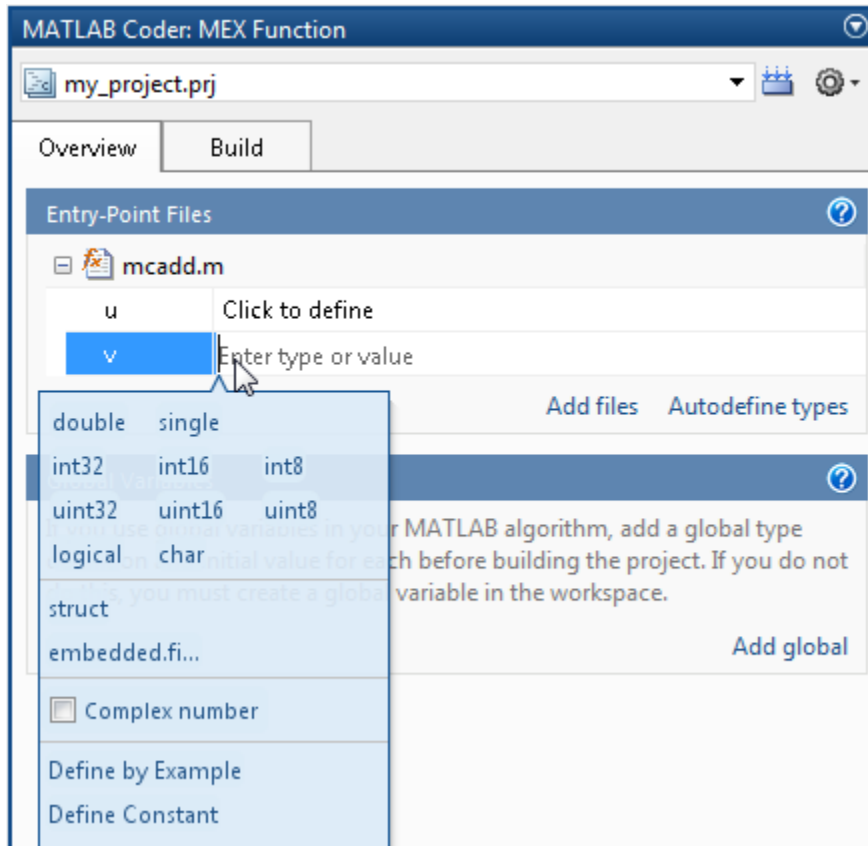
- `num2hex`
- `strcmpi`
- `strjust`
- `strncmp`
- `strncmpi`
- `strtok`
- `strtrim`
- `upper`

Visualization functions in generated MEX functions

The MATLAB Coder software now detects calls to many common visualization functions, such as `plot`, `disp`, and `figure`. For MEX code generation, MATLAB Coder automatically calls out to MATLAB for these functions. For standalone code generation, MATLAB Coder does not generate code for these visualization functions. This capability reduces the amount of time that you spend making your code suitable for code generation. It also removes the requirement to declare these functions extrinsic using the `coder.extrinsic` function.

Input parameter type specification enhancements

The updated project user interface facilitates input parameter type specification.



Project import and export capability

You can now export project settings to a configuration object stored as a variable in the base workspace. You can then use the configuration object to import the settings into a different project or to generate code at the command line with the `codegen` function. This capability allows you to:

- Share settings between the project and command-line workflow
- Share settings between multiple projects
- Standardize on settings for code generation projects

For more information, see [Share Build Configuration Settings](#).

Package generated code in zip file for relocation

The `packNGo` function packages generated code files into a compressed zip file so that you can relocate, unpack, and rebuild them in another development environment. This capability is useful if you want to relocate files so that you can recompile them for a specific target environment or rebuild them in a development environment in which MATLAB is not installed.

For more information, see [Package Code For Use in Another Development Environment](#).

Fixed-point instrumentation and data type proposals

MATLAB Coder projects provide the following fixed-point conversion support:

- Option to generate instrumented MEX functions
- Use of instrumented MEX functions to provide simulation minimum and maximum results
- Fixed-point data type proposals based on simulation minimum and maximum values
- Option to propose fraction lengths or word lengths

You can use these proposed fixed-point data types to create a fixed-point version of your original MATLAB entry-point function.

Note: Requires a Fixed-Point Toolbox™ license.

For more information, see [Fixed-Point Conversion](#).

New toolbox functions supported for code generation

To view implementation details, see [Functions Supported for Code Generation — Alphabetical List](#).

Computer Vision System Toolbox

- `integralImage`

Image Processing Toolbox

- `bwlookup`

- bwmorph

Interpolation and Computational Geometry

- interp2

Trigonometric Functions

- atan2d

New System objects supported for code generation

The following System objects are now supported for code generation. To see the list of System objects supported for code generation, see [System Objects Supported for Code Generation](#).

Communications System Toolbox

- comm.ACPR
- comm.BCHDecoder
- comm.CCDF
- comm.CPMCarrierPhaseSynchronizer
- comm.GoldSequence
- comm.LDPCDecoder
- comm.LDPCEncoder
- comm.LTEMIMOChannel
- comm.MemorylessNonlinearity
- comm.MIMOChannel
- comm.PhaseNoise
- comm.PSKCarrierPhaseSynchronizer
- comm.RSDecoder

DSP System Toolbox

- dsp.AllpoleFilter
- dsp.CICDecimator
- dsp.CICInterpolator

- `dsp.IIRFilter`
- `dsp.SignalSource`

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R2012a

Version: 2.2

New Features

Compatibility Considerations

Code Generation for MATLAB Classes

In R2012a, there is preliminary support for code generation for MATLAB classes targeted at supporting System objects defined by users. For more information about generating code for MATLAB classes, see [Code Generation for MATLAB Classes](#). For more information about generating code for System objects, see the [DSP System Toolbox](#), [Computer Vision System Toolbox](#) or the [Communications System Toolbox](#) documentation.

Dynamic Memory Allocation Based on Size

By default, dynamic memory allocation is now enabled for variable-size arrays whose size exceeds a configurable threshold. This behavior allows for finer control over stack memory usage. Also, you can generate code automatically for more MATLAB algorithms without modifying the original MATLAB code.

Compatibility Considerations

If you use scripts to generate code and you do not want to use dynamic memory allocation, you must disable it. For more information, see [Controlling Dynamic Memory Allocation](#).

C/C++ Dynamic Library Generation

You can now use MATLAB Coder to build a dynamically linked library (DLL) from the generated C code. These libraries are useful for integrating into existing software solutions that expect dynamically linked libraries.

For more information, see [Generating C/C++ Dynamically Linked Libraries from MATLAB Code](#).

Automatic Definition of Input Parameter Types

MATLAB Coder software can now automatically define input parameter types by inferring these types from test files that you supply. This capability facilitates input type definition and reduces the risk of introducing errors when defining types manually.

To learn more about automatically defining types:

- In MATLAB Coder projects, see Autodefining Input Types.
- At the command line, see the `coder.getArgTypes` function reference page <http://www.mathworks.com/help/releases/R2012a/toolbox/coder/ref/coder.getargtypes.html>.

Verification of MEX Functions

MATLAB Coder now provides support for test files to verify the operation of generated MEX functions. This capability enables you to verify that the MEX function is functionally equivalent to your original MATLAB code and to check for run-time errors.

To learn more about verifying MEX function behavior:

- In MATLAB Coder projects, see How to Verify MEX Functions in a Project.
- At the command line, see the `coder.runTest` function reference page <http://www.mathworks.com/help/releases/R2012a/toolbox/coder/ref/coder.runtest.html>.

Enhanced Project Settings Dialog Box

The **Project Settings** dialog box now groups configuration parameters so that you can easily identify the parameters associated with code generation objectives such as speed, memory, and code appearance. The dialog boxes for code generation configuration objects, `coder.MexCodeConfig`, `coder.CodeConfig`, and `coder.EmbeddedCodeConfig`, also use the same new groupings.

To view the updated **Project Settings** dialog box:

- 1 In a project, click the **Build** tab.
- 2 On the **Build** tab, click the More settings link to open the **Project Settings** dialog box.

For information about the parameters on each tab, click the **Help** button.

To view the updated dialog boxes for the code generation configuration objects:

- 1 At the MATLAB command line, create a configuration object. For example, create a configuration object for MEX code generation.

```
mex_cfg = coder.config;
```

- 2 Open the dialog box for this object.

open mex_cfg

For information about the parameters on each tab, click the **Help** button.

Projects Infer Input Types from `assert` Statements in Source Code

MATLAB Coder projects can now infer input data types from `assert` statements that define the properties of function inputs in your MATLAB entry-point files. For more information, see [Defining Inputs Programmatically](#) in the MATLAB File.

Code Generation from MATLAB

For details about new toolbox functions and System objects supported for code generation, see the [Code Generation from MATLAB Release Notes](#).

New Demo

The following demo has been added:

Demo...	Shows How You Can...
coderdemo_reverb	Generate a MEX function for an algorithm that uses MATLAB classes.

Check bug reports for issues and fixes

Software is inherently complex and is not free of errors. The output of a code generator might contain bugs, some of which are not detected by a compiler. MathWorks reports critical known bugs brought to its attention on its Bug Report system at www.mathworks.com/support/bugreports/. Use the Saved Searches and Watched Bugs tool with the search phrase "Incorrect Code Generation" to obtain a report of known bugs that produce code that might compile and execute, but still produce wrong answers.

The bug reports are an integral part of the documentation for each release. Examine periodically all bug reports for a release, as such reports may identify inconsistencies between the actual behavior of a release you are using and the behavior described in this documentation.

In addition to reviewing bug reports, you should implement a verification and validation strategy to identify potential bugs in your design, code, and tools.

R2011b

Version: 2.1

New Features

Support for Deletion of Rows and Columns from Matrices

You can now generate C/C++ code from MATLAB code that deletes rows or columns from matrices. For example, the following code deletes the second column of matrix X:

```
X(:,2) = [];
```

For more information, see [Diminishing the Size of a Matrix](#) in the MATLAB documentation.

Code Generation from MATLAB

For details of new toolbox functions and System objects supported for code generation, see [Code Generation from MATLAB Release Notes](#).

Check bug reports for issues and fixes

Software is inherently complex and is not free of errors. The output of a code generator might contain bugs, some of which are not detected by a compiler. MathWorks reports critical known bugs brought to its attention on its Bug Report system at www.mathworks.com/support/bugreports/. Use the Saved Searches and Watched Bugs tool with the search phrase "Incorrect Code Generation" to obtain a report of known bugs that produce code that might compile and execute, but still produce wrong answers.

The bug reports are an integral part of the documentation for each release. Examine periodically all bug reports for a release, as such reports may identify inconsistencies between the actual behavior of a release you are using and the behavior described in this documentation.

In addition to reviewing bug reports, you should implement a verification and validation strategy to identify potential bugs in your design, code, and tools.

R2011a

Version: 2.0

New Features

Compatibility Considerations

New User Interface for Managing Projects

The new MATLAB Coder user interface simplifies the MATLAB to C/C++ code generation process. Using this user interface, you can:

- Specify the MATLAB files from which you want to generate code
- Specify the data types for the inputs to these MATLAB files
- Select an output type:
 - MEX function
 - C/C++ Static Library
 - C/C++ Executable
- Configure build settings to customize your environment for code generation
- Open the code generation report to view build status, generated code, and compile-time information for the variables and expressions in your MATLAB code

To Get Started

You launch a MATLAB Coder project by doing one of the following:

- From the MATLAB main menu, select **File > New > Code Generation Project**
- Enter `coder` at the MATLAB command line

To learn more about working with MATLAB Coder, see [Generating C Code from MATLAB Code Using the MATLAB Coder Project Interface](#).

Migrating from Real-Time Workshop emlc Function

In MATLAB Coder, the `codegen` function replaces `emlc` with the following differences:

New `codegen` Options

Old <code>emlc</code> Option	New <code>codegen</code> Option
<code>-eg</code>	<code>-args</code>
<code>emlcoder.egc</code>	<code>coder.Constant</code>
<code>emlcoder.egs</code>	<code>coder.typeof(a,b,1)</code> specifies a variable-size input with the same class and complexity

Old emlc Option	New codegen Option
	<p>as <code>a</code> and same size and upper bounds as the size vector <code>b</code>.</p> <p>Creates <code>coder.Type</code> objects for use with the <code>codegen -args</code> option. For more information, see <code>coder.typeof</code>.</p>
-F	Nocodegen option available. Instead, use the default <code>fimath</code> . For more information, see the Fixed-Point Toolbox documentation.
-global	<p>-globals</p> <hr/> <p>Note: -global continues to work with codegen</p>
-N	This option is no longer supported. Instead, set up <code>numericType</code> in MATLAB.
-s	<p>-config</p> <p>Use with the new configuration objects, see “New Code Generation Configuration Objects” on page 9-4.</p>
-T rtw:exe	<p>-config:exe</p> <p>Use this option to generate a C/C++ executable using default build options. Otherwise, use <code>-config</code> with a <code>coder.CodeConfig</code> or <code>coder.EmbeddedCodeConfig</code> configuration object.</p>
-T mex	<p>-config:mex</p> <p>Use this option to generate a MEX function using default build options. Otherwise, use <code>-config</code> with a <code>coder.MexCodeConfig</code> configuration object.</p>

Old emlc Option	New codegen Option
-T rtw -T rtw:lib	-config:lib Use either of these options to generate a C/C++ library using default build options. Otherwise, use -config with a coder.CodeConfig or coder.EmbeddedCodeConfig configuration object.

New Code Generation Configuration Objects

The `codegen` function uses new configuration objects that replace the old `emlc` objects with the following differences:

Old emlc Configuration Object	New codegen Configuration Object
<code>emlcoder.MEXConfig</code>	<code>coder.MexCodeConfig</code>
<code>emlcoder.RTWConfig</code> <code>emlcoder.RTWConfig('grt')</code>	<code>coder.CodeConfig</code> The <code>SupportNonFinite</code> property is now available without an Embedded Coder license. The following property names have changed: <ul style="list-style-type: none"> • <code>RTWCompilerOptimization</code> is now <code>CCompilerOptimization</code> • <code>RTWCustomCompilerOptimization</code> is now <code>CCustomCompilerOptimization</code> • <code>RTWVerbose</code> is now <code>Verbose</code>
<code>emlcoder.RTWConfig('ert')</code>	<code>coder.EmbeddedCodeConfig</code> The following property names have changed: <ul style="list-style-type: none"> • <code>MultiInstanceERTCode</code> is now <code>MultiInstanceCode</code> • <code>RTWCompilerOptimization</code> is now <code>CCompilerOptimization</code> • <code>RTWCustomCompilerOptimization</code> is now <code>CCustomCompilerOptimization</code> • <code>RTWVerbose</code> is now <code>Verbose</code>

Old emlc Configuration Object	New codegen Configuration Object
emlcoder. HardwareImplementation	coder.HardwareImplementation

The codegen Function Has No Default Primary Function Input Type

In previous releases, if you used the `emlc` function to generate code for a MATLAB function with input parameters, and you did not specify the types of these inputs, by default, `emlc` assumed that these inputs were real, scalar, doubles. In R2011a, the `codegen` function does not assume a default type. You must specify at least the class of each primary function input. For more information, see [Specifying Properties of Primary Function Inputs in a Project](#).

Compatibility Considerations

If your existing script calls `emlc` to generate code for a MATLAB function that has inputs and does not specify the input types, and you migrate this script to use `codegen`, you must modify the script to specify inputs.

The codegen Function Processes Compilation Options in a Different Order

In previous releases, the `emlc` function resolved compilation options from left to right so that the right-most option prevailed. In R2011a, the `codegen` function gives precedence to individual command-line options over options specified using a configuration object. If command-line options conflict, the right-most option prevails.

Compatibility Considerations

If your existing script calls `emlc` specifying a configuration object as well as other command-line options, and you migrate this script to use `codegen`, `codegen` might not use the same configuration parameter values as `emlc`.

New coder.Type Classes

MATLAB Coder includes the following new classes to specify input parameter definitions:

- `coder.ArrayType`

- `coder.Constant`
- `coder.EnumType`
- `coder.FiType`
- `coder.PrimitiveType`
- `coder.StructType`
- `coder.Type`

New `coder` Package Functions

The following new package functions let you work with objects and types for C/C++ code generation:

Function	Purpose
<code>coder.config</code>	Create MATLAB Coder code generation configuration objects
<code>coder.newtype</code>	Create a new <code>coder.Type</code> object
<code>coder.resize</code>	Resize a <code>coder.Type</code> object
<code>coder.typeof</code>	Convert a MATLAB value into its canonical type

Script to Upgrade MATLAB Code to Use MATLAB Coder Syntax

The `coder.upgrade` script helps you upgrade to MATLAB Coder by searching your MATLAB code for old commands and options and replacing them with their new equivalents. For more information, at the MATLAB command prompt, enter `help coder.upgrade`.

Embedded MATLAB Now Called Code Generation from MATLAB

MathWorks is no longer using the term *Embedded MATLAB* to refer to the language subset that supports code generation from MATLAB algorithms. This nomenclature incorrectly implies that the generated code is used in embedded systems only. The new term is *code generation from MATLAB*. This terminology better reflects the full extent of the capability for translating MATLAB algorithms into readable, efficient, and compact MEX and C/C++ code for deployment to both desktop and embedded systems.

MATLAB Coder Uses `rtwTargetInfo.m` to Register Target Function Libraries

In previous releases, the `emlc` function also recognized the customization file, `sl_customization.m`. In R2011a, the MATLAB Coder software does not recognize this customization file, you must use `rtwTargetInfo.m` to register a Target Function Library (TFL). To register a TFL, you must have Embedded Coder software. For more information, see [Use the `rtwTargetInfo` API to Register a CRL with MATLAB Coder Software](#) in the Embedded Coder documentation.

New Getting Started Tutorial Video

To learn how to generate C code from MATLAB code, see the “Generating C Code from MATLAB Code” video in the MATLAB Coder Getting Started demos.

New Demos

The following demos have been added:

Demo...	Shows How You Can...
Hello World	Generate and run a MEX function from a simple MATLAB program
Working with Persistent Variables	Compute the average for a set of values by using persistent variables
Working with Structure Arrays	Shows how to build a scalar template before growing it into a structure array, a requirement for code generation from MATLAB.
Balls Simulation	Simulates bouncing balls and shows that you should specify only the entry function when you compile the application into a MEX function.
General Relativity with MATLAB Coder	Uses Einstein's theory of general relativity to calculate geodesics in curved space-time.
Averaging Filter	Generate a standalone C library from MATLAB code using <code>codegen</code>
Edge Detection on Images	Generate a standalone C library from MATLAB code that implements a Sobel filter

Demo...	Shows How You Can...
Read Text File	Generate a standalone C library from MATLAB code that uses the <code>coder.ceval</code> , <code>coder.extrinsic</code> and <code>coder.opaque</code> functions.
“Atoms” Simulation	Generate a standalone C library and executable from MATLAB code using a code generation configuration object to enable dynamic memory allocation
Replacing Math Functions and Operators	Use target function libraries (TFLs) to replace operators and functions in the generated code
	Note: To run this demo, you need Embedded Coder software.
Kalman Filter	<ul style="list-style-type: none"> • Generate a standalone C library from a MATLAB version of a Kalman filter • Accelerate the Kalman filter algorithm by generating a MEX function

Functionality Being Removed in a Future Version

This function will be removed in a future version of MATLAB Coder software.

Function Name	What Happens When You Use This Function?	Compatibility Considerations
<code>emlc</code>	Still runs in R2011a	None

Function Elements Being Removed in a Future Release

Function or Element Name	What Happens When You Use the Function or Element?	Use This Element Instead
<code>%#eml</code>	Still runs	<code>%#codegen</code>
<code>eml.allowpcode</code>	Still runs	<code>coder.allowpcode</code>
<code>eml.ceval</code>	Still runs	<code>coder.ceval</code>
<code>eml.cstructname</code>	Still runs	<code>coder.cstructname</code>

Function or Element Name	What Happens When You Use the Function or Element?	Use This Element Instead
<code>eml.extrinsic</code>	Still runs	<code>coder.extrinsic</code>
<code>eml.inline</code>	Still runs	<code>coder.inline</code>
<code>eml.nullcopy</code>	Still runs	<code>coder.nullcopy</code>
<code>eml.opaque</code>	Still runs	<code>coder.opaque</code>
<code>eml.ref</code>	Still runs	<code>coder.ref</code>
<code>eml.rref</code>	Still runs	<code>coder.rref</code>
<code>eml.target</code>	Still runs	<code>coder.target</code>
<code>eml.unroll</code>	Still runs	<code>coder.unroll</code>
<code>eml.varsize</code>	Still runs	<code>coder.varsize</code>
<code>eml.wref</code>	Still runs	<code>coder.wref</code>

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