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AccelDSP Synthesis Tool Supported MATLAB Constructs and Functions

This document provides a concise overview of the subset of the MATLAB language, including operators, as well as built-in and toolbox functions supported by AccelDSP™ Synthesis Tool for algorithmic synthesis targeting Xilinx FPGAs. Consult the *AccelDSP MATLAB for Synthesis Style Guide* for additional information.

Programming with MATLAB

Table 1: **Data Types and Quantize Functions**

Name	Description
Scalar arrays	An array with dimensions 1 x 1
Vector arrays	An array with dimensions 1 x n
Matrix arrays	An array with dimensions m x n
structure	Create a structure inside the design function
char	Limited to String Constants
gf	Create a Galois field array
quantize	Defines the fixed-point parameters of a variable
quantizer	Applies the quantize object to a variable

Table 2: **Flow Control**

Name	Description
if-elseif-else	Evaluates an expression and executes a set of commands
for / end	Repeats a set of commands a specified number of times
switch-case	Executes a set of commands based on an expression
while / end	Repeats a set of commands until a logical condition is false
end	Defines the end of an IF, FOR and WHILE statement
otherwise	Supported as part of the switch statement

Table 3: **Scripts and Functions**

Name	Description
function	Defines a function containing executable MATLAB
persistent	Define persistent variable
%	Comment

Table 4: **Basic Information**

Name	Description
eps	Floating-point relative accuracy
isempty	True for an empty matrix. Supported for the initialization of persistent variables.
length	Length of a vector
ndims	Number of array dimensions
size	Size of a matrix

Table 5: **Array Operations and Manipulations**

Name	Description
:	Index into array
dot	Scalar product of two vectors
end	Last index
max	Max elements of array
min	Min elements of array
reshape	Use to modify the shape of a matrix
inv	Matrix Inverse. Supported with AccelWare.
norm	Vector and matrix norm
mean	Return the mean of a matrix or array elements
all	Test to determine if all elements are non-zero
any	Test for non-zeros
sum	Sum of an array of elements
cumsum	Cumulative sum along different dims
prod	Product of the elements of an array
cumprod	Cumulative product of the elements of an array
fliplr	Flip matrices left-right
flipud	Flip matrices up-down
rot90	Rotate matrix 90 degrees
diff	Differences and approximate derivatives
cat	Concatenation. Limited to two variables

Table 6: **Elementary Matrices and Arrays**

Name	Description
:	Regularly spaced vector
eye	Identity matrix
ones	Create array of all ones
zeros	Create array of all zeros
bi2de	Convert input matrices to decimal numbers. Input is restricted to base 2 numbers.
de2bi	Convert decimal numbers to binary vectors

Table 7: **Opening, Loading, and Saving Files**

Name	Description
load	Load workspace from disk

Mathematics

Table 8: **Mathematical Operators**

Name	Description
+, plus, accel_complex_plus	Addition
-, minus, accel_complex_minus	Subtraction
.*, times, accel_complex_times	Array multiplication
*, mtimes, accel_complex_mtimes	Matrix multiplication
.^, power	Array power
^, mpower	Matrix power where the exponent must be a scalar integer
pow2	Base 2 power and scale floating-point number
nextpow2	Next power of two
./	Right array divide
/, rdivide	Right matrix divide
.\	Left array divide
\, ldivide	Left matrix divide
'	Transpose
.'	Noconjugated transpose

Table 9: **Relational Operators**

Name	Description
<	Less than
<=	Less than or equal
>	Greater than
>=	Greater than or equal
==, eq	Test for equality
~=, ne	Not equal

Table 10: **Logical Operators**

Name	Description
&&	Logical AND
||	Logical OR
&	Logical AND for arrays
|	Logical OR for arrays
~	Logical NOT
false	False array
true	True array

Table 11: **MATLAB Bit-Wise Operators**

Name	Description
bitand	Bitwise and
bitcmp	Bitwise compare. Overloaded with accel_bitcmp.
bitget	Bitwise get
bitor	Bitwise or
bitset	Bitwise set
bitshift	Bitwise shift. Overloaded with accel_bitshl and accel_bitshr.
bitxor	Bitwise xor

Table 12: **AccelDSP Bit-Wise Operators**

Base Function	Description
accel_bitand	Returns the unsigned bit-wise AND of two integers
accel_bitcmp	Returns the unsigned bit-wise complement of an integers
accel_bitmerge	Concatenates two components, MSB (most-significant bits) and LSB (least-significant bits) into one output word
accel_bitnand	Returns the unsigned bit-wise NAND of two integers
accel_bitnor	Returns the unsigned bit-wise NOR of two integers
accel_bitor	Returns the unsigned bit-wise OR of two integers
accel_bitpack	Returns a single value-representation of the bit-vector argument x quantized to quantizer q
accel_bitrev2	Returns the unsigned digit reversal of the argument IN
accel_bitrev	Returns the unsigned bit-wise reversal of the argument IN
accel_bitshl	Returns the unsigned bit-wise shift-left of the argument IN shifted left by N bits
accel_bitshr	Returns the unsigned bit-wise shift-right of the argument IN shifted right by N bits
accel_bitsplit	Splits the input value into MSB (most-significant bits) and LSB (least-significant bits) components according to the bitwidths specified in the specified quantizers
accel_bitunpack	Returns a row-vector bit-representation of the scalar argument x quantized to the quantizer qout
accel_bitunpackselect	Returns the i'th element from the output of accel_bitunpack(x,q)
accel_bitxor	Returns the unsigned bit-wise XOR of two integers

Table 13: **Linear Algebra**

Name	Description
chol	Matrix factorization using Cholesky method. Supported with AccelWare.
inv	Matrix Inverse (QR, Cholesky, Upper Triangular). Supported with AccelWare.
qr	Matrix factorization using QR Decomposition method. Supported with AccelWare.
qrdrls	QRD-RLS Spatial Filter. Supported with AccelWare.
svd	Singular value decomposition. Supported with AccelWare.
vector rotation	Preforms a givens rotation on a vector pair. Supported with AccelWare.
Triangular System of Equations Solver	Computes the solution to an upper or lower triangular system of equations using backward or forward substitution, respectively. Supported with AccelWare.

Table 14: **Statistics**

Name	Description
mean	Mean value. Supported with AccelWare.
norm	Norm. Supported with AccelWare.
std	Standard Deviation. Supported with AccelWare.
var	Variance. Supported with AccelWare.

Table 15: **Trigonometric Functions**

Name	Description
sin, accel_sin	Sine
cos, accel_cos	Cosine
tan, accel_tan	Tangent
asin, accel_asin	Inverse sine
acos, accel_acos	Inverse cosine
atan, accel_atan	Inverse tangent
atan2, accel_atan2	Four-quadrant inverse tan

Table 16: **Polynomials**

Name	Description
polyval	Returns the value of a polynomial. Supported with AccelWare.

Table 17: **Exponential Functions**

Name	Description
exp	Exponential
log	Natural logarithm
log10	Base 2 logarithm
log2	Base 10 logarithm
pow2	Base 2 power
power	Array power. Same as X.^Y
mpower	Matrix power where the exponent must be a scalar integer. Same as X^Y where Y is a scalar integer.
reallog	Base e logarithm
sqrt	Square root
realsqrt	Square root for non-negative real arrays
Inverse Square Root	Returns 1/sqrt(x). Supported through AccelWare.
realpow	Array power for real output

Table 18: **Complex Numbers**

Name	Description
abs, accel_abs	Absolute value
angle, accel_angle	Returns phase angle and magnitude
cart2pol	Cartesian corrdinates to polar or cylindrical
complex norm	Complex Normalization. Supported with AccelWare.

Table 19: **Rounding and Remainder**

Name	Description
ceil	Round towards positive infinity
convergent	Round to nearest integer
fix	Round towards zero
floor	Round towards negative infinity
mod	Modulus after division
rem	Remainder after division
round	Round towards integer
sign	Signum

Table 20: **Discrete Math**

Name	Description
factorial	Is the product of all the integers from 1 to n

Table 21: **Math Constants**

Name	Description
pi	Ratio of a circle's circumference/diameter

Signal Processing Library

Table 22: **General-Purpose FIR Filters**

Name	Description
dfilt	Discrete-Time Filters. Supported with AccelWare.
filter	Fixed coefficient FIR filter. Supported with AccelWare.
filter - loadcoef	Loadable coefficients FIR filter. Supported with AccelWare.
filter - multchan	Multi-channel FIR filter. Supported with AccelWare.

Table 23: **Multi-Rate Filters**

Name	Description
cicdecim	Cascaded Integrator-Comb decimation filter. Supported with AccelWare.
cicinterp	Cascaded Integrator-Comb interpolation filter. Supported with AccelWare.
mfilt.firdecim	Construct direct-form FIR polyphase decimator filter. Supported with AccelWare.
mfilt.firtdecim	Construct direct-form transposed FIR filter. Supported with AccelWare.
firhalfband	Half-band FIR filter. Supported with AccelWare.

Table 24: **Other Filters**

Name	Description
a_dsinccompensation	A/D Sinc Compensation filter. Supported with AccelWare.
cicdecimate	Cascaded Integrator-Comb (CIC) decimation filter. Supported with AccelWare.
cicinterpolate	Cascaded Integrator-Comb (CIC) interpolation filter. Supported with AccelWare.
rcosfir	Root-Raised Cosine (RRC) filter. Supported with AccelWare.

Table 25: **Transformations**

Name	Description
fft - radix 2	Fast-Fourier transform. Supported with AccelWare.
ifft - radix 2	Inverse Fast-Fourier transform. Supported with AccelWare.
fft - radix 4	Fast-Fourier transform. Supported with AccelWare.
ifft - radix 4	Inverse Fast-Fourier transform. Supported with AccelWare.

Communications Library

Table 26: **Direct Digital Synthesizers**

Name	Description
dds	Direct Digital Synthesizer. Supported with AccelWare.

Table 27: **Encoders/Decoders**

Name	Description
convenc	Convolutional encoder. Supported with AccelWare.
convintlv	Convolutional interleaver. Supported with AccelWare.
convdeintlv	Convolutional deinterleaver. Supported with AccelWare.
rsenc	Reed Solomon/BCH encoder. Supported with AccelWare.
rsdec	Reed Solomon/BCH decoder. Supported with AccelWare.
vitdec	Viterbi decoder. Supported with AccelWare.
bchenc	BCH encoder. Supported with AccelWare.
bchdec	BCH decoder. Supported with AccelWare.

Table 28: **Scramblers/Descramblers**

Name	Description
scrambler	Custom 16-bit wide scrambler. Supported with AccelWare.
descrambler	Custom 16-bit wide scrambler. Supported with AccelWare.

Revision History

The following table shows the revision history for this document.

Date	Version	Revision
04/19/06	1.0	Initial Xilinx release.
12/11/06	1.1	Updated all the tables.