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Adaptive Predistortion: Simulink project

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Digital Communication

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INTRODUCTION

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- Communications Toolbox
- System Model
- Source
- Debug tools
- Crest Reduction
- Rapp Model
- MATLAB Functions

COMMUNICATIONS TOOLBOX

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It includes blocks and functions, that are able to «*Design and simulate the physical layer of communications systems*» (Sources, Modulators, Filters, Equalizers, Channel Models, Error detectors, etc).

It requires **DSP System Toolbox** and **Signal Processing Toolbox**.

How to install them?

COMMUNICATIONS TOOLBOX

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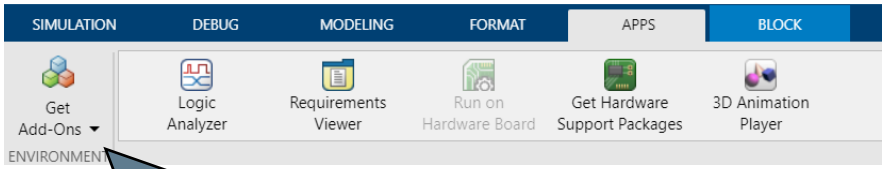

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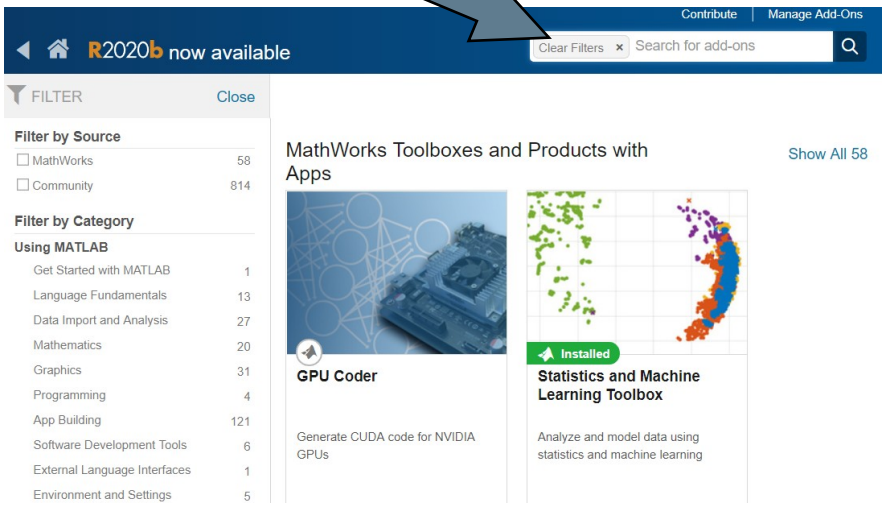

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SYSTEM MODEL

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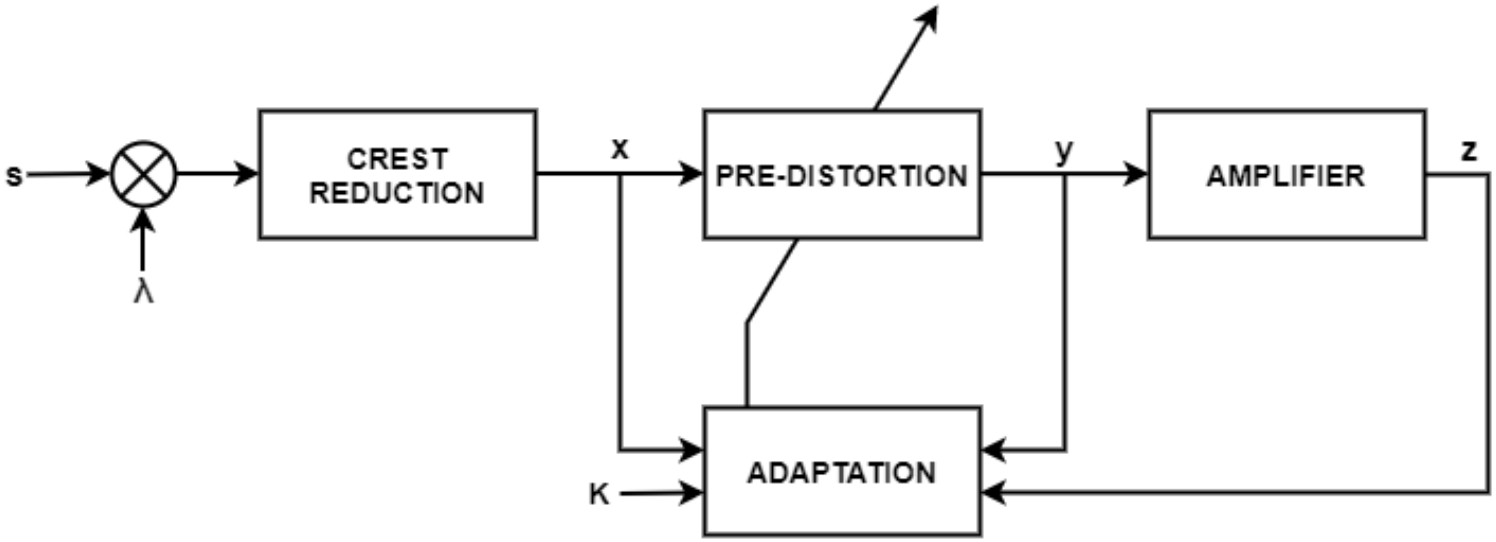

SOURCE

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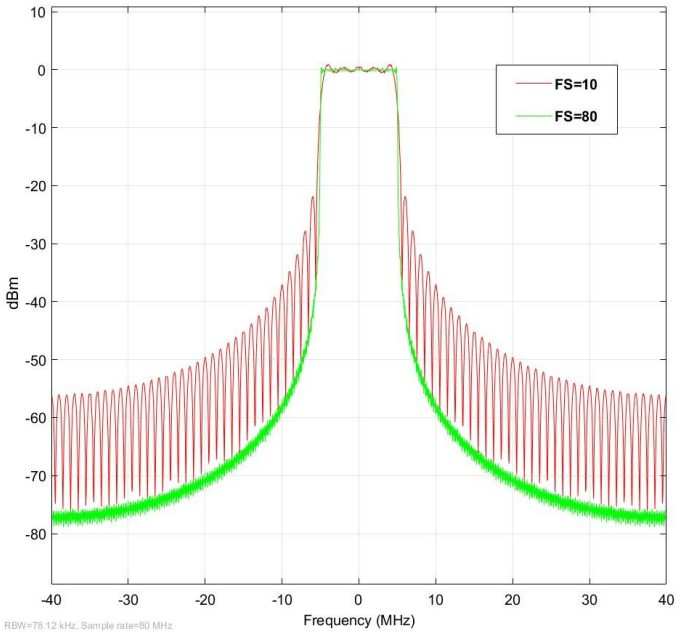
“use real Gaussian number generator followed by a square root Nyquist filter with oversampling factor 8”

Raised Cosine Transmit Filter parameters

- Rolloff factor ($0 \leq \alpha \leq 1$)
- Filter span in symbols: *number of symbols after which the block truncates the impulse response*
- Output samples per symbols: *oversampling factor*



SOURCE

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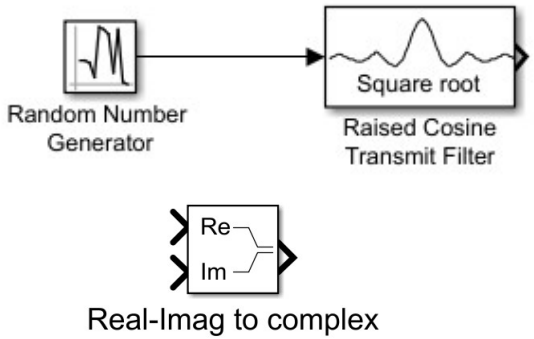
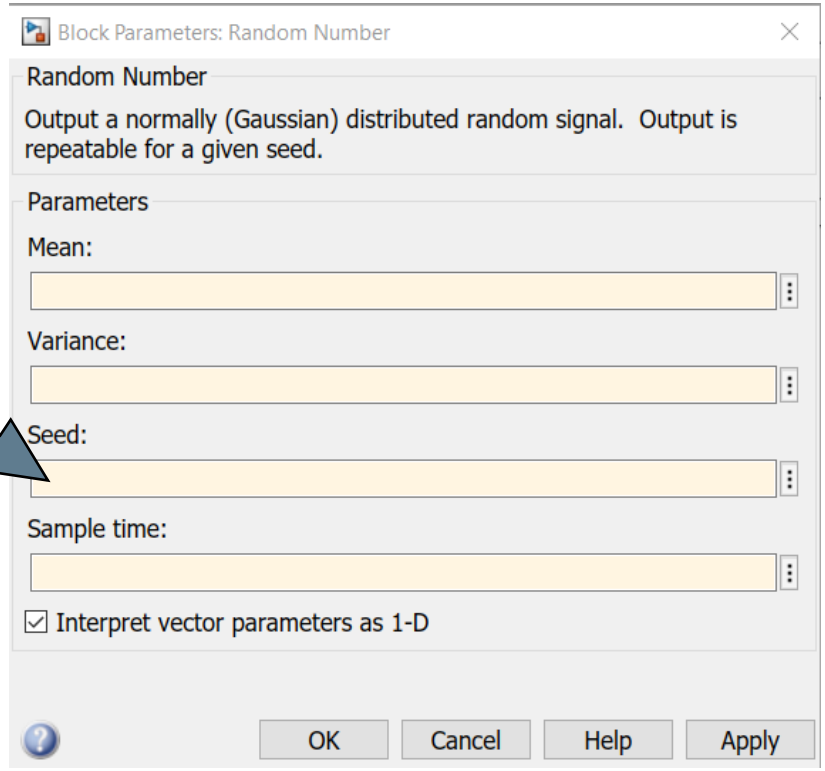
"Encode two systems, one with real input, the other with complex input using two independent Gaussian generators"





Be careful to the seed!

In order to have a random complex signal, the seeds of the generators must be different

DEBUG TOOLS

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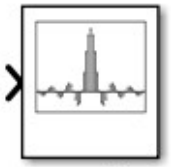
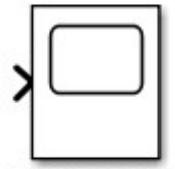
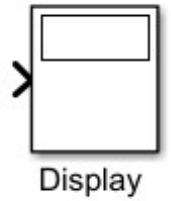


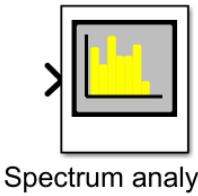
It shows the evolution of a vector or data array



Used to trace the development in time of a signal



Display every type of variable (useful for power control)



It represents the frequency content of the signal

DEBUG TOOLS

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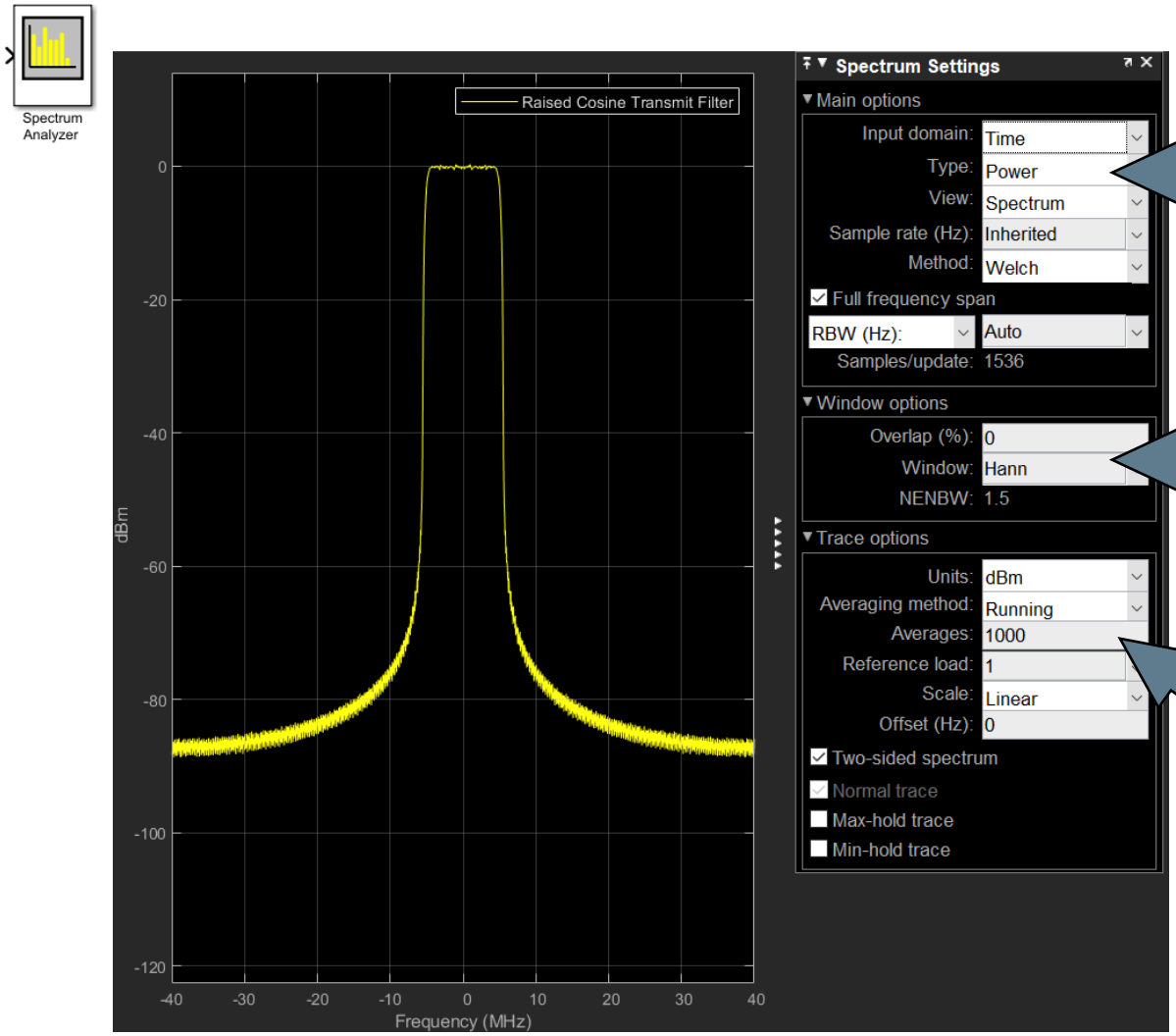


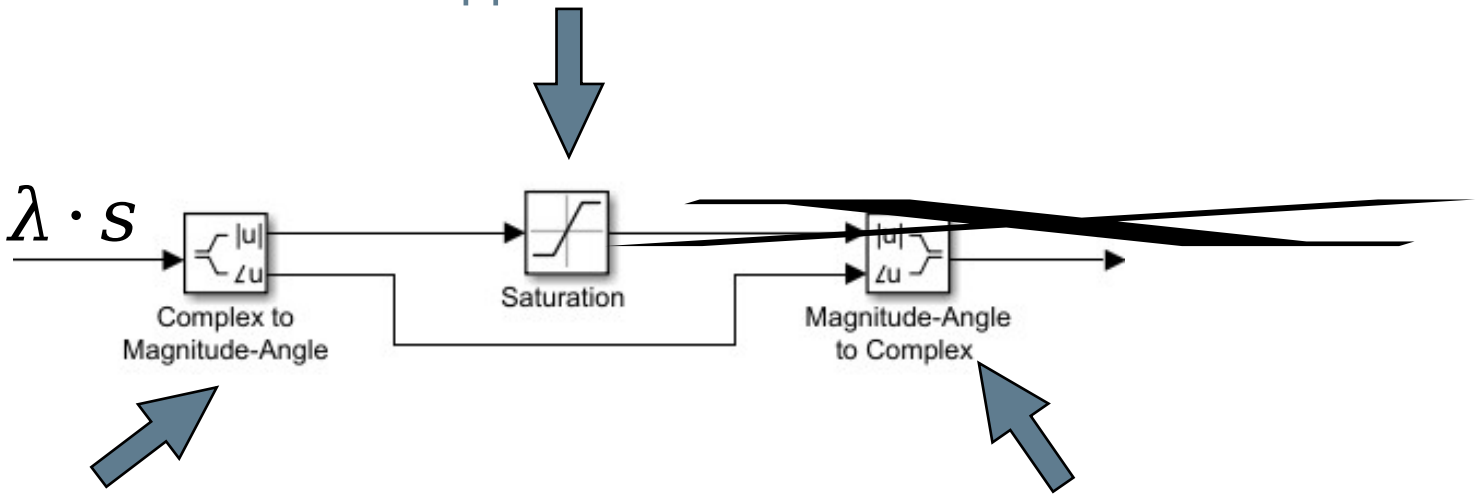
Type: *Power, Power Spectral Density, etc*

Window: *used to control the effect of sidelobes*

Averages: *running average of the last N power spectrum estimates*

CREST REDUCTION

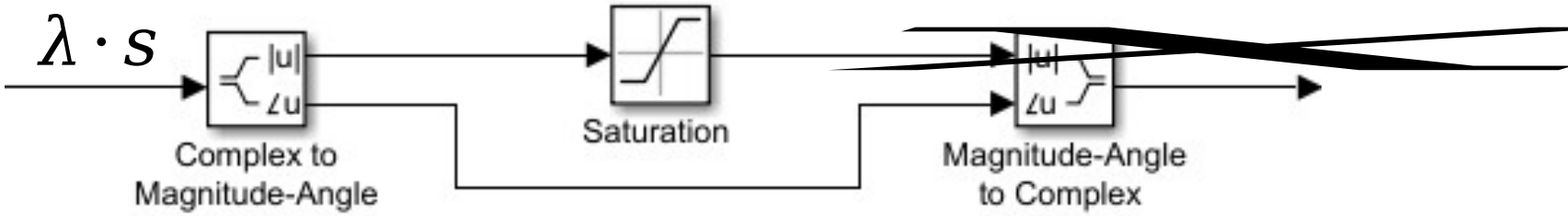
It produces an output signal that is the value of the input signal bounded to the upper and lower saturation values



It divides the complex signal into two branches, one with the magnitude and one with the phase.

It recombines the complex signal

CREST REDUCTION



Given a complex input signal with magnitude | and angle the complex output is:

$$x = \begin{cases} \lambda\, s \; if \; |\lambda\, s| \leq 1 \\ ¿\, 1 \cdot e^{j \angle \lambda\, s} \; otherwise \end{cases}$$

RAPP MODEL

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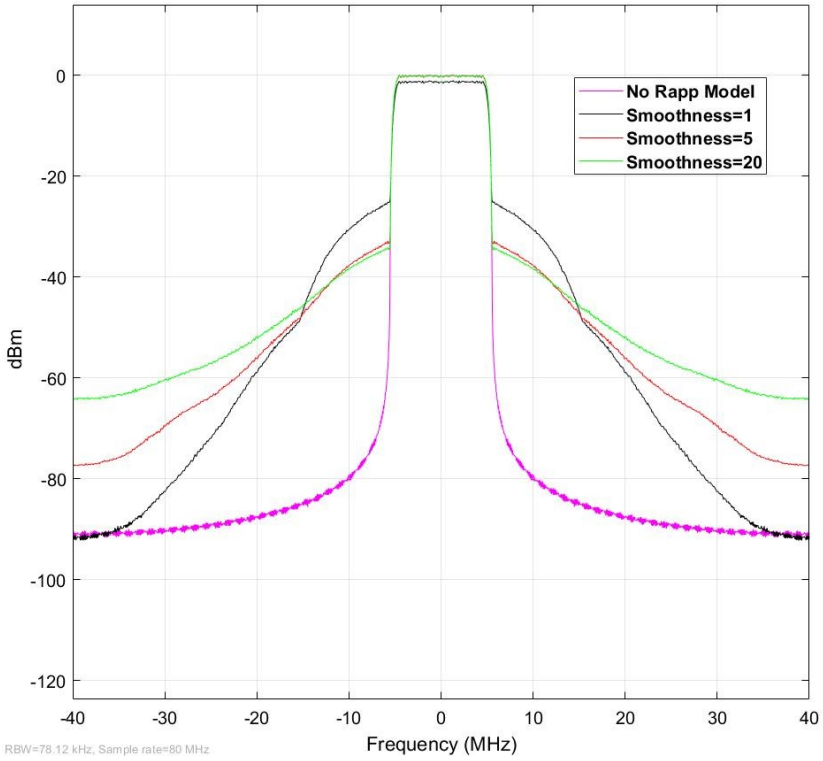
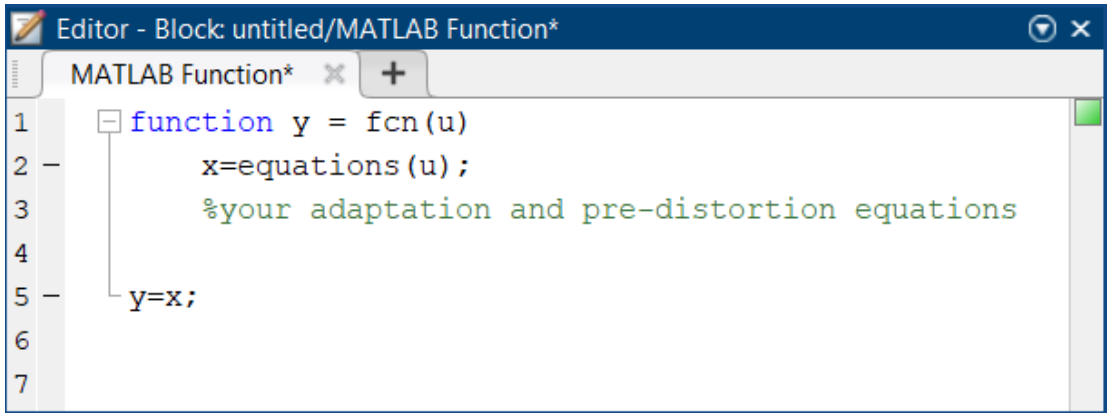
- It is a method of the Memoryless Nonlinearity Block.
- Its input must be a complex signal.
- It applies a distortion, given by:

where
- u is the magnitude of the scaled signal;
- S is the smoothness factor;
- O_{sat} is the output saturation level.



MATLAB FUNCTION

It opens an editor, where you can write the MATLAB functions related to the adaptive algorithms and pre-distortion ones.



MATLAB FUNCTION

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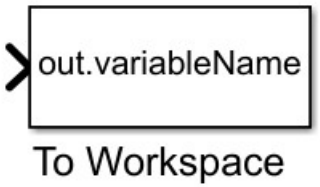
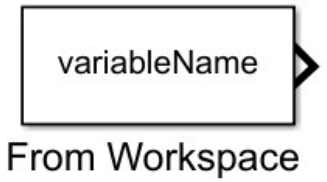
How to pass a Simulink variable to MATLAB and viceversa?



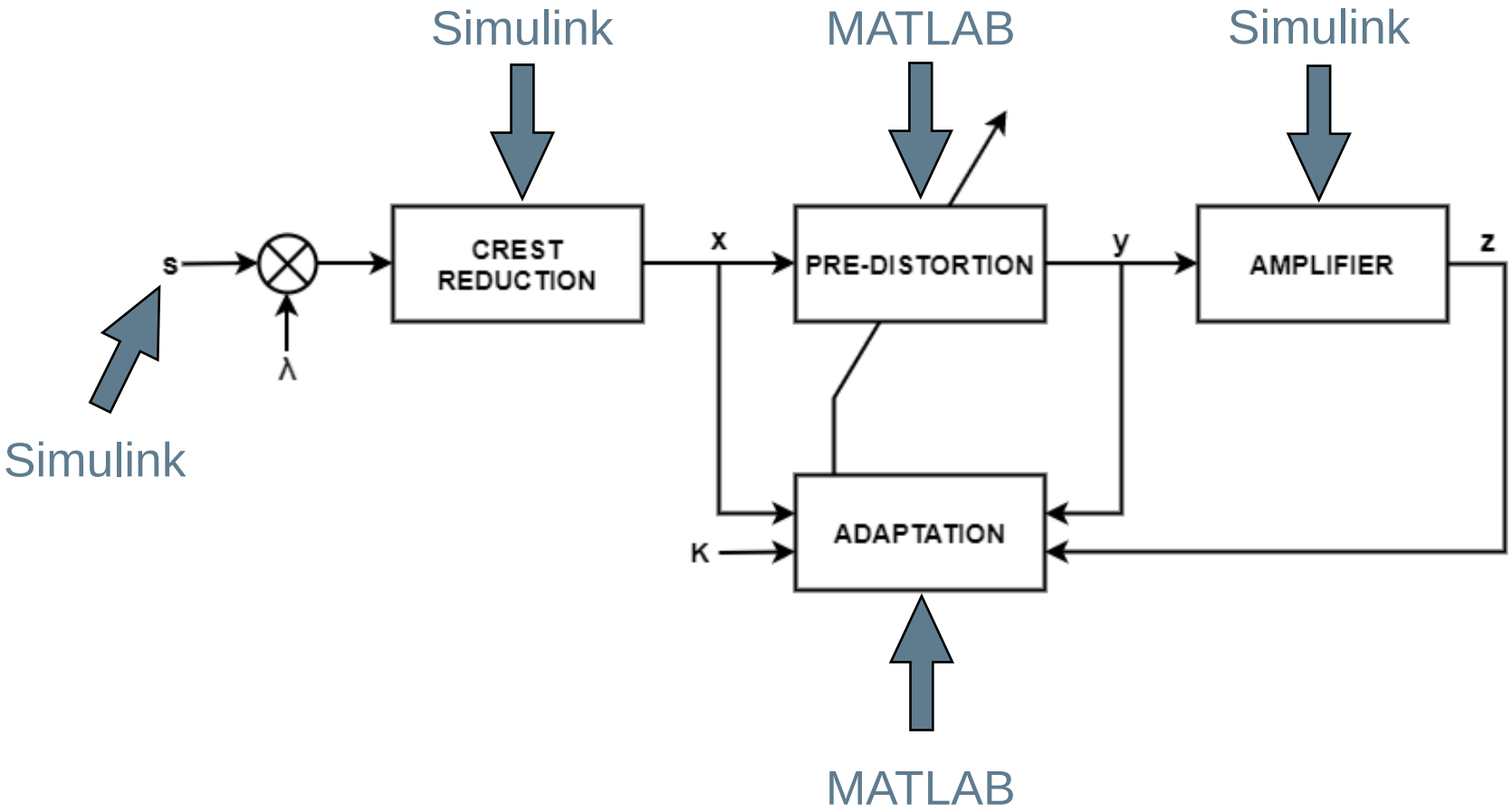

```
% Two methods to extract the information

desiredVariable = out.get('variableName');

desiredVariable = out.variableName;
```

```
% For the block 'From workspace'

variableName = value;
```




```
% For the block 'Data Store Memory'
global variableName

variableName = value;
```

SUMMARY


Simulink
MATLAB
Simulink
s
λ
CREST REDUCTION
x
PRE-DISTORTION
y
AMPLIFIER
z
Simulink
K
ADAPTATION
MATLAB

Thank you!