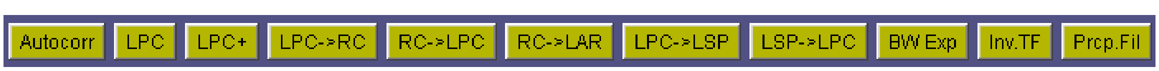
Section M8: Speech blocks

These blocks appear at the top of the simulation area

Table of blocks

Block notation	Description
Autocorr	Computes the autocorrelation sequence of the input signal
LPC	Calculates the linear predictor coefficients (LPC)
LPC+	Computes the LP coefficients
LPC -> RC	Converts the LP coefficients to reflection coefficients (RC)
RC -> LPC	Converts reflection coefficients to LP coefficients
RC-> LAR	Computes the log-area-ratio values (LARs)
LPC ->LSP	Converts LP coefficients to line spectral pairs (LSP)
LSP->LPC	Computes LP coefficients from the LSP
BW Exp	Function to expand the bandwidth of the filter
Inv.TF	Reciprocates the input transfer function
Prcp.Fil	Performs perceptual weighted filtering



M8.1

Block name : Autocorrelation **Notation**: ***Autocorr***

Please refer to section M7, block M7.1

M8.2

Block name : LP coefficients **Notation**: ***LPC***

Please refer to section M7, block M7.2

M8.3

Block name : LP coefficients + **Notation**: ***LPC+***

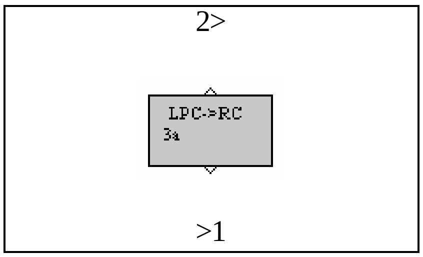
Please refer to section M7, block M7.3

M8.4

Block name : LPC to RC **Notation**: ***LPC->RC***

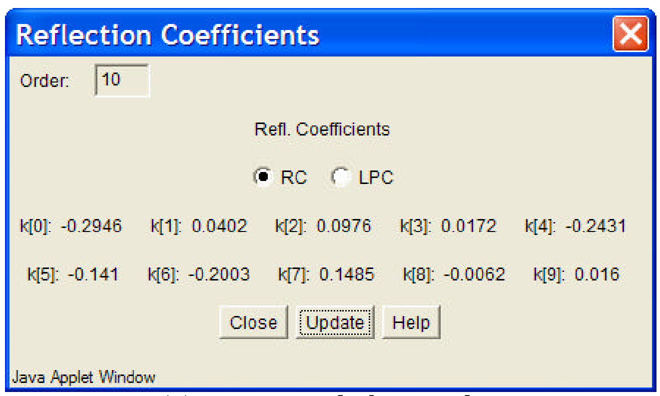
Description: This block converts the direct-form LP coefficients (a_i) to reflection coefficients (k_i). The Levinson recursion algorithm is used to implement the LPC to RC conversion. A check-box option is provided to view the LP coefficients and reflection coefficients.

Pin assignment:



Pin	Description
1	LP coefficients of order 10, a_i
2	Reflection coefficients, k_i
3	
4	
5	
6	

Dialog window(s):



(a)LPC->RC dialog window

Script use:

Name: lpc2rc

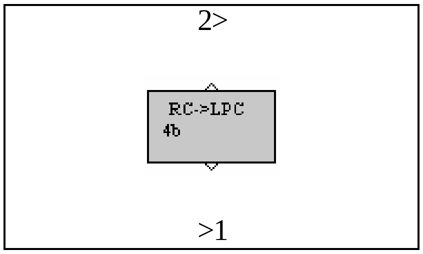
Example code: <param name = “3” value = “B3-lpc2rc(3,1)”>

M8.5

Block name : RC to LPC **Notation**: ***RC->LPC***

Description: This block computes the LP coefficients (a_i) from the reflection coefficients (k_i).

Pin assignment:



Pin	Description
1	Reflection coefficients, k_i
2	LP coefficients of order 10, a_i
3	
4	
5	
6	

Dialog window(s):

(a)RC->LPC dialog window

Script use:

Name: rc2lpc

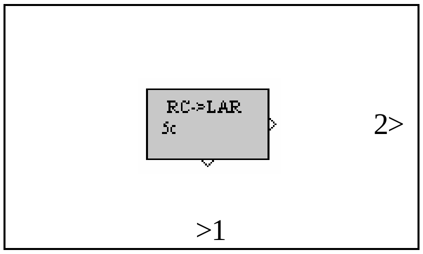
Example code: <param name = “3” value = “B3-rc2lpc(3,1)”>

M8.6

Block name : RC to LAR **Notation**: ***RC->LAR***

Description: This block converts the reflection coefficients to log area ratios (LARs).

Pin assignment:



Pin	Description
1	Reflection coefficients, k_i
2	Log area ratios (LARs)
3	
4	
5	
6	

Dialog window(s):

(a)RC->LAR dialog window

Script use:

Name: rc2lar

Example code: <param name = “3” value = “B3-rc2lar(3,1)”>

Equation(s) Implemented :

$$LAR(i) = \left(\frac{1 + k_i}{1 - k_i} \right)$$

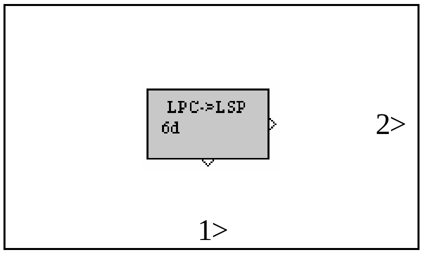
where k_i = reflection coefficients, *LAR(i)* = Log area ratio (i)

M8.7

Block name: LPC to LSP **Notation**: ***LPC->LSP***

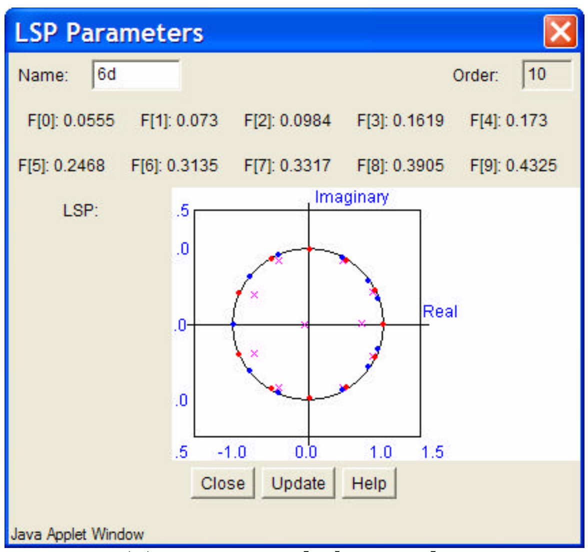
Description: This block computes the line spectral pairs (LSP) from the LP coefficients.

Pin assignment:



Pin	Description
1	LP coefficients, a_i
2	Line spectral pairs, F_i
3	
4	
5	
6	

Dialog window(s):



(a)LPC->LSP dialog window

Script use:

Name: lpc2lsp

Example code: <param name = "3" value = "B3-lpc2lsp(3,1)">

Equation(s) Implemented :

The sum polynomial F_1 (z) is given by, $F_1(z) = \dfrac{A(z) + z^{-11}A(z^{-1})}{1 + z^{-1}}$

The difference polynomial F_2 (z) is given by, $F_2(z) = \dfrac{A(z) - z^{-11}A(z^{-1})}{1 - z^{-1}}$

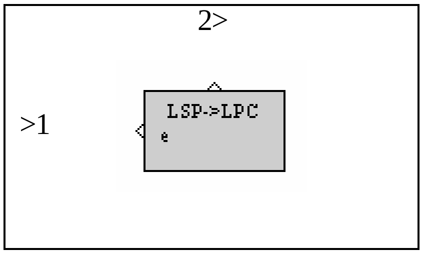
Each polynomial has five conjugate roots on the unit circle and they alternate each other.

M8.9

Block name : LSP to LPC **Notation**: ***LSP->LPC***

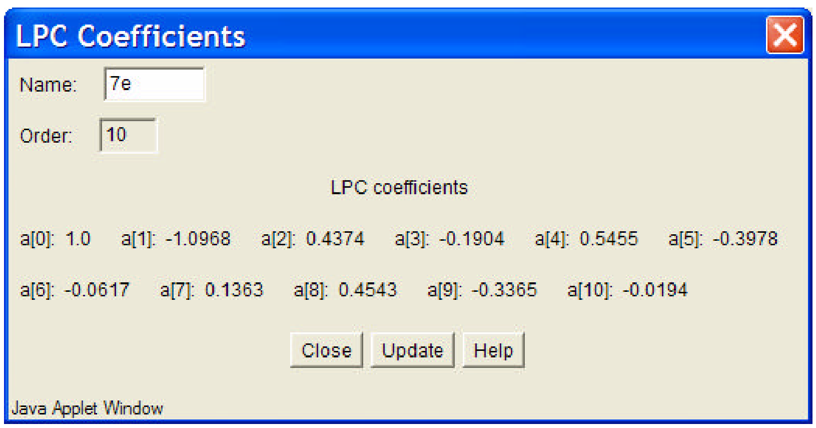
Description: This block computes the LP coefficients from the line spectral pairs.

Pin assignment:



Pin	Description
1	Line spectral pairs, F_i
2	LP coefficients, a_i
3	
4	
5	
6	

Dialog window(s):



(a)LSP->LPC dialog window

Script use:

Name: lsp2lpc

Example code: <param name = “3” value = “B3-lsp2lpc(3,1)”>

Equation(s) Implemented :

$$A(z) = \frac{F_1(z) + F_2(z)}{2}$$

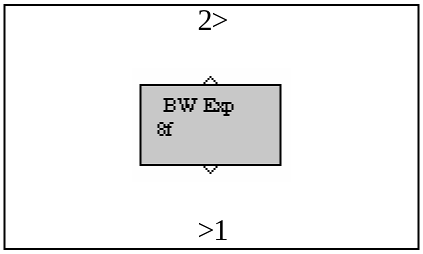
where, $F_1(z)$ = sum polynomial, $F_2(z)$ = difference polynomial, and $A(z)$ = LP filter

M8.10

Block name : Bandwidth expansion **Notation**: ***BW. Exp.***

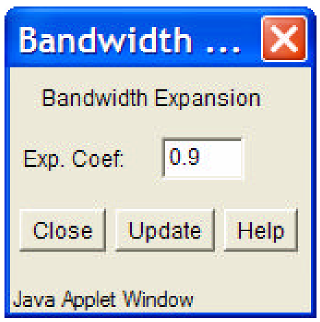
Description: This block performs the bandwidth expansion operation.

Pin assignment:



Pin	Description
1	Filter coefficients
2	Bandwidth expanded filter coefficients
3	
4	
5	
6	

Dialog window(s):



(a)BW. Exp. dialog window

Script use:

Name: BWExp

Example code: <param name = "3" value = "B3-BWExp(3,1)">

Equation(s) Implemented :

Input filter transfer function, $$H(z)=\frac{b_0+b_1z^{-1}+b_2z^{-2}...+b_{10}z^{-10}}{1+a_1z^{-1}+a_2z^{-2}...+a_{10}z^{-10}}$$

Bandwidth expanded filter, $$H_B(z)=\frac{b_0+b_1g\,z^{-1}+b_2g^{2}z^{-2}...+b_{10}g^{10}z^{-10}}{1+a_1g\,z^{-1}+a_2g^{2}z^{-2}...+a_{10}g^{10}z^{-10}}$$

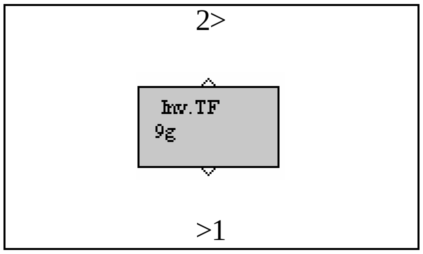
where g is the bandwidth expansion coefficient.

M8.11

Block name : Inverse Transfer Function **Notation**: ***Inv. TF***

Description: This block inverts the transfer function at its input.

Pin assignment:



Pin	Description
1	Filter coefficients
2	Inverse transformed transfer function
3	
4	
5	
6	

Dialog window(s):

-None-

Script use:

Name: Inv.TF

Example code: <param name = “3” value = “B3-Inv.TF(3,1)”>

Equation(s) Implemented :

$$\text{Input filter, } H(z) = \frac{b_0 + b_1 z^{-1} + b_2 z^{-2} \ldots + b_{10} z^{-10}}{1 + a_1 z^{-1} + a_2 z^{-2} \ldots + a_{10} z^{-10}}$$

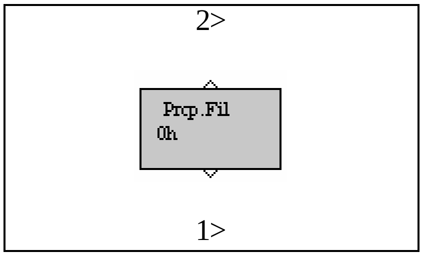
$$\text{Inverse transformed transfer function, } H_I(z) = \frac{(1 + a_1 z^{-1} + a_2 z^{-2} \ldots + a_{10} z^{-10}) / b_0}{1 + (b_1 z^{-1} + b_2 z^{-2} \ldots + b_{10} z^{-10}) / b_0}$$

M8.12

Block name : Perceptual weighted filtering **Notation**: ***Prcp.Fil.***

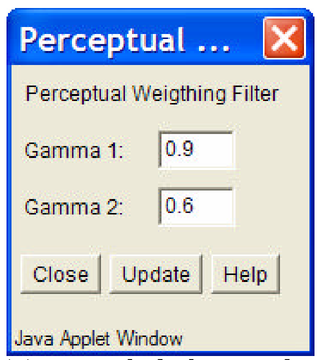
Description: This block performs the perceptual weighted filtering or simply perceptual weighting. The weights ?$_1$, ?$_2$ can be entered by the user.

Pin assignment:



Pin	Description
1	LP coefficients, A(z)
2	Perceptual weighted output, *W(z)*
3	
4	
5	
6	

Dialog window(s):



(a)Prcp.Fil dialog window

Script use:

Name: Prcp.Fil

Example code: <param name = "3" value = "B3-Prcp.Fil(3,1)">

Equation(s) Implemented :

Perceptual weighting filter is given by $W(z) = \dfrac{A(z/g_1)}{A(z/g_2)} = \dfrac{1+\sum_{i=1}^{10} g_1{}^i a_i z^{-i}}{1+\sum_{i=1}^{10} g_2{}^i a_i z^{-i}}$

g_1, g_2 are the perceptual weights, and a_i are the LP coefficients.