

Application Note AS-222

05.06.05

Pseudorandom Stimuli Following Stimulus Presentation

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Overview

This Application Note explains how to generate pseudorandom stimuli during a stimulus presentation experiment.

- In this example, a random electrical shock is delivered within a 6-second window after an image is presented to a subject.
- This routine can be used with BIOPAC software and a variety of stimulus presentation programs, including **SuperLab**[®] (Cedrus), **E-Prime**[®] (Psychology Software Tools, Inc.), and **Presentation**[®]

(Neurobehavioral Systems).

• The routine can be modified to present random stimuli.

Setup

Hardware Setup

1. Hard-wire I/O 7 to I/O 15 as the control channel to deliver the stimuli.

Software Setup

Overview

2.

Digital I/O 8 to 12 will be used to generate the delay. The Equation Generator will be used to apply a weight corresponding to the required time interval (e.g. 0.25,0 .5, 1, 2, 3 seconds) to the I/O channels. The results will be added and peak amplitude will be measured using a predetermined time after stimulus presentation when the stimuli should be delivered (from zero to six in this example).

1. MP menu > Set Up Acquisition

Set Acquisition Sample Rate to 200 samples/second and Length to 5 minutes.

Set Up acquisition fo	r '0003AB' graph '\randomstimprotoc 🗙
Record 💌 and S	ave once 💌 to Disk 💌 acquisition
Acquisition Sample Rate: 200.0	samples/second
Max acquisition length	(40928 kSamples)
Current acquisition req	uires: 223 Mbytes
Total Length: 5.0	minutes
	Þ
🗖 Repeat every 🛛	second: 🔽 for 🔽 1 times
MP menu > Set up Select "Acquire," "Plo	Channels: Analog t' and "Values" for Analog Channel A1.
📲 Input channels s	etup for '0003AB' graph '\randomstimprotoc
Acquire	Contra Contra Contra

Acquire Plot Values Channel Labe	Scaling	⊙ Analog ⊖ Calc	🔿 Digital	Presets	Channel Sample Rate
▼ ▼ ▼ ● A1 Ar	alog input			-	200.000 💌

 MP menu > Set up Channels: Digital Select "Acquire" and "Plot' for Digital Channels D7 – D15. ASS22 - Pseudorandom Stimuli Following Stimulus Presentation

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Acquire Plot Values Channel L	abel	C Analog C Calc	 Digital 	Presets	Channel Sample Ra	ite
□ □ □ • D0	Digital input			•	200.000	-
	Digital input			v	200.000	-
□ □ □ ○ D2	Digital input			•	200.000	-
□ □ □ ○ D3	Digital input			•	200.000	-
	Digital input			•	200.000	-
	Digital input			•	200.000	-
	Digital input			•	200.000	-
🗹 🗖 🗆 O D7	Digital input			v	200.000	-
V V 🗆 🗆 D8	Digital input			•	200.000	-
V V 🗆 🗆 O D9	Digital input			•	200.000	-
🗹 🗖 🗖 O D10	Digital input			•	200.000	-
🗹 🗖 🗆 O D11	Digital input			•	200.000	•
🗹 🗖 🗖 O D12	Digital input			•	200.000	-
🔽 🗖 🗖 🔿 D13	Digital input			-	200.000	-
🗹 🗹 🗆 🔿 D14	Digital input			-	200.000	-
🗹 🗹 🗆 🔿 D15	Digital input			-	200.000	-

4. MP menu > Set up Channels: Calculation

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ASS22 - Pseudorandom Stimuli Following Stimulus Presentation
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📲 Input channels	setup for '0003AB' graph '\randoms	timproto	col.acq' 🗙
Acquire Plot Values Channel L	Setup O Analog O Digital © Calc Equation abel	_ Presets	Channel Sample Rate
V V 🗆 🔍 CO	C0 - Equation Generator		200.000 💌
	max value of stim time		200.000 💌
	Calculation		200.000 💌
	Calculation		200.000 💌
🔽 🗖 🗖 🔿 C4	C4 - Rate stim marker		200.000 💌
	C5 - Rate		200.000 💌
	Calculation		200.000 💌
V V V C C7	C7 - Math		200.000 💌
V V V C C8	C8 - Equation Generator		200.000 💌
🗹 🗹 🔽 C C9	C9 - Function		200.000 💌
🗹 🗹 🗆 🔿 C C10	C10 - Difference		200.000 💌
🗹 🗖 🗋 🔿 C11	C11 - Integrate		200.000 💌
🗹 🗖 🗖 🔿 C12	C12 - Control		200.000 💌
	Calculation		200.000 💌
	Calculation		200.000 💌
	Calculation		200.000 💌

a. **C0** Apply a weight corresponding to the required time interval to I/O D8-D11. Set Calculation Channel C0 to Equation Generator and enter an equation to apply the weighted values.

Equation Genera	tor	×					
Destination							
Channel)						
Channel Label	CO - Equation Generator						
Channel Preset	Equation Generator						
	New Channel Preset						
Equation		ΟΚ					
D8*.05+D9*.1+[D10*.2+D11*.4						
		Cancel					
Sources							
A1 D7	D8 D9 D10 D11						
Choose a chann	el source						
-Functions/Opera	ators	Clear					
+ -	× / ^ (
		Scaling					
Choose an opera	ator						

b. C1 Identify the maximum value of the weighted stimuli presentation.
 Set Calculation Channel C1 to Rate Detector > Function = Peak maximum

Rate Detector Setup	×
ChannelC1Channel Labelmax value of stim timeChannel PresetRate	
Source C0, C0 - Equation Generate Sample rate: 200.000 samples	s/sec
Function Peak maximum Remove baseline Polarity Auto threshold detect Polarity	
Threshold level: 0.25 Volts Peak Interval Window Windowing Units BPM Windowing Units BPM Volts Minimum: 40 Volts Maximum: 180 mV	Show Threshold
New Channel Preset	Cancel

c. C4 Extract the time of stimulus presentation.
 Set Calculation Channel C4 to Rate Detector > Function = Peak time (sec)

Rate Detector S	etup		×
Channel	C4		
Channel Label	C4 - Rate sti	m marker	
Channel Preset	Rate		
Source D8, D Sample rate: 20)igital input	▼ sample	s/sec
Function Peak	time (sec) 🔻	[
 Remove base Auto threshol 	eline d detect	Polarity	
Threshold level:	2	Volts	
Peak Interval W Windowi	/indow ng Units Sec	conds 💌	Show-
Minimum: 0.3	333 Sec	onds	
Maximum: 1.5	Sec	onds	Modified
New Channel Pr	eset	OK	Cancel

d. **C7** Add the time of stimulus presentation to the interval required. Set Calculation Channel C7 to Math: C4 + C1

Math Setup
Destination
Channel C7
Channel Label C7 - Math
Channel Preset Math
Source 1 C4, C4 - Rate stim marker 💌
Sample rate: 200.000 samples/sec
Operand +, Addition
Source 2 C1, max value of stim time 💌
Sample rate: 200.000 samples/sec
Constant 0
New Channel Preset Scaling OK Cancel

e. **C8** Subtract the current time from the time when the stimuli should be delivered; this function crosses zero at time of stimuli presentation.

Equation Genera	tor		×				
Destination							
Channel	C8						
Channel Label	el Label C8 - Equation Generator						
Channel Preset	Equation Generator						
	New Channel Preset						
Equation							
TIME-C7							
		Cancel					
Ľ.							
Sources							
A1 D7	D8 D9 D10 D11						
Choose a chann	el source						
-Functions/Opera	ators	Clear					
+ -	× / ^ (
		Scaling					
Choose an opera	ator						

Set Calculation Channel C8 to Equation Generator: Time-C7.

f. **C9** Use the Threshold function (Transform > Function >Threshold) to establish an Integration of 40 samples at 200 Hz (this example uses a 200 msecs stimuli).

Set Calculation Channel C9 to Function: Threshold and set the upper and lower levels.

Function Setup		×
C Destination		
Channel	C9	
Channel Label	C9 - Function	
Channel Preset	Function	
Source C8, C	8 - Equation Genera	<mark>atr</mark> ▼ Scaling
Sample rate: 2	200.000	samples/sec
Sample rate: 3	200.000 shol 💌	samples/sec
Sample rate: 2 Function Three Lower: 0.1	shol 🔽 Volts	samples/sec
Sample rate: 2 Function Three Lower: 0.1 Upper: 0.2	shol 💌 Volts Volts	samples/sec

g. Perform a one interval Difference on the Threshold result.

C10 Set Calculation Channel C10 to Difference: Source C9, Intervals 1

Difference Setup							
	- Destination						
	Channel	C10					
	Channel Label	C10 - Difference					
	Channel Preset	Difference					
	Source C9, C9	3 - Function 💽 Scaling.					
	Sample rate: 200.000 samples/sec						
	Intervals between Samples 1						
	New Channel Pr	reset OK Cancel					

h. **C11** Integrate the result of C10 (this example uses a 200 msecs stimuli). Set Calculation Channel C11 to Integrate: Average over samples: 40 samples at 200 Hz

Integrate Setup		×						
Destination								
Channel:	C11							
Channel Label:	C11 - Integrate							
Channel Preset:	Integrate							
Source channel:	C10, C10 - Difference	Scaling						
Sample rate: 200.000	samples/sec							
Option Option O Reset via channel								
Samples: 40 Control Channel: A1, Analog input								
	Beset thresholds	sampicarace						
Parameters		Volte						
C Bectifu								
Boot mean square	HIGH JO.00000	Volts						
	Reset trigger							
	Positive	ean subtraction						
	C Negative Period	cycle 1.00000 sec						
New Channel Preset		Cancel OK						

i. C12 Direct the output to Digital I/O 7.
 Set Calculation Channel C12 to Control > Output D7.
 Adjust the Threshold function and Levels to determine when or if the stimuli will be presented.

Ca	ntrol Set	up				×
	C12, C12	- Con	trol			
	Source:	C11	, C11 - Int	egrate	•	
	Sample ra	ate:	200.000		samples/sec	
	Output:		D7		•	
	– Threshol	d Fun	ction: —			1
	0	L2 L1 = Out =	A	۲	L2 L1 Out	
	o	L2 L1 = Out =	Ð	0	L^2 L^1 Out	
	Level (L2 Level (L1)):):	1		Volts Volts	
		0	ĸ		Cancel	

5. Save the set up (File > Save As).

Recording

1. Press "Start" in the BIOPAC software window to begin acquiring data.



- 2. Press "Stop" in the BIOPAC software window to stop acquiring data.
- 3. Save the data (File > Save).

Return To Application Note Menu