

A FLEXIBLE MONOPOLAR STIMULATOR FOR ANIMAL STUDIES IN AUDITORY PROSTHESES

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1. Introduction

- This paper presents the design of a bench-top monopolar stimulator (BT-MoSTM) that can be used for animal studies in cochlear implants.
- The stimulator is controlled by three high-speed digital Input/Output (I/O) cards manufactured by National Instruments Corporation and is electrically isolated.
- stimulator provides sixteen independently • The controlled charge-balanced monopolar channels, each varying in stimulation parameters.
- Four stimulation patterns, which are symmetric biphasic, non-symmetric biphasic, triphasic and amplitude modulate biphasic, are available in either simultaneous or interleaved modes.
- A user-friendly and intuitive MATLAB Graphical User Interface (GUI) is provided with the stimulator board to simplify its control and use.

2. System Overview



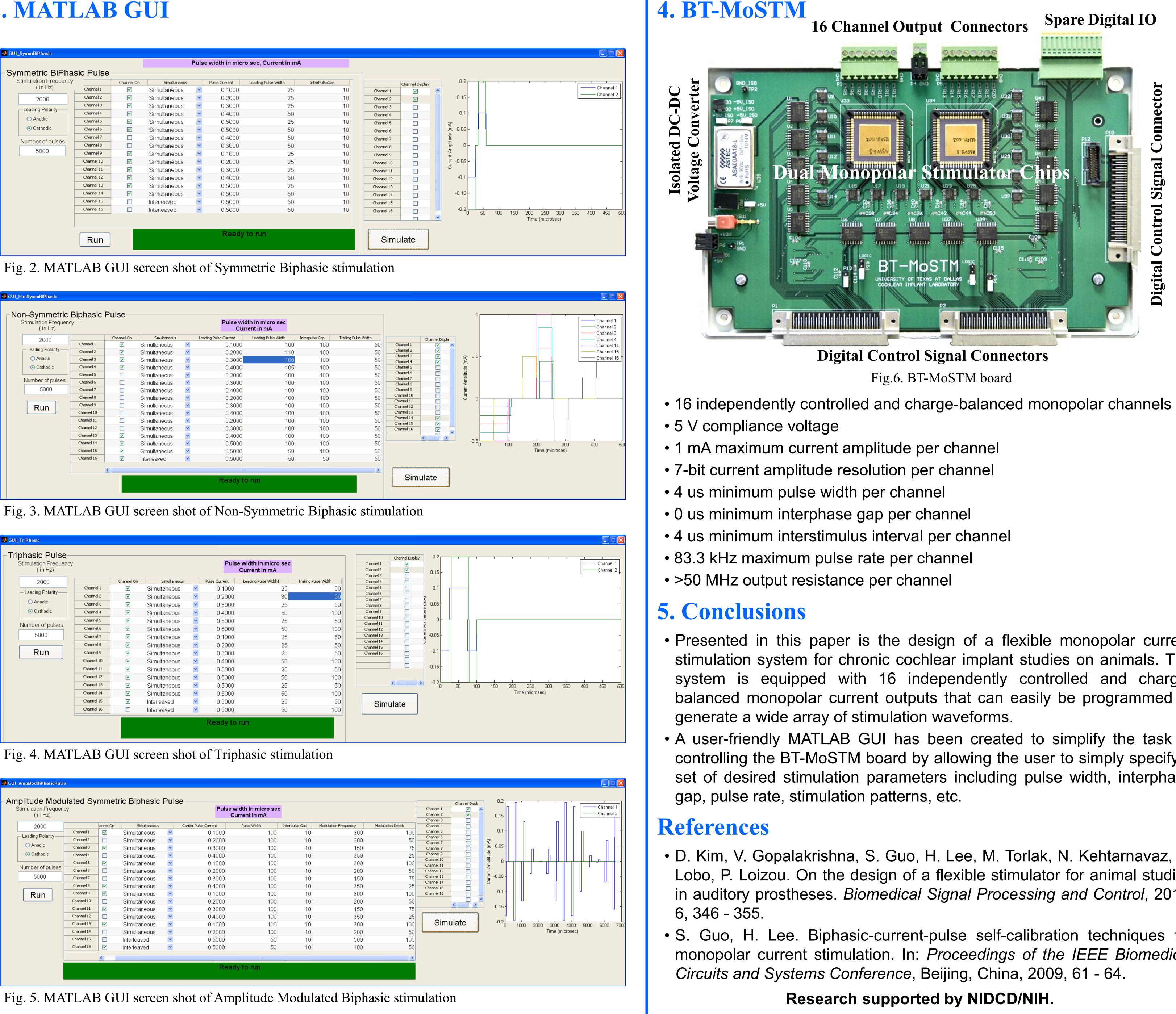
MATLAB GUI



BT-MoSTM



3. MATLAB GUI

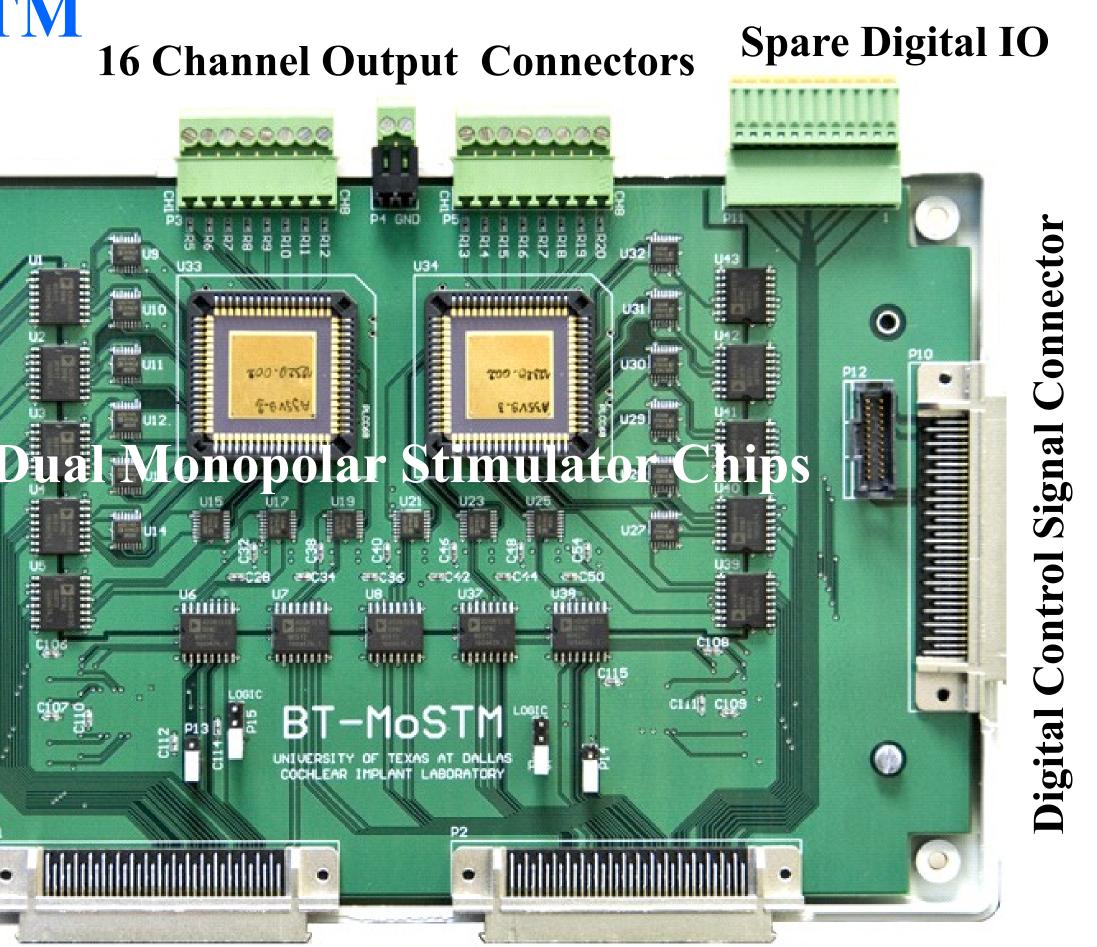


mulation Frequen (in Hz)	cy					dth in micro sec rent in mA				
2000		Channel On	Simultaneous		Leading Pulse Current	Leading Pulse Width	Interpulse Gap	Trailing Pulse Width		Channel Di
	Channel 1	~	Simultaneous	~	0.1000	100	100	50	Channel 1	
Leading Polarity	Channel 2		Simultaneous	*	0.2000	110	100	50	Channel 2 Channel 3	
 Anodic 	Channel 3		Simultaneous	*	0.3000	100	100	50	Channel 4	 ✓ ✓
 Cathodic 	Channel 4	~	Simultaneous	~	0.4000	105	100	50	Channel 5	
	Channel 5		Simultaneous	*	0.2000	100	100	50	Channel 6 Channel 7	
umber of pulses	Channel 6		Simultaneous	~	0.3000	100	100	50	Channel 8	
5000	Channel 7		Simultaneous	*	0.4000	100	100	50	Channel 9	
	Channel 8		Simultaneous	*	0.2000	100	100	50	Channel 10	
Run	Channel 9		Simultaneous	~	0.3000	100	100	50	Channel 11 Channel 12	
Kull	Channel 10		Simultaneous	~	0.4000	100	100	50	Channel 13	
	Channel 11		Simultaneous	~	0.2000	100	100	50	Channel 14	
	Channel 12		Simultaneous	~	0.3000	100	100	50	Channel 15 Channel 16	
	Channel 13	Image: A start of the start	Simultaneous	~	0.4000	100	100	50		
	Channel 14		Simultaneous	~	0.5000	100	100	50		<
	Channel 15		Simultaneous	~	0.5000	50	100	50		
	Channel 16		Interleaved	~	0.5000	50	50	50		
		-							(
	Ready to run									ulate

GUI_TriPhasic										
Triphasic Pulse Stimulation Frequency (in Hz)				Channel 1 Channel 2	Channel Display	0.2				
2000		Channel On	Simultaneous		Pulse Current	Leading Pulse Width1	Trailing Pulse Width	Channel 3 Channel 4		
	Channel 1	~	Simultaneous	~	0.1000	25	50	Channel 5		0.1 -
 Leading Polarity 	Channel 2	V	Simultaneous	~	0.2000	30	50	Channel 6 Channel 7		-
🔿 Anodic	Channel 3	~	Simultaneous	~	0.3000	25	50	Channel 8		C 0.05 -
💿 Cathodic	Channel 4		Simultaneous	~	0.4000	50	100	Channel 9		200
	Channel 5	~	Simultaneous	~	0.5000	25	50	Channel 10 Channel 11		0 -
Number of pulses	Channel 6	~	Simultaneous	~	0.5000	50	100	Channel 12		τ
5000	Channel 7	 Image: A start of the start of	Simultaneous	~	0.1000	25	50	Channel 13		-0.05 -
	Channel 8	~	Simultaneous	~	0.2000	25	50	Channel 14 Channel 15		5
Run	Channel 9	~	Simultaneous	~	0.3000	25	50	Channel 16		-0.1
	Channel 10	~	Simultaneous	~	0.4000	50	100			
	Channel 11	~	Simultaneous	~	0.5000	25	50			-0.15 -
	Channel 12	~	Simultaneous	~	0.5000	50	100			
	Channel 13	~	Simultaneous	~	0.5000	25	50		<	-0.2
	Channel 14	~	Simultaneous	~	0.5000	50	100			-
	Channel 15	~	Interleaved	~	0.5000	25	50	Sim	ulata	
	Channel 16		Interleaved	~	0.5000	50	100	511	ulate	
					Ready to	run				

JI_AmpModBiPhasicPuls	8									
mplitude Modu	ulated Sv	mmoti	ria Rinhasia	Dul	50					
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Stimulation Frequen (in Hz)	су					e width in micro sec Current in mA				Channel 1 Channel 2
(1111/2)						Current III IIIA				Channel 3
2000		hannel On	Simultaneous		Carrier Pulse Current	Pulse Width	Interpulse Gap	Modulation Frequency	Modulation Depth	Channel 4
Looding Delerity	Channel 1		Simultaneous	*	0.1000	100	10	300	100	Channel 5
Leading Polarity	Channel 2		Simultaneous	*	0.2000	100	10	200	50	Channel 6 Channel 7
🔿 Anodic	Channel 3		Simultaneous	~	0.3000	100	10	150	75	
💿 Cathodic	Channel 4		Simultaneous	~	0.4000	100	10	350	25	Channel 9
·	Channel 5		Simultaneous	~	0.1000	100	10	300	100	Channel 10
Number of pulses	Channel 6		Simultaneous	~	0.2000	100	10	200	50	Channel 11 Channel 12
5000	Channel 7		Simultaneous	~	0.3000	100	10	150	75	Channel 13
	Channel 8		Simultaneous	~	0.4000	100	10	350	25	Channel 14
Dur	Channel 9		Simultaneous	~	0.4000		10			Channel 15 Channel 16
Run	Channel 10	-				100		300	100	
			Simultaneous	~	0.2000	100	10	200	50	
	Channel 11		Simultaneous	~	0.3000	100	10	150	75	·····
	Channel 12		Simultaneous	*	0.4000	100	10	350	25	
	Channel 13		Simultaneous	*	0.1000	100	10	300	100	Sir
	Channel 14		Simultaneous	*	0.2000	100	10	200	50	L
	Channel 15		Interleaved	*	0.5000	50	10	500	100	
	Channel 16		Interleaved	*	0.5000	50	10	400	50	
		< <)>	
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Digital Control Signal Connectors Fig.6. BT-MoSTM board

• Presented in this paper is the design of a flexible monopolar current stimulation system for chronic cochlear implant studies on animals. The system is equipped with 16 independently controlled and chargebalanced monopolar current outputs that can easily be programmed to

• A user-friendly MATLAB GUI has been created to simplify the task of controlling the BT-MoSTM board by allowing the user to simply specify a set of desired stimulation parameters including pulse width, interphase

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• S. Guo, H. Lee. Biphasic-current-pulse self-calibration techniques for monopolar current stimulation. In: Proceedings of the IEEE Biomedical Circuits and Systems Conference, Beijing, China, 2009, 61 - 64.

Research supported by NIDCD/NIH.