TI Stimulation Virtual Bench

Waveform Visualiser

Parameter settings:

I1	
Frequency 1 (Hz)	**2000**
Phase 1 (Degrees)	**0**
Amplitude 1 (mA)	**1**
I2	
Frequency 2 (Hz)	**2010**
Phase 2 (Degrees)	**180**
Amplitude 2 (mA)	**1**

Inspect the waveform of the applied currents and voltages.
Is the amplitude of the current or voltage modulated? Why or Why Not?

	Current	*Voltage*
Modulated?		

If modulation is observed – why?

Inspect the spectrum of the sum current.
Does it have a frequency component at Δf ? Why or Why Not?

Inspect the waveform and spectrum of the sum current.
What is the maximum amplitude?

What is the envelope amplitude ((maximum envelope – minimum envelope)/2)?

Decrease the amplitude of I1 (Ampitude 1) to 0.5 mA.
Increase the amplitude of I2 (Amplitude 2) to 1.5 mA.
Inspect the waveform and spectrum of the sum current.
Is the maximum current different?

Is the envelope amplitude different? Why?

Field Distribution Visualiser

Switch to the Field Distribution Visualiser tab, and apply the following settings:

Parameter Settings:

Pair A Electrodes	
A+	**E11**

A-	**E8**
f1 (Hz)	**2000**
I1 (mA)	**1**
Pair B Electrodes	
B+	**E1**
B-	**E4**
f2 (Hz)	**2010**
I2 (mA)	**1**

Inspect the locus of the TI stimulation (envelope modulation amplitude) in the x and y directions.
Which one is stronger?

Change A+ to E10 and B+ to E2
How does it affect the TI stimulation locus?

Change the Pair A current I2 amplitude to 0.5mA
Change the Pair B current I2 amplitude to 1.5mA
What is current sum and current amplitude ratio?

How does it affect the location of the TI locus relative to the electrodes?

Change the Pair A current I1 amplitude to 0.2 mA
Change the Pair B current I2 amplitude to 1.8 mA
What is current sum and current ratio?

How does it affect the location of the TI locus relative to the electrodes?

Switch back to the Waveform Visualiser tab.

FSK TI stimulation

Change to TI stimulation with frequency shift keying (FSK) waveform and set the following parameters:

I1 Parameters	
Frequency 1 (Hz)	**2000**
Phase 1 (Degrees)	**0**
Amplitude I1 (mA)	**1**
I2 Parameters	
Freq 2 Outside Pulse (Hz)	**2000**
Freq 2 Inside Pulse (Hz)	**2100**
Phase 2 (Degrees)	**180**
Amplitude I2 (mA)	**1**

FSK Parameters	
Pulse Repetition Frequency (Hz)	**10**
Number of Pulses	**1**

Inspect the waveform of the applied **currents**.
The simulation speed can be slowed down with the 'Time Speed' slider in the Playback controls. The simulation can also be paused with the pause button in the Playback controls.

Is the frequency shift evident in I2?

Inspect the spectrum of the applied currents.
How does it differ from normal TI stimulation?

Inspect the spectrum of the sum current.
How does it differ from the individual applied currents?

Does it have a frequency component at Δf ?

How is the pulse repetition frequency evident in the spectrum?

Change Phase 2 to various values (0, 90, 180, 270)
How does the phase delay between the currents affect the sum current?

Change Phase 2 to 180 degrees
Change Freq 2 inside pulse to 2020Hz
Change PRF to 5Hz
What is the time from frequency switch onset to offset?

Change Number of Pulses to 3
What is the time from frequency switch onset to offset? Why?

Set the parameters to 100Hz Δf, every 200ms, with 50ms between frequency switch onset and offset.

PWM TI stimulation

Change to TI stimulation with PWM waveform and set the following parameters:
Parameter settings:

I1	
Frequency 1 (Hz)	**2000**
Phase 1 (Degrees)	**0**
Amplitude 1 (mA)	**1**
I2	
Frequency 2 (Hz)	**2010**
Phase 2 (Degrees)	**180**
Amplitude 2 (mA)	**1**

Inspect the waveform and spectrum of the sum current.
How does it differ from normal TI stimulation?

Does it have a frequency component at Δf ?