

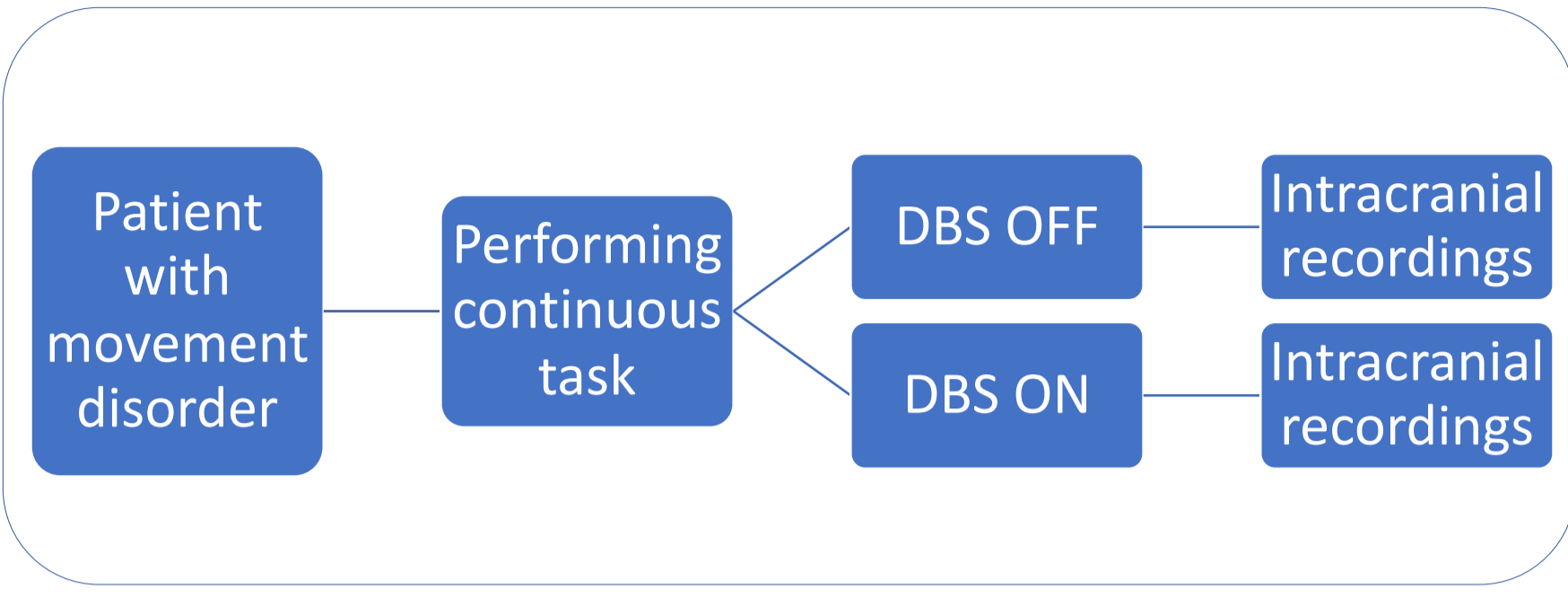
# The effect of deep brain stimulation on task-related and task-unrelated frequencies of deep brain signals in both contralateral and ipsilateral hemispheres during performing a continuous task: a case study

P2.059

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## INTRODUCTION



## CONCLUSION

- The frequency content of signals acquired from intracranial recordings during the continuous task consist of two distinct components that correspond to **voluntary movements**, referred to as **task-related frequencies**, and **involuntary movements** and background activity, referred to as **task-unrelated frequencies**.
- DBS is associated with: 1. **increase** of power of task-related frequency components, 2. **change of pattern** of abnormal frequency power in basal ganglia and thalamus.
- Future work:** We are currently using different methods to decompose task-unrelated frequencies to involuntary and background components. Moreover, we are looking into the relation between task-unrelated frequency components found in intracranial recordings and in kinematic and EMG data.

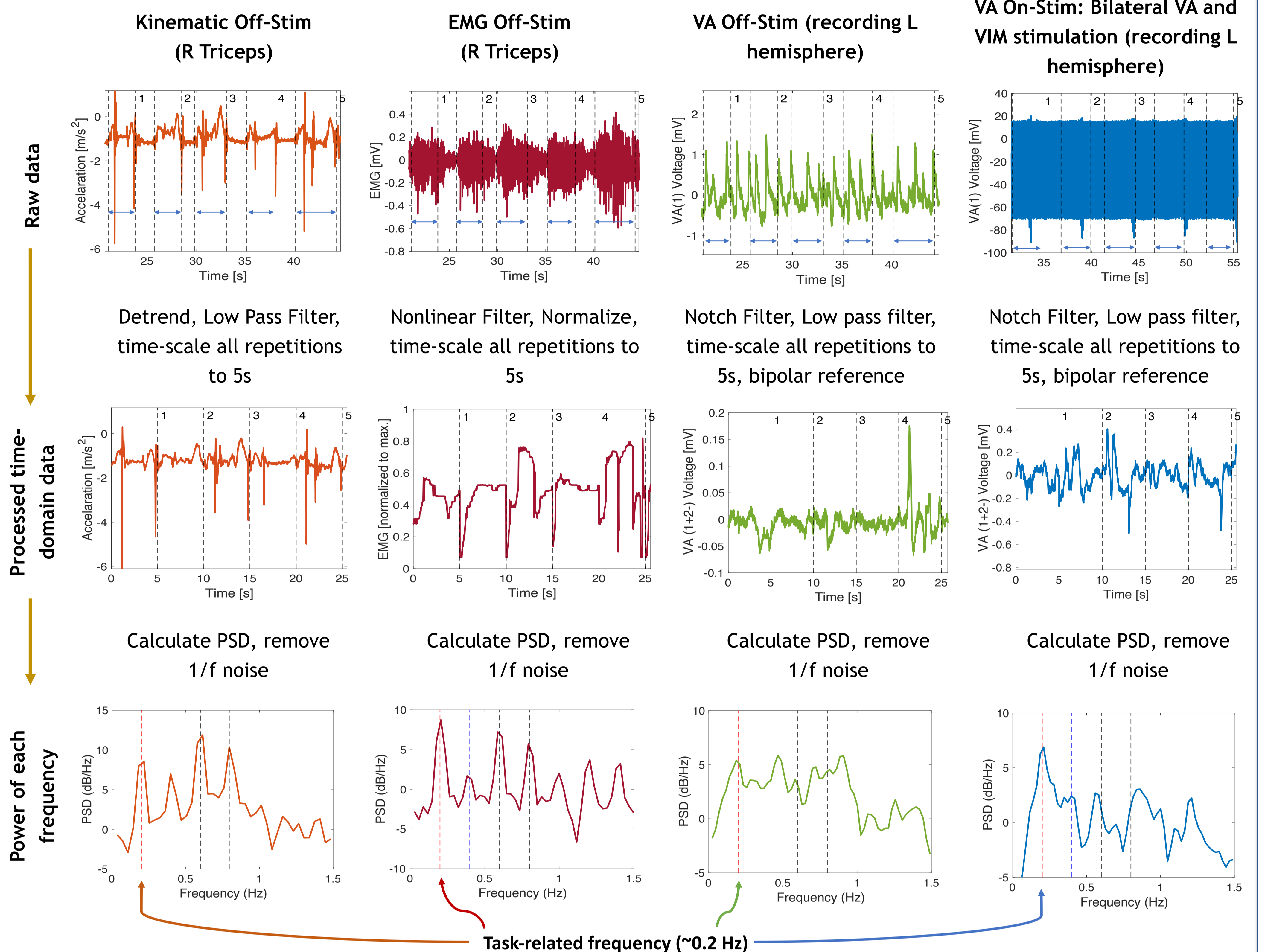
## Methods

- Patient:** A 24 yo male with unknown diagnosis, with dystonic tremor present bilaterally.
- DBS:** Patient had previous implanted leads in the Ventral Intermediate (VIM), at next implantation 8 temporary depth leads, each consisting of 10 recording microcontacts, were implanted into Globus Pallidus Internus (GPi), Ventral Oralis/Subthalamic Nucleus (VoSTN), Ventral Anterior (VA) nuclei and pedunculopontine nucleus (PPN) [3] in both hemispheres. Stimulation was sent **bilaterally** to VA leads at 90 Hz (with bursts at 5 Hz) and VIM leads at 150 Hz.
- Task:** Multiple repetitions of a continuous point-to-point task (Fig. 1) was performed using **right** hand in two conditions: 1. "Off-Stim" and 2. "On-Stim".
- Recording:** 3 types of signals were recorded in both task conditions:
  - Intracranial activity through high impedance depth electrodes
  - Kinematic data using the accelerometer sensors
  - Hand muscle activity using electromyography (EMG) sensors

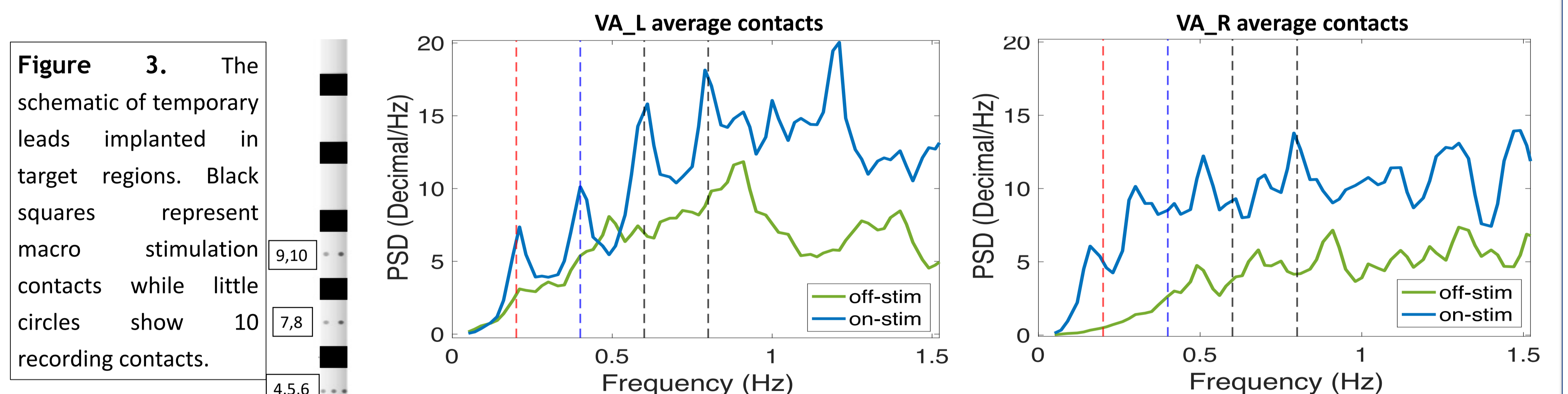
**Figure 1.** Point-to-point task. Each repetition is going from big green button to colored button and coming back. The colored LEDs indicate the target, which changes randomly with each repetition.



## RESULTS



**Figure 2.** Signal types (columns) and processing steps (rows) for 5 task repetitions. Left to Right: Accelerometer data from right triceps, EMG of right triceps, intracranial data from Left VA in the "Off-Stim" condition, and intracranial data from Left VA in the "On-Stim" condition with bilateral stimulation in VA and VIM. Repetitions were time-scaled to 5 seconds and concatenated together. Power Spectral Density was calculated on all signals, with task-related activity in the frequency domain expected to be 0.2 Hz and its first three harmonics, which are seen in PSDs of all signals.



**Figure 3.** The schematic of temporary leads implanted in target regions. Black squares represent macro stimulation contacts while little circles show 10 recording contacts. **Figure 4.** PSD Comparison of recording VA-L average (left panel) and VA-R average (right panel) when task was performed with right hand. The power of task-related frequencies increases during DBS compared to that of the non-stimulated, more in contralateral side to the task.

Frequency range (Hz)	Task-related	GPi_L			PPN_L			VoSTN_L			VA_L					
		0 - 4	4 - 13	13 - 30	0 - 4	4 - 13	13 - 30	0 - 4	4 - 13	13 - 30	0 - 4	4 - 13	13 - 30			
Off-Stim Power	6	898	764	996	5	879	1190	896	17	993	601	991	9.86	702	596	1020
On-Stim Power	11	1425	759	923	20	1332	782	836	70	1847	655	792	20.61	1303	875	853

**Table 1.** Power comparison on-stim vs off-stim of task-related frequency (~0.2 Hz) and task-unrelated frequencies (frequencies up to 30 Hz excluding task-related frequency), in all regions, where recording contacts are averaged. The power of task-related frequencies increases during DBS compared to that of the non-stimulated, in all regions. The pattern of power of task-unrelated frequencies changes during DBS compared to that of the non-stimulated, showing a decrease in higher frequencies but increase in lower ones. Task-unrelated frequencies can be associated with abnormal motions caused by dystonia, tremor and background brain activity.

## REFERENCES

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## CONNECT WITH ME!



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