Visualizing Deep Brain Stimulation Settings in Obsessive Compulsive Disorder

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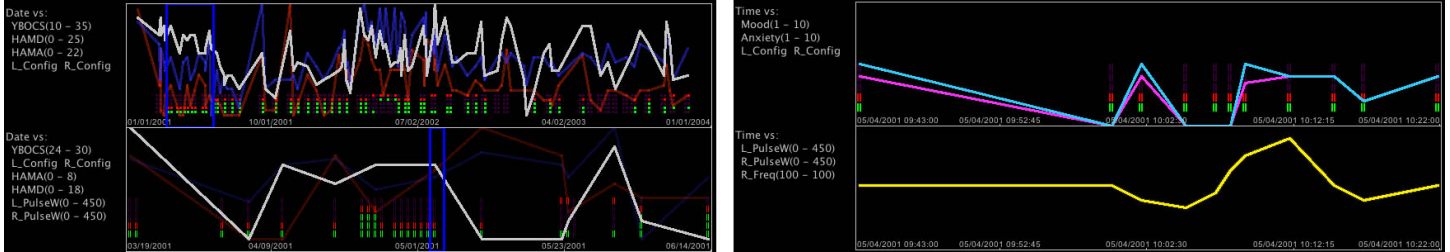*Butler Hospital, Providence RI*

Figure 1: Our system in use. On the left, the YBOCS measure (white) and electrode configurations (red and green boxes) are displayed at coarse scales. On the right, mood (blue), anxiety (magenta) and pulse width (yellow) are displayed for a single forty-minute adjustment session. The user selected this session using interval windows (blue) in the coarse scale view.

We present a visualization system to explore data collected on Deep Brain Stimulation (DBS) for Obsessive Compulsive Disorder (OCD). DBS is a new surgical treatment in which electrodes are inserted into a patient's brain. After surgery, settings for the electrodes must be adjusted to find the stimulation that best reduces symptoms. Our tool is designed for interactively exploring relationships between the electrode settings and patient response. This visual exploration allows us to develop intuitions and tentative relationships to target with statistical analyses.

1 Background

OCD is an anxiety disorder in which the individual is overcome by fears, anxieties, thoughts or impulses. In response to these obsessions, the individual performs certain acts or rituals, often repetitively. Approximately 2% of the national population is diagnosed with OCD.

Around 30-50% of patients do not respond entirely to modern behavioral or pharmacological treatment. Of those that do respond, many are unhappy with the side effects, and discontinue treatment. Severe OCD has been successfully treated by directed lesioning of the brain. DBS is just starting to be used as an alternative in these cases.

The effectiveness of DBS greatly depends on the settings of control parameters. Many electrical properties can be adjusted, such as pulse width and current. These settings change which areas of the brain are stimulated, as well as which tissue types are most affected.

Complicating matters further is the fact that the effects of a certain stimulation may not appear until the patient has spent hours or days with the setting. In our project, we tried to find relationships between settings and patient response for both long- and short-term data.

2 The System

Our system produces 2D visualizations from data stored in a SQL database. It can produce several types of representations, including glyphs representing which electrodes are on, line graphs and scatter plots.

The user can explore short-term data within a long-term context by viewing the data at multiple time scales. The scales are linked together by specifying interval windows in a coarse-scale visualization. The user can set the minimum and maximum values of finer scales by changing this interval.

The user can also constrain the data by entering SQL code fragments that our system inserts into its queries. This is used, for example, to limit the data to certain electrode configurations, or to show only the so-called "pre" data — the first ratings collected in a day.

3 Results

Using our tool, we noticed that mood and anxiety, two of the acute measures, tend to be inversely related. This is consistent with prior clinical experience. This success is important because two groups arrived at this finding independently — one using only our tool, and one from clinical experience.

We also found some adjustment sessions with links between pulse width and mood/anxiety. However, it is hard to tell how this affects the chronic symptoms, since the settings were often changed by the end of the day.

Finally, our collaborators are excited by the prospect of being able to inspect this previously intimidating data set. They also became more convinced that they did not vary settings in a controlled enough way. There are few sessions aimed at varying only one parameter and keeping the rest constant. This makes it hard to find relationships using any method. In the future, there may be more effort to vary parameters systematically.

4 References

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