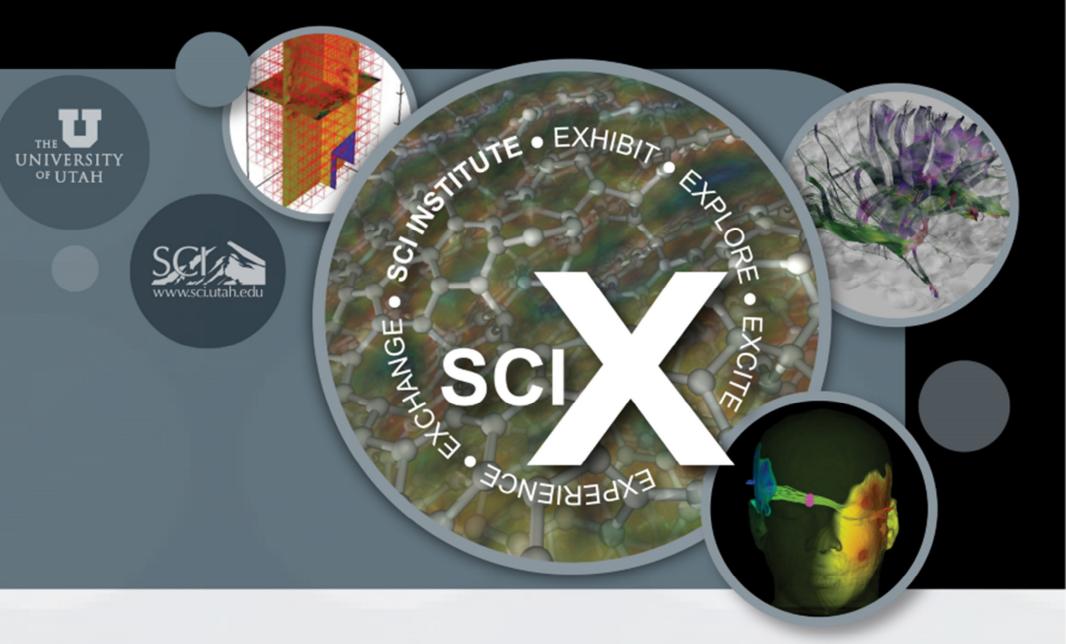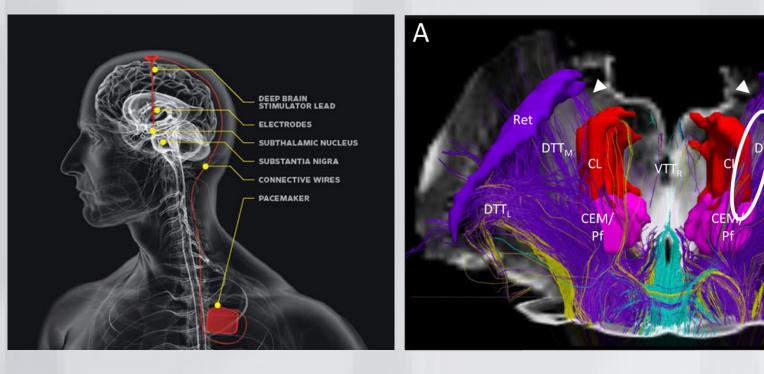# Patient-Specific Computational Modeling Aids Deep Brain Stimulation Therapies

Andrew Janson, Johannes Vorwerk PhD, Christopher R. Butson PhD
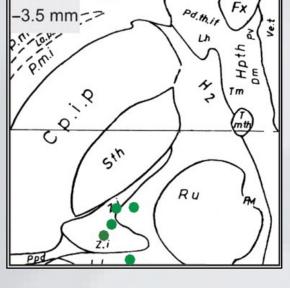
Can we use computational models to guide the clinical application of deep brain stimulation (DBS) therapy?
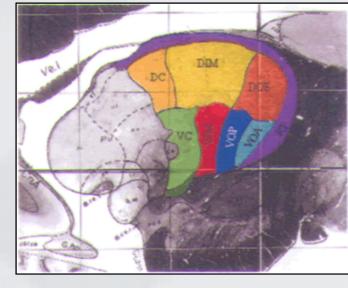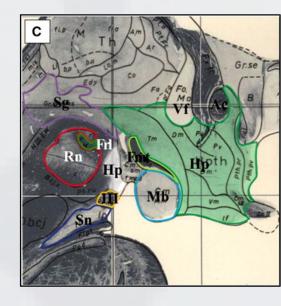
What is the Stimulation Target?

Each disorder treated by DBS has a different target in the brain and new applications of DBS are targeting fiber pathways.

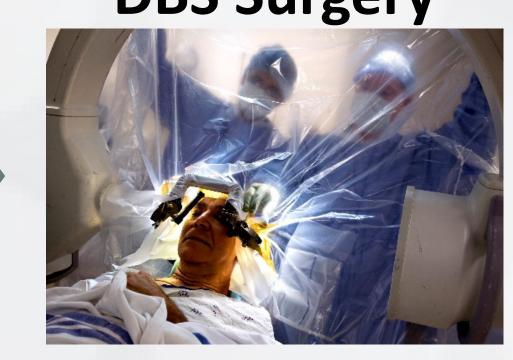### Atlas-Based Surgical Planning

The current approach for determining surgical placement of the electrode relies on atlases that do not necessarily represent the patient.

Pre-surgical Planning

1. Pre-surgical planning to identify where to place the DBS lead, integrating existing knowledge of stimulation targets.

DBS Surgery

2. Surgical implantation of the DBS lead at the location identified in the pre-surgical plan.
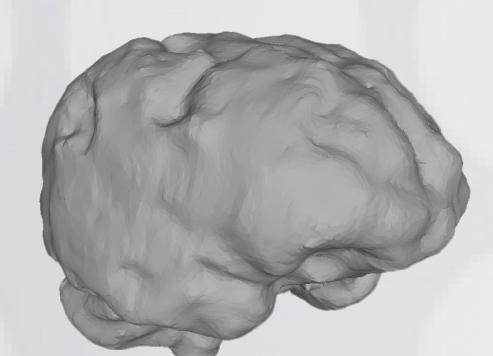
Post-Operative Care

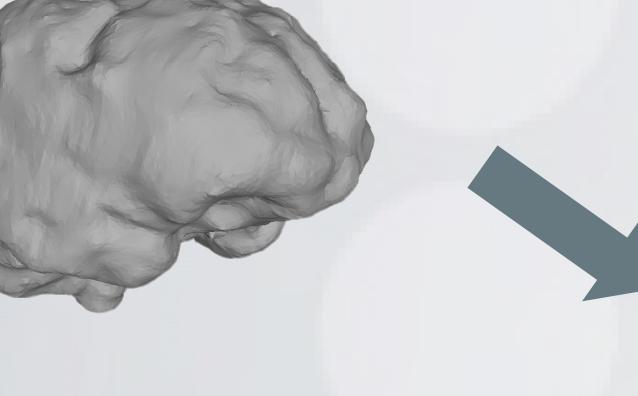3. Post-operative programming of the device to provide therapeutic effect.

Patient-Specific Computational Modeling Pipeline

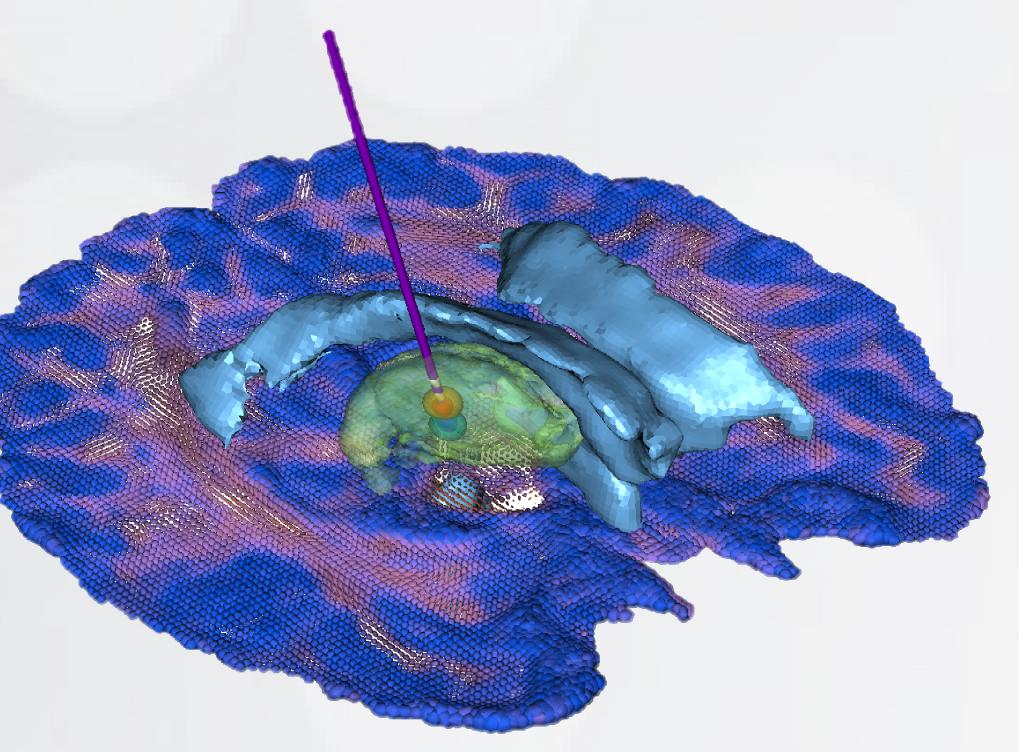### 3D Reconstruction of the Patient's Brain

Biophysical Model of DBS

3D Representation of Electrode Geometry

Diffusion Tensor Imaging and Tractography
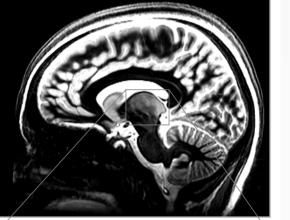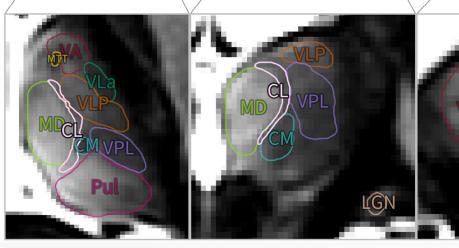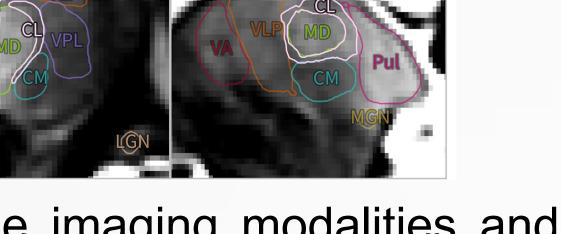

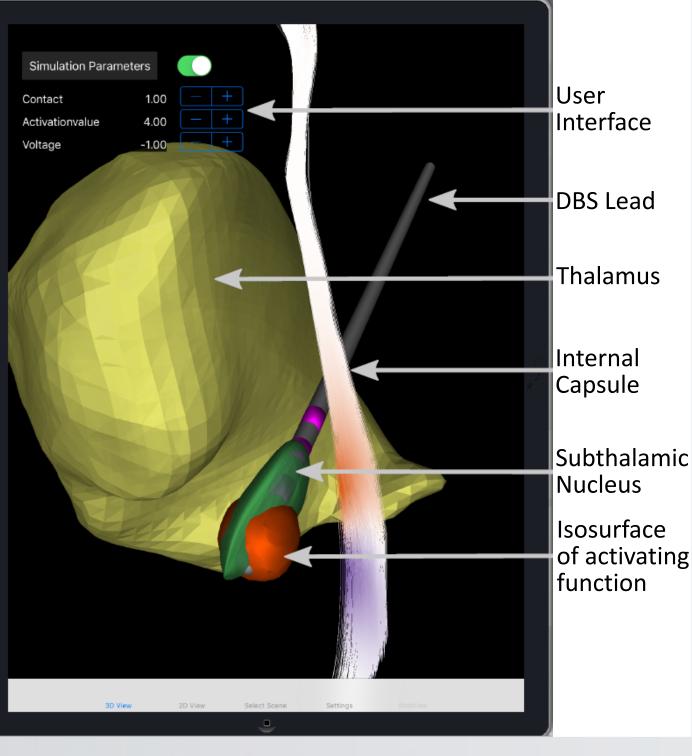### Patient-Specific Anatomical Segmentation

Patient-specific models incorporate both the anatomy and physical properties of the patient's brain. We incorporate multiple imaging modalities and physical representation of electrode geometries to simulate the effects of DBS. These models help determine where to place the lead before it is implanted in the patient, as well as aid clinicians in selecting therapeutic stimulation settings by visualizing the effects of stimulation.

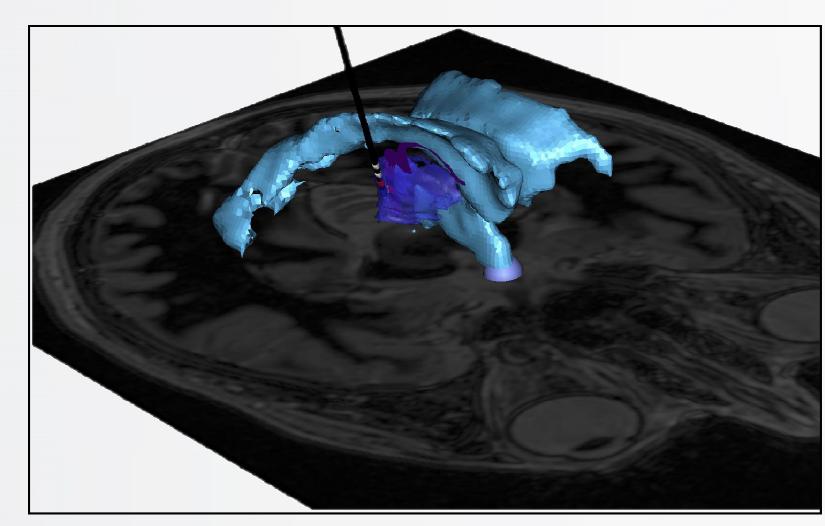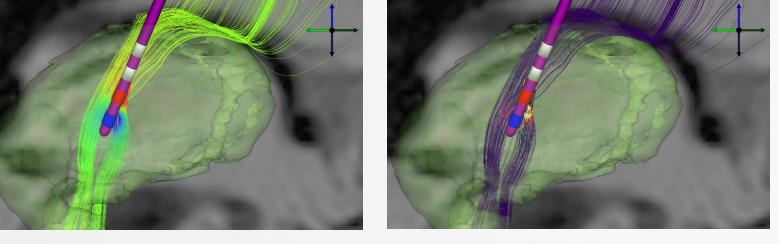## Clinical Studies

Remote Management of DBS Patients

The goal of this study is to improve access to DBS programming using a mobile decision support system over the Utah Education & Telehealth Network (UETN) to help clinicians at remote hospitals to manage patients who are receiving DBS therapy. It is costly for patient's to travel to DBS centers and this system allows them to be programmed closer to home.

Central Thalamic DBS for Traumatic Brain Injury

The goal of this study is to target specific fiber pathways responsible for arousal regulation in patients with cognitive deficiencies. This is a novel therapy and these targets are difficult to identify. Our models aid in determining placement of the electrode prior to surgery to give DBS therapy the best chance of success. These models will also guide post-operative programming to determine the best therapeutic stimulation settings.

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