The role of imaging in programming deep brain stimulation

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DBS programming

- Complex, time-intensive process requiring expert clinical adjustments

- Initial programming relies on healthcare professionals' (neurologists, specialist nurses) experience and trial-and-error adjustments: time consuming process and lead to variability in patient outcomes and prolonged optimization periods.

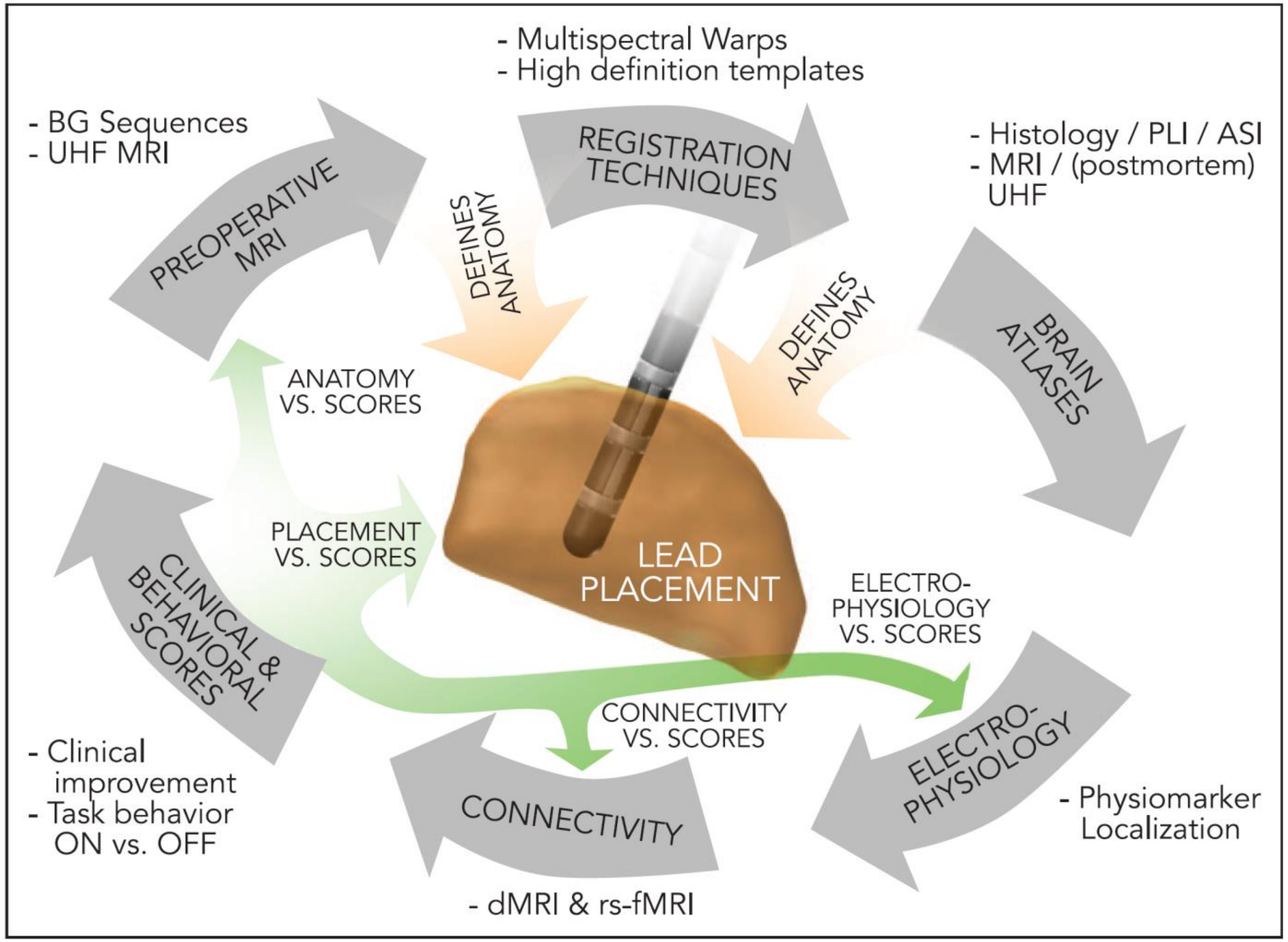
- Recent advancements in AI have introduced AI-assisted DBS programming, which leverage machine learning algorithms to streamline initial parameter selection

The importance of neuroimaging in programming

- Improving the visualization of brain networks to create patient-specific treatment plans
- Predicting and evaluating the clinical outcome
- Enhancing the overall effectiveness and safety of DBS

The impact of modern-day neuroimaging on the field of deep brain stimulation

Andreas Horn

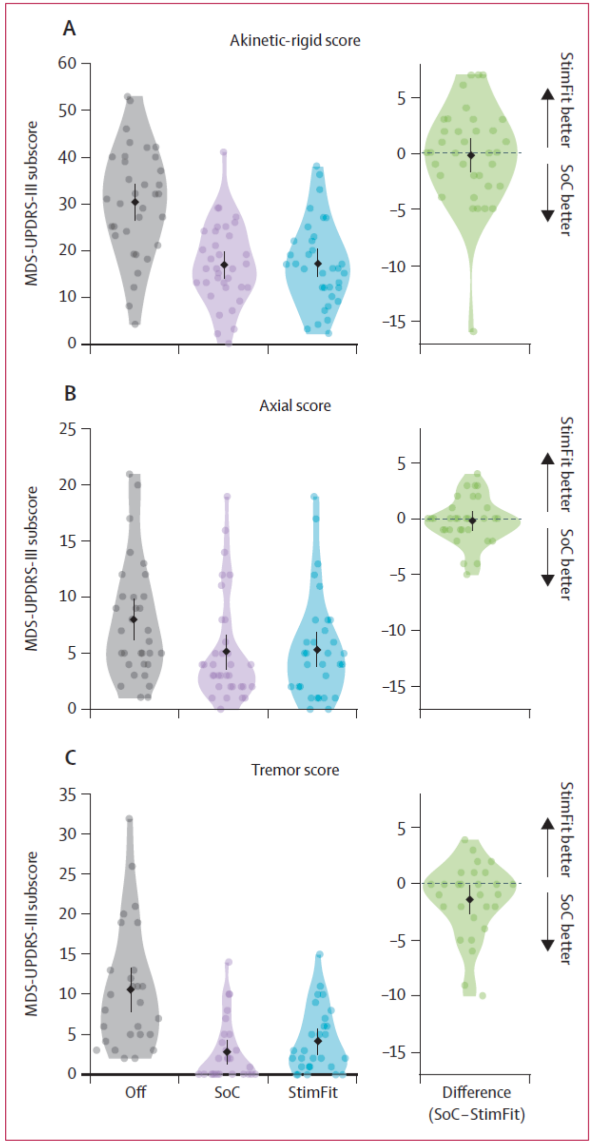


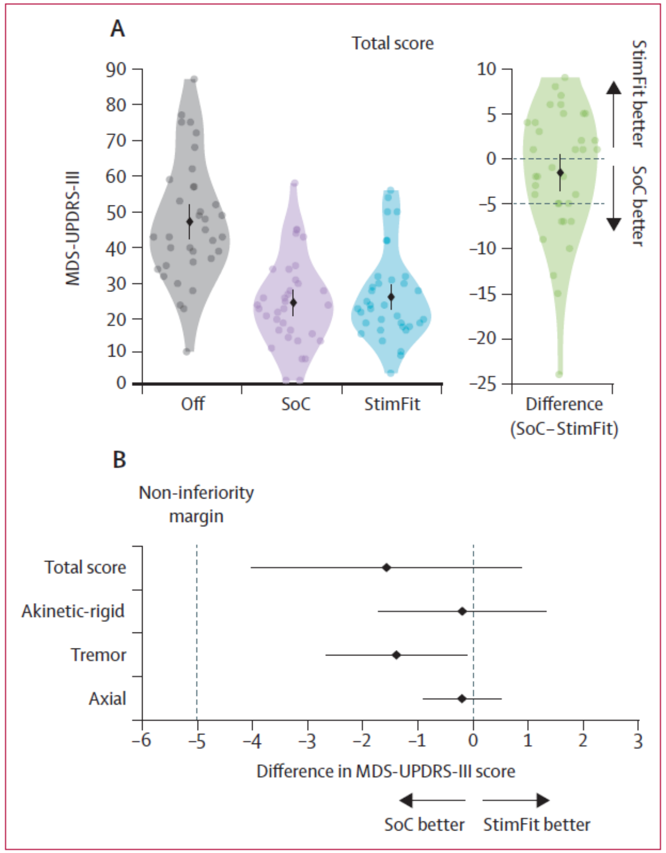
Automated deep brain stimulation programming based on electrode location: a randomised, crossover trial using a data-driven algorithm

Jan Roediger, Till A Dembek, Johannes Achtzehn, Johannes L Busch, Anna-Pauline Krämer, Katharina Faust, Gerd-Helge Schneider, Patricia Krause, Andreas Horn, Andrea A Kühn

Lancet Digit Health 2023; 5: e59–70

- Double blinded randomized trial
- 35 Parkinson's patients treated with STN
- 18 received automated programming (StimFit) followed by SoC stimulation, and 17 received SoC followed by StimFit programming
- Mean MDS-UPDRS-III scores improved from 47.3 at OFF-stimulation baseline to 24.7 under SoC and 26.3 under StimFit
- Non-inferiority of StimFit stimulation at a margin of –5 points
- In 17% patients initial programming of StimFit settings resulted in acute side-effects and amplitudes were reduced until side-effects disappeared

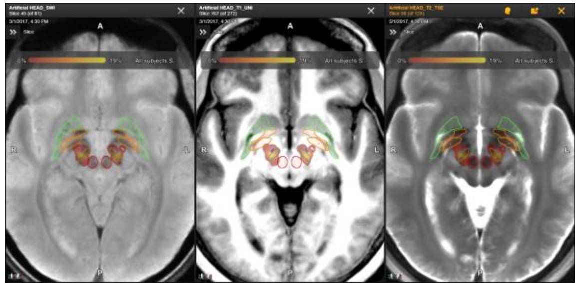




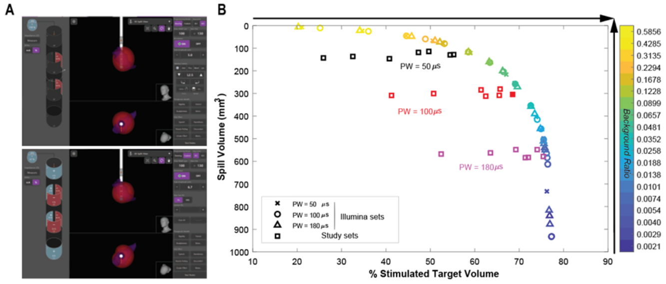
Imaging based augmented programming

GUIDE XT & STIMVIEW XT

Aggregation and Analytics



DBS Illumina 3D



Neuroimaging guided Automated Programming

DBS Illumina 3D algorithm

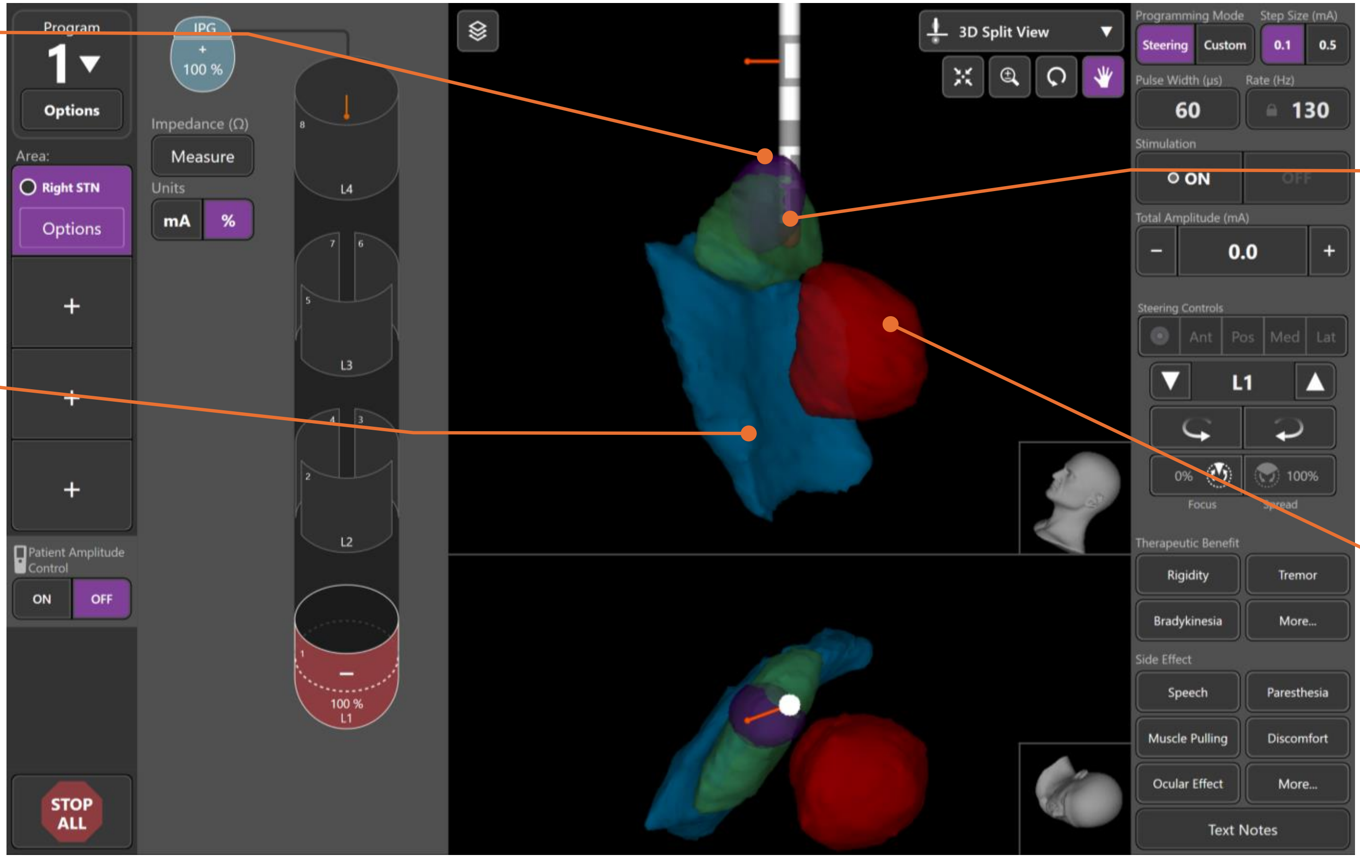
- Download target volume to review locally
- View relative to patient specific anatomy
- Use target (or avoidance) volume as a visual programming aid
- **Algorithm calculates a stimulation setting that provides the best fit to the target and avoidance volumes**

Concept device or technology. Not available for sale

Illumina 3D

Target volume

Substantia Nigra



Subthalamic nucleus

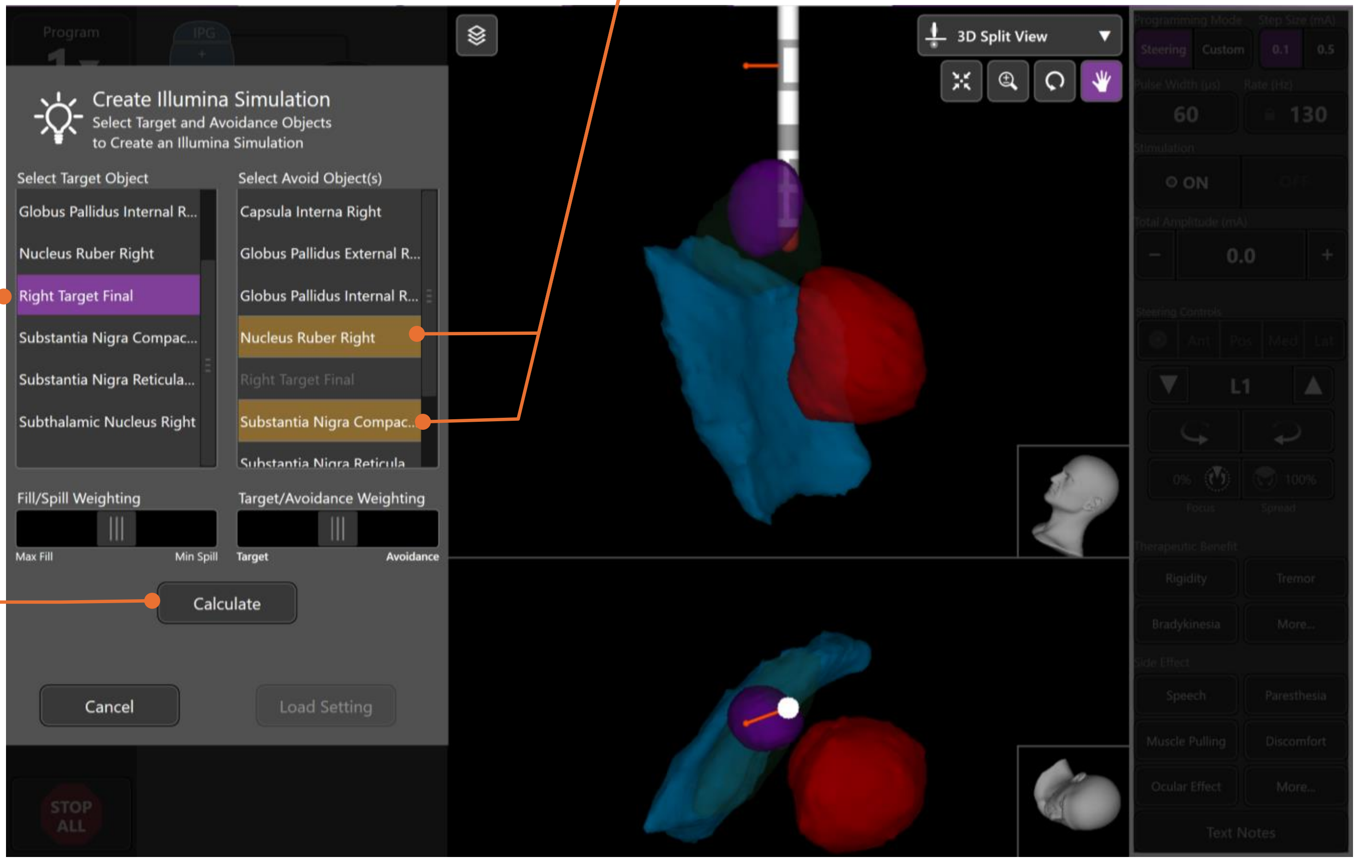
Red Nucleus

Concept device or technology. Not available for sale

Select Avoidance

Select Target

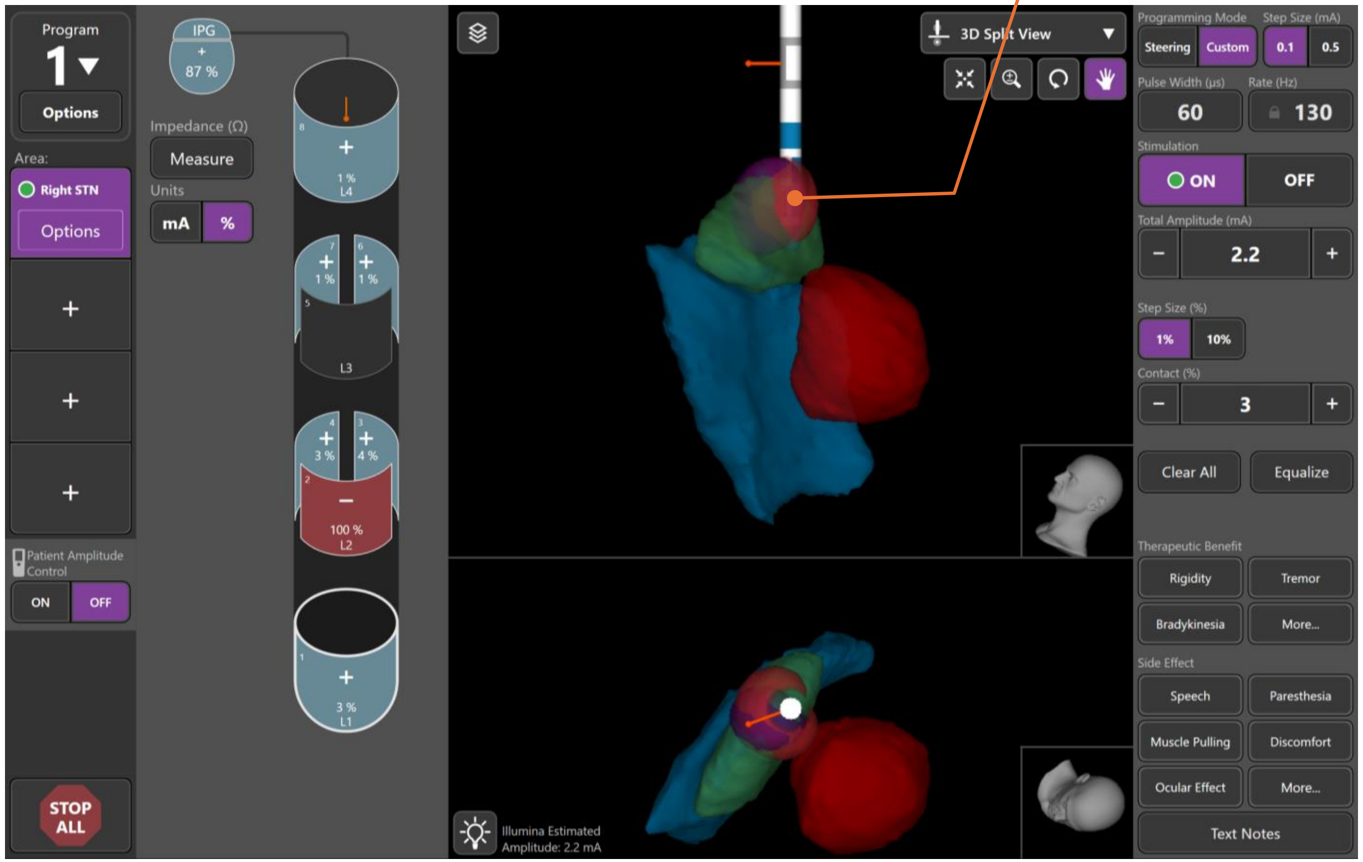
Find solution



Concept device or technology. Not available for sale

How to use Illumina 3D?

Stimulation field model

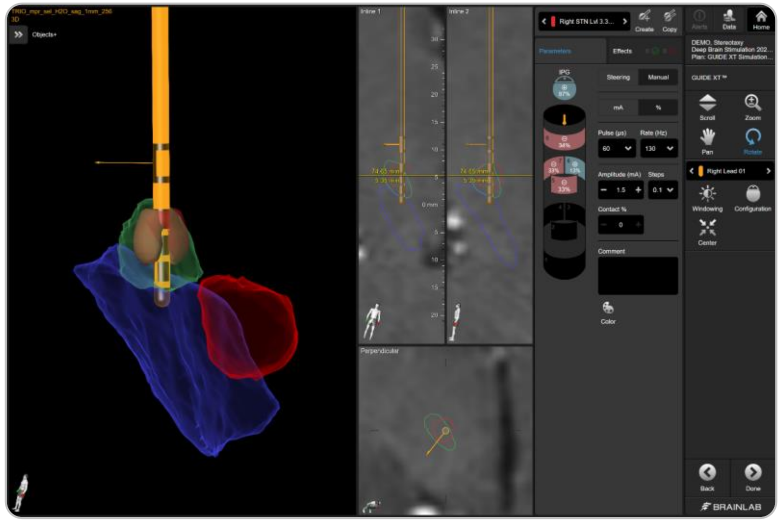


Ramp up the amplitude to reach the solution amplitude

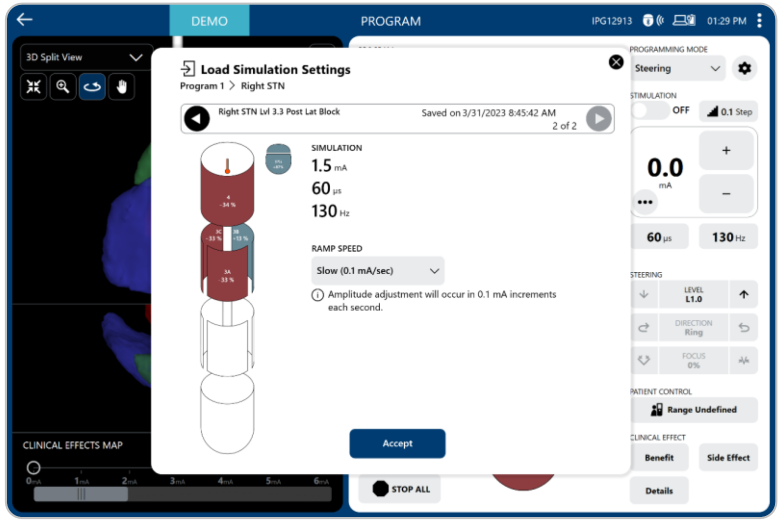
Concept device or technology. Not available for sale

Import Pre-Planned Guide XT Settings

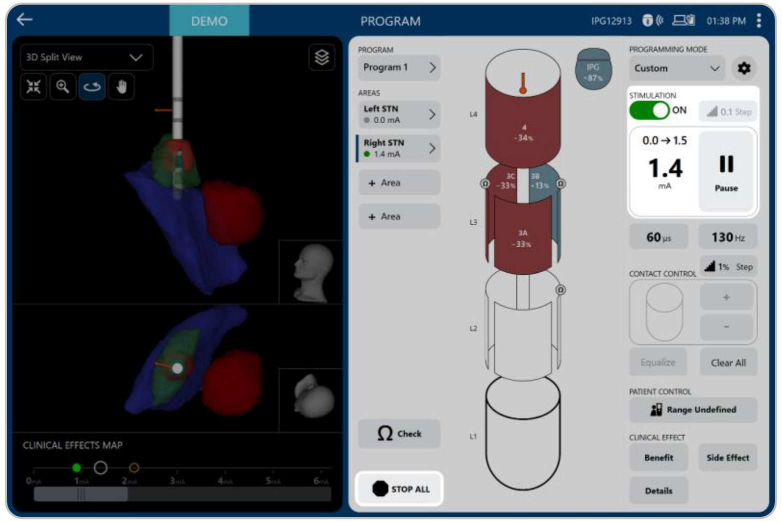
Pre-plan personalized therapy with Guide XT to make your time with the patient even more efficient



Pre-plan in Guide XT **based on patient specific anatomy**



Load pre-planned stimulation **when the patient is in the room**



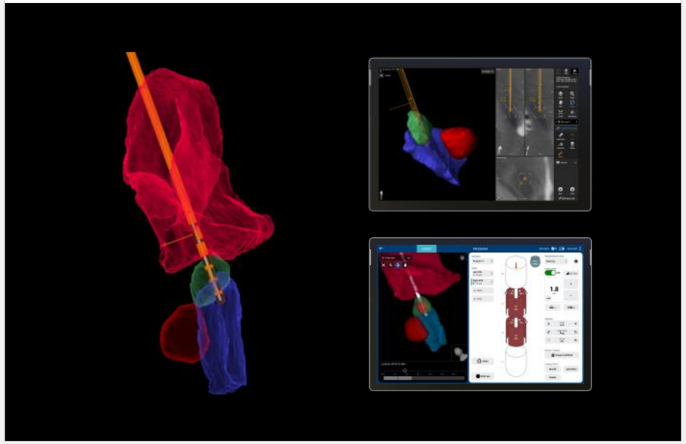
Automatically ramp amplitude **as you clinically assess the patient**

The Future with Image-Guided Programming

GUIDE XT & STIMVIEW XT

Patient Specific Anatomical Visualization

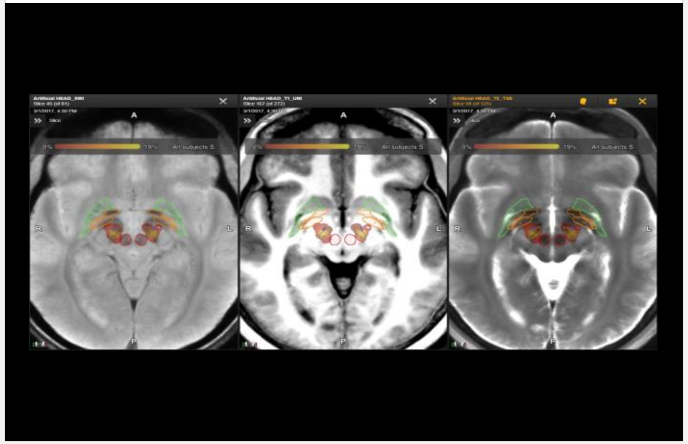
With lead and Stimulation



Aggregation & Analytics

Learn from Population Analysis

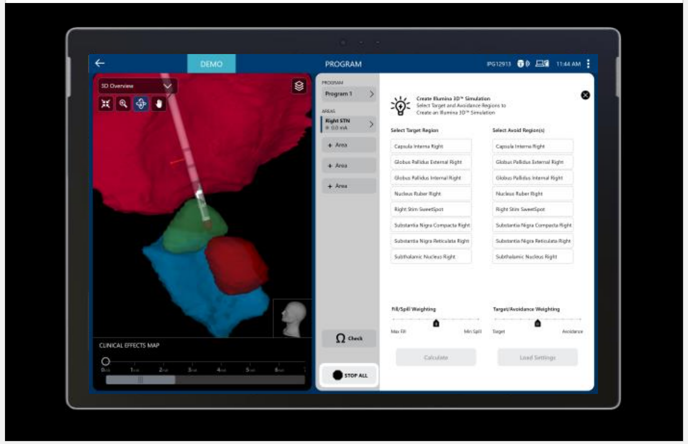
Probabilistic maps that correlate brain anatomy with objective outcomes



DBS Illumina 3D

Anatomical Programming Aid

Inform Stimulation Location and automate optimization



Traditional Deep Brain Stimulation Programming versus Automated Image-Guided Algorithm in Patients with Parkinson's Disease

H. Maghzi, C. Kim, S. Worthge, C. Malatt, M. Tagliati (Los Angeles, USA)

Meeting: 2025 International Congress

- 4 patients with Parkinson's disease treated with DBS (3 STN, 1 GPi).
- Traditional initial programming resulted in 8 monopolar configurations (6 ring, 2 segmented) with average amplitude of 2.08mA (0.5 SD) vs AI-assisted algorithm generated 8 semi-bipolar configurations (1 ring,7 segmented) with average amplitudes of 2.46mA (0.9SD). Pulse width and frequency were kept constant across the two approaches.
- Clinical outcomes were equivalent
- AI-assisted algorithm resulted in significantly shorter programming sessions than the traditional approach

Automated Image-Guided Programming Algorithm Supports Clinicians During DBS Programming for Parkinson's Disease Patients

J. Aldred, C. Luca, A. Ramirez-Zamora, J. Wong, K. Wessels, T. Peabody, B. Reese, B. Farber Petrey, R. Mustakos, S. Niketeghad, R. Shivacharan, M. Malekmohammadi (Valencia, USA)

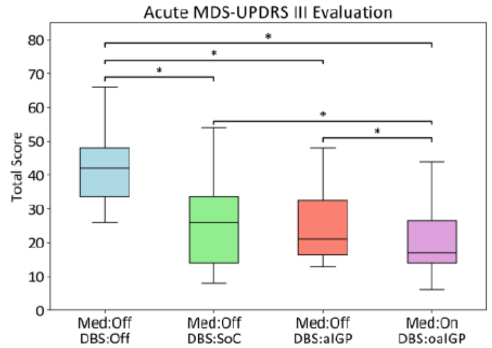
Meeting: 2025 International Congress

- Prospective, blinded, acute cross-over study involving 13 patients (10 male; 11STN, 2 GPi)
- Patients present to clinic in a meds-off state and undergo programming with either standard of care (chronic stimulation) or automated image-guided programming before crossing to receive alternative therapy.
- Automated image-guided DBS program provides beneficial motor improvement equivalent to optimized SoC DBS programming.

RESULTS

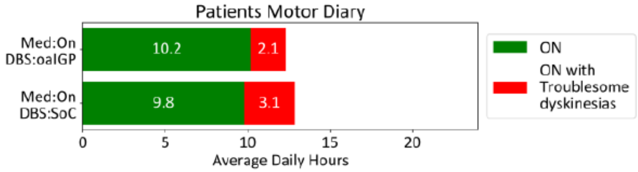
Motor Symptom Improvements

- **Meds-OFF:** Initial aIGP DBS-on improved symptoms by **39%** vs. DBS-off ($p<0.0001$); with no significant difference from optimized SoC DBS ($p=0.44$)
- **Meds-ON:** Clinician-optimized aIGP DBS-on improved symptoms by **54%** vs. DBS-off ($p<0.0001$); with no significant difference from optimized SoC DBS ($p=0.33$)



Chronic Assessment Via Motor Diary

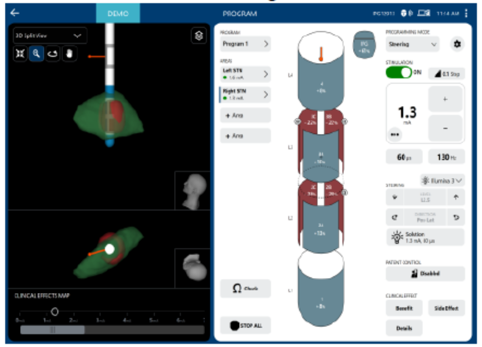
- aIGP-guided programs (clinician-optimized) led to **25 min/day more "ON" time** and **58 min/day less "ON with dyskinesias"** vs. SoC, though group-level differences were not statistically significant.



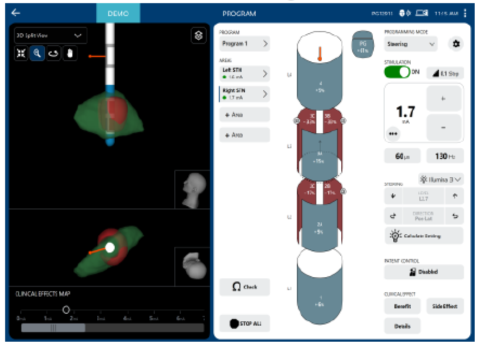
SFM Assessment

- Following clinical optimization, the initial I3D settings were mostly unchanged or only slightly modified (DICE = 0.83 ± 0.16)

aIGP setting



oaIGP setting

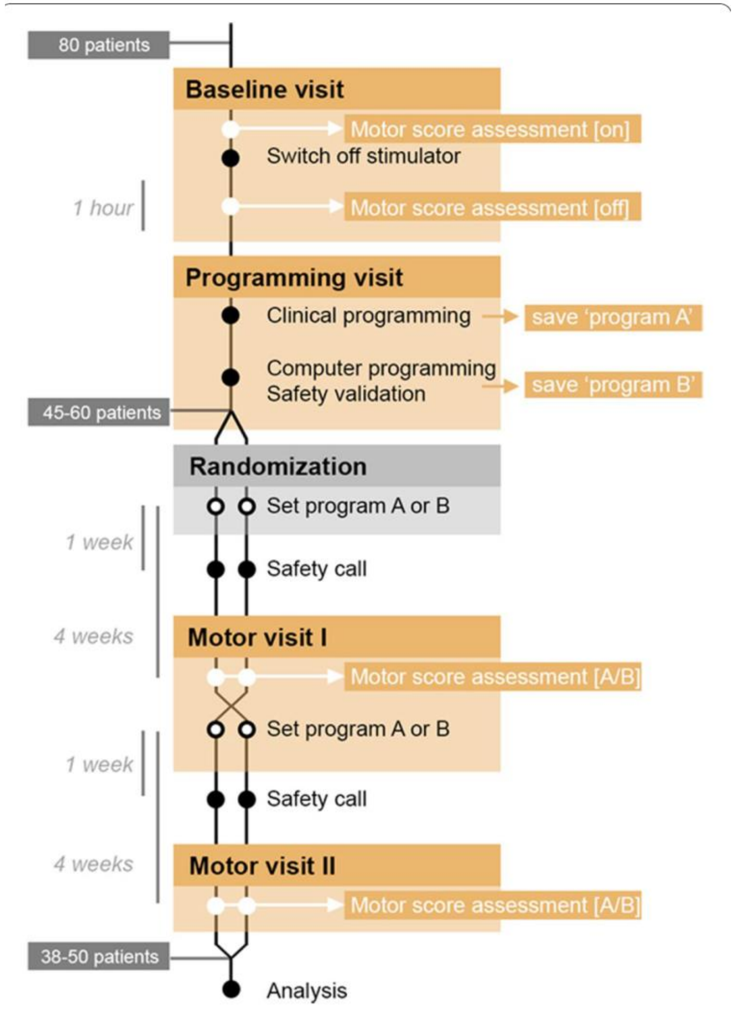


CLINICAL TRIAL PROTOCOL Open Access

DIPS (Dystonia Image-based Programming of Stimulation: a prospective, randomized, double-blind crossover trial)

Florian Lange[1*], Jonas Roothans[1], Tim Wichmann[1], Götz Gelbrich[2,3], Christoph Röser[3], Jens Volkmann[1] and Martin Reich[1]

Lange et al. Neurological Research and Practice (2021) 3:65
https://doi.org/10.1186/s42466-021-00165-6



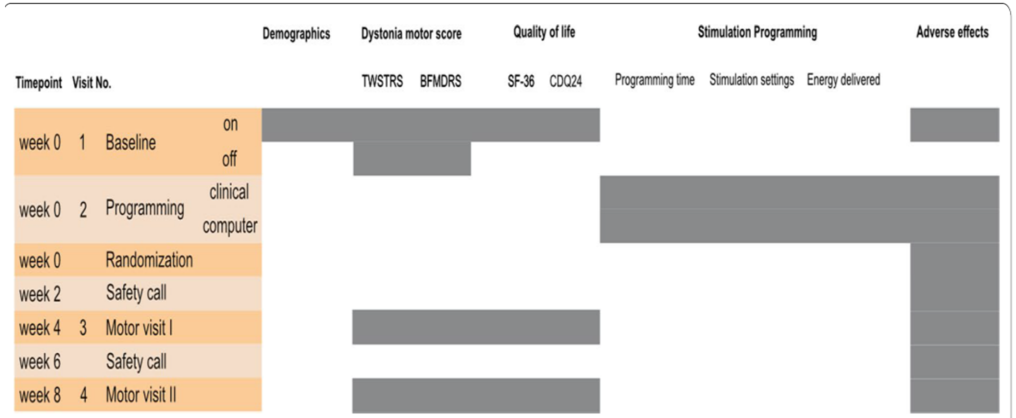
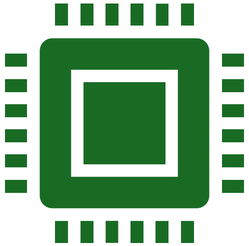


Fig. 2 gives an overview of the examinations per visit. The visits are represented as a row below each other, the respective examinations as marked columns on the right-hand side

THE FUTURE

Combining neuroimaging with electrophysiology data (local field potentials) to identify the most effective stimulation contacts and refine settings



Using computational models integrated with imaging data to predict the effects of different stimulation parameters, enabling more personalized programming

Developing multicenter studies on the use of automated DBS programming on dystonia syndromes and compex tremor

Neurofunctional team

The Walton Centre NHS Foundation Trust

- Thank you for your attention!