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TRR 295 ReTune

StimVision: smartphone video kinematics to optimize DBS programming in Parkinson‘s disease.

Lange F*, Köberle P*, Adaçay G, Guarin DL, Volkmann J, Peach R#, Reich MM#.
*/#equal contribution

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Deep brain stimulation (DBS) reliably improves motor function in Parkinson’s disease, but programming remains time-consuming and largely subjective. With StimVision, we developed and prospectively evaluated a smartphone video-based kinematic framework that enables objective, within-session optimization of stimulation settings and, at the same time, quantitatively characterizes the motor signature of a given therapy. Fifteen patients with STN-DBS performed repetitive hand opening-closing in the medication-off state across multiple stimulation programs. From 60 fps smartphone video, markerless pose estimation extracted 23 quantitative kinematic features per recording.

At the core of the framework is the Dynamically Weighted Improvement Score (DWIS), a patient-specific composite score that weights each tested program relative to the DBS-off baseline and translates it into an objective ranking. For every patient, StimVision identified a unique optimal program, with high ranking stability in robustness analyses. At the group level, improvements at the optimal setting were dominated by gains in speed and rhythm metrics — including mean velocity, closing speed, and movement frequency — alongside reduced intra-sequence decay; twelve of the 23 features showed a median improvement significantly greater than zero after BH-FDR correction. Sparse principal component analysis (sPCA) distilled the 23 features into three interpretable kinematic domains — Movement Speed, Movement Consistency, and Rhythm & Timing — together explaining 80.3% of the variance.

To compare electrical and pharmacological therapies on a shared scale, we applied the same sPCA structure to a previously analyzed levodopa cohort and quantified structural similarity using Tucker‘s congruence coefficient. The consistency domain was nearly identical between DBS and levodopa (Φ = 0.905), the speed domain showed moderate congruence (Φ = 0.545), while the timing domain showed an inverse relationship (Φ = −0.458) — pointing to shared mechanisms in speed and consistency but divergent rhythmic effects. Because StimVision runs on a standard smartphone, it offers a scalable route to objective DBS programming and to direct, quantitative comparison of therapies.

Dr. Florian Lange
Florian Lange is an advanced clinician scientist in the visualDBSlab at Universitätsklinikum Würzburg (UKW). He has contributed to the development of quantitative, computer-vision–based assessments of motor function and to data-driven approaches that refine DBS targeting and programming.

Dr. Philipp Köberle
Philipp Köberle is a clinician scientist in the visualDBSlab at UKW. His primary area of activity is clinical research focused on image based and data driven optimization of DBS.

Dr. Robert Peach
Robert Peach is a Postdoc, and Principal Investigator at the UKW and a Senior Research Fellow at Imperial College London. His research focuses on developing novel deep learning architectures for decoding neural signals in movement disorders.

Prof. Martin Reich
Martin Reich is the group leader of the visualDBSlab, which tackles clinical questions related to DBS and the pathophysiology of movement disorders through computer visualisation, modelling and imaging.

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