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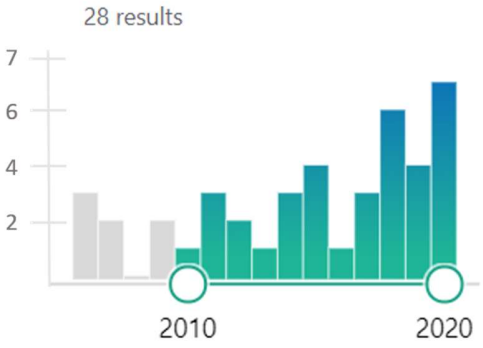
Semi-automatic DBS Path Planning

A Quick Scan of the Research Landscape

PubMed Query

A quick PubMed search with the query given on the right reveals the following graph for publications per year. After one-by-one article evaluation, 17 papers were found to be relevant. Here, it may be noted that prior to 2010, the publications are mostly feasibility studies (such as [1]), while in later years some serious attempts were made at building a working system for DBS path planning (e.g. [2]).



Search: **(DBS[Title/Abstract] OR Deep Brain Stimulation[Title/Abstract]) AND (Autonomous[Title/Abstract] OR automated[Title/Abstract] OR automatic[Title/Abstract]) AND (planning[Title/Abstract] OR path[Title/Abstract] OR trajectory[Title/Abstract])** Filters: **in the last 10 years, English**

Landscape

First of all, it should be noted that a mere 18 relevant papers found in PubMed is of course quite a small amount. This is indicative for the fact that simply not a lot of research has been done with regards to automated path planning for DBS surgery. In recent years, however, the topic has gained (some) popularity, with most papers having been published in the last three years or so.

The papers found may be grossly divided into three groups. Here, we distinguish between feasibility studies ([1]), papers that propose an actual system ([2]–[15]) and reviews of current findings ([16], [17]).

Highlights

An interesting paper that may be highlighted is a review from Zanello et al. from 2020 [17], which, on the basis of 42 reviewed papers, states that though automatic DBS surgery path planning seems very promising, it is not yet being used in clinical practice. General approaches to path planning software seem to be limited to surgical evasion of blood vessels, certain cerebral sulci and cerebral ventricles. Additionally, average safety margins seem to be significantly larger when using the reviewed automatic approaches than manual planning by neurosurgeons.

Another paper that seems interesting at first glance is one by Segato et al. from 2019 [2], which takes fiber tracts into account as well (through DTI MRI).

Clinical Implementation

To accelerate the implementation of this technology in clinical practice, which would save neurosurgeons quite some time as well as potentially improve safety margins, it seems important to allow for adequate user input and interaction. Here, it should be noted that this part seems to be missing from previous research. I feel like this project could make a difference on this aspect, which is what my proposal will likely focus on.

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